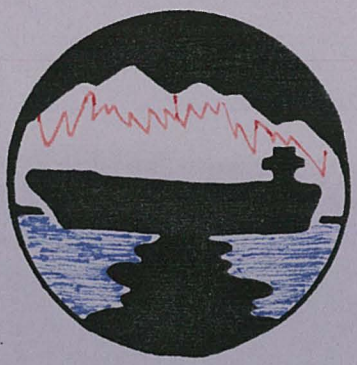
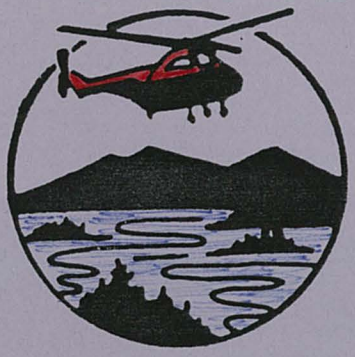
BALLARD

RPWG
R

Preliminary Draft



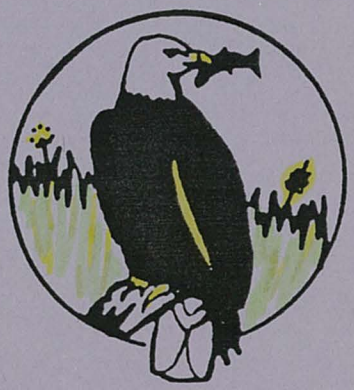


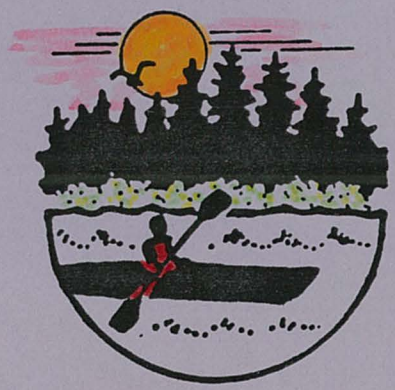
ECOLOGICAL RESTORATION OF PRINCE WILLIAM SOUND AND THE GULF OF ALASKA

An Annotated Bibliography of Relevant Literature

Prepared for Restoration Planning Work Group
by EPA Office of Research & Development

March 1990





ECOLOGICAL RESTORATION OF PRINCE WILLIAM SOUND AND THE GULF OF ALASKA:

An Annotated Bibliography of Relevant Literature

Preliminary Draft
Compiled for the Restoration Planning Work Group

by
EPA- Office of Research and Development

Edited by

William Warren-Hicks
Kilkelly Environmental Associates
P.O. Box 31265
Raleigh, NC 27622

and

Benjamin Parkhurst
Western Aquatic
P.O. Box 546
Laramie, Wyoming 82070

DRAFT

Important literature for Aquisition,
As of 5/3/90
listed by page number as in
March 1990 Preliminary Draft of
Ecological Restoratrion
of Prince William Sound and the Gulf of Alaska,
an Annotated Bibliography of Relevant Literature

1
7
11-17
24
26-27
29
30-31
32-33, 34, 35
39-40
46-50, 51
60
63
64-65
71
73-75
76-78
81-82
85
86
87
89
(91)
92-94
98
99
100
101
102
105
109
110
112
127-114, 123, 124
135-137
141
143-147
149
151
153
155
158

160-162
163-164
166
169
170-172
173
176
178
(179)
182
(183)
185
(189)
191-192
195
197
200
201
202-203
204
205
206
207
209
213-215
216
218-220
221-224
225
228-239
241
242-246, 247
254-249
260
264
265
286-293
294
298-301 302
307
311
314
321

327
328-329
331-334
338
339
341
342-343, 345
346
348
349
350
352
353
355
357
358
363-364
368-371
376
380
382
383-386, 395, 396, 397
398
404
406
407
410-411
412
414 418, 419 421
416-422, 424, 425
435 432
442
447
448

FROM: [illegible] bibliography

Literature for Possible Acquisition
Taken From 1990 Preliminary Draft of Ecological Restoration of Prince William Sound and the Gulf of Alaska, an Annotated Bibliography of Relevant Literature

Southern Hemisphere:
24ar, **26, 27, 29ar,** 30ar, **31,** 32ar, **86,** 151, 158, 166, 185, 213ar, 202, **205,** 376, **407,** 416ar

Northern Hemisphere:
1, 7, 11, 33, 39, 40, 75, 82, 87, **137, 176, 197, 203,241,** 251, 311, **338,** 365, 348ar, 349ar, **383, 386, 422**

Seagrass, Estuary, Vegetation:
60, 85, 92, 155, 155, 173, 178, 264, 298, 328, 346, 380, 398, 410, 411, 414, 448

Soil Organisms\Structure, Habitat:
34, 78, 94, 100, 147, 153, **162, 195, 206, 207, 218,** 228, **239, 254, 265, 293, 294, 301,** 302, **327, 353, 329, 334, 342, 352, 358, 395, 397, 421, 424, 425, 442, 447,**

Oil Spill General:
17, 18, **50, 89,** 90, **102, 105, 109, 112, 114, 123, 1227, 135, 141,** 149, 160, 169, 179, 182, 183, 191, **192, 215, 216,** 225, 242, **249,** 290, 295, **314, 331, 339, 343, 357,** , 404, 406, **418, 419,** 420,

Foreign:
337, 46, 63, **64,** 66, 71ar, 73ar, 76ar, 77, 99,**143,** 163, **164,** 170, 201ar, 209, 219, 237, **246, 286,** 350, 363, **371, 382, 396,** 388, **432, 368, 412,** 437,

Bivalves, Fish, Other organisms:
35, 53, **98, 110, 124,** 133, **172, 204, 221, 220, 247, 260, 293, 321, 341, 345,** 355, **364, 435**

ar= artificial reefs
bold= priority
not bold= valuable but not priority

some, not many, additions/deletions from Kinsten list.

Frankie
5/30

PRELIMINARY DRAFT

NOTICE

This is a Preliminary Draft of annotated bibliography relevant to restoration of Prince William Sound and the gulf of Alaska. **THIS DOCUMENT HAS NOT RECEIVED THE OFFICE OF RESEARCH AND DEVELOPMENT'S NORMAL PEER REVIEW. IT IS BEING CIRCULATED FOR COMMENT ONLY!!**

As with any computerized literature search, relevant literature is missed. This preliminary draft is being circulated for comment and to obtain additional references relevant to the restoration of Prince William Sound and the Gulf of Alaska. It is recognized that additional editing of the references will occur over the next month. An annotated bibliography will be available for distribution by June 1, 1990.

Comments and citations to the literature should be sent to:

Hal Kibby
Environmental Research Laboratory
200 S.W. 35th
Corvallis, OR 97333

Addy, J.M.; Levell, D. (1975)

Sand and Mud Fauna and the Effects of Oil Pollution and Cleansing

Presented at the Institute of Petroleum/Field Studies Council Meeting on Marine Ecology and Oil Pollution, Scotland, April 21-25, 1975, P91 (100). The original document is available from Bowker.

Field Studies Council, U.K.

ABSTRACT
An initial biological survey of the Milford Haven area, U.K., was conducted primarily to identify communities within the haven and the spatial and numerical distribution of these communities relative to environmental influences. Proposals for a monitoring scheme for Milford Haven macrobenthos are discussed. Field experiments on the lugworm Arenicola marina L. were conducted at a small estuary on the northern shore of Milford Haven. The effect of Kuwait crude oil and the dispersant BP 1100X on the lugworm was observed. Preliminary experiments to determine the influence of surface water and heavy rainfall on the extent of the pollutant impact were also conducted. Depression of feeding activity on the day following the oil spillage occurred in up to 75% of the animals. From 50-75% of the original population recovered normal feeding activity within a few days. The remainder either died or quit the substrate area. (54 diagrams, 14 graphs, 53 references, 11 tables)

Adey, W.H. (1987)

Marine microcosms

Mar. Syst. Lab., MNH 310, Smithson. Inst., Washington, DC 20008, USA

Restoration Ecology: A Synthetic Approach to Ecological Research

Jordan, W.R., III; Gilpin, M.E.; Aber, J.D., eds. Pages 133-149

Report Number: ISBN 0-521-33110-2

ABSTRACT
This chapter describes the construction and refinement of an artificial tropical coral reef and lagoon ecosystem. Emphasis is placed on the extensive process of synthesizing such systems through prototype and pilot stages, and on the insights that this work has added to the understanding of wild ecosystems.

Aitchison, S.M.; Carothers, S.W.; Johnson, R.R. (1977)

Some ecological considerations associated with river recreation management

River Recreation Management and Research Symposium Minneapolis, MN (USA) January 24, 1977.

USDA Forest Service General Technical Report. Mus. Northern Arizona, Flagstaff, AZ 86001, USA, NC-28, pp. 222-225.

Publisher(s): USDA Forest Service, St. Paul, MN (USA)

ABSTRACT
Drawing from an ecological study on the Colorado River, four river recreation management concerns are discussed: (1) river research vs. river management - their interrelationships and priorities (2) extensive resource inventories - their role as indicators of environmental deterioration (3) human impact - its identification and proposed mitigation and (4) suggested guidelines for identifying unique and ecologically sensitive areas.

Akeda, S.; Uekita, Y. (1987)

Sosho no keijo to haichi ni yoru ryusoku teigen koka ni tsuite

(Studies on reduction effect of velocity on the shape and arrangement of artificial reef)

Technical Report, Natl. Res. Inst. Fish. Eng., Hasaki, Kashima, Ibaragi 314-04, Japan

Suikoken Giho Suisandoboku, No. 8, pp. 101-109

ABSTRACT
In order to facilitate propagation of useful fish et al., the artificial formation of seaweed beds is aimed at increasing the seaweed beds to serve as bait grounds or nursery grounds. A field survey and model test were performed to clarify the favorable hydraulic environments for attachment or growth of seaweed spores. The results are as follows: (1) the importance was recognized of decreasing current velocity around the seaweed beds during the season of release of Sargassum spores and (2) in order to form favorable hydraulic environments, the interval of blocks that are perpendicular to flow must be less than half of block width, and interval of blocks that are parallel with flow must be less than three times block height.

Anderson, D.C. (1987)

Evaluation of Habitat Restoration on the Naval Petroleum Reserve No. 1, Kern County, California

Santa Barbara Operations, EG and G Energy Measurements, Inc., Goleta, CA

Sponsor: Department of Energy, Washington, DC.

107 pp.

Portions of this document are illegible in microfiche products.

NTIS Prices: PC A06/MF A01

Country of Publication: United States

Corp. Source Codes: 085084001; 9520079

Report No.: EGG-10282-2179

Contract No.: AC08-83NV10282

ABSTRACT
The habitat restoration program on Naval Petroleum Reserve number 1 (NPR-1) began with the revegetation of approximately 121 acres of disturbed lands in 1985 and continued in 1986 with the revegetation of an additional 112 acres. A revegetation monitoring program was developed and implemented in the spring of 1987 with the objectives of evaluating the success of the current program and providing needed information on techniques and methodologies. During the spring of 1987, 430 sites that had been revegetated in 1985 or 1986 were evaluated qualitatively. The amount of vegetative cover and plant density by species along with other quantitative information was taken at 100 of the revegetation sites. Soil samples were taken at each revegetation site and analyzed for salts and content of various elements of concern. Results of the sampling show 45% vegetative cover on sites revegetated in 1985 and 21% cover on 1986 sites. Composition of the total cover was primarily annual forbs and grasses (96% on 1985 sites and 98% on 1986 sites). Plant density was 30.2 plants/ft sup 2 on sites revegetated in 1985 and 16.4 plants/ft sup 2 on 1986 sites. Soil analysis reveals high amounts of salts and low organic matter content for many of the soils sampled. The only elements with levels considered to be in the toxic range were barium and molybdenum. (8 references, 5 figures, 16 tables) (ERA citation 13:020985)

Anderson, E.P. (1985)

Use by juvenile chinook salmon of artificial habitat constructed from dredged material in the Campbell River Estuary

Ocean Dumping R and D Pacific Region. Department of Fisheries and Oceans, 1983 - 1984 Sidney, B.C. (Canada), 7 Dec 1984

Institute of Ocean Sciences, Sidney, B.C. (Canada)

Can. Contract. Rep. Hydrogr. Ocean Sci., No. 20, pp. 4-15

ABSTRACT
Numerous potentially conflicting commercial, recreational and wildlife users compete for the resources of the relatively small (about 75 ha) Campbell River Estuary. Two of the largest users are the logging industry and juvenile salmon on their downstream migration. In order to improve the efficiency of log handling and to relieve resource-use conflicts, British Columbia Forest Products (BCFP) dredged a new logpond at the southwestern periphery of the estuary. In cooperation with the Department of Fisheries and Oceans, BCFP rehabilitated the old booming ground and constructed four experimental islands. The islands were built from materials dredged from the new logpond. The purpose of this study was to determine the stage of development of animal communities on the islands, to assess the use of the islands by fish (in particular relative use by wild and hatchery salmon) and to evaluate the island communities as food sources for juvenile salmon.

Anderson, R.C. (1983)

Economic perspectives on oil spill damage assessment

Am. Pet. Inst., WA, USA

Oil Petrochem. Pollut., Vol. 1, No. 2, pp. 79-84

ABSTRACT
Oil and petrochemical spills frequently result in damage to publicly-owned natural resources such as birds, fish, and beaches. Presently over half of the American States and the Federal Government have provisions in law that permit recovery from the polluter for such damages to natural resources. The objectives of these statutes are two-fold: (1) to provide compensation to the victims for their losses, and (2) to provide incentives for greater care on the part of those who transport petroleum products. The measurement of natural resource damages in economic terms is a difficult and controversial task. This paper provides insights into the strengths and limitations of several techniques of valuation that have been proposed or are currently being used. Additionally, the paper provides several research suggestions to specialists in the biological and physical science communities regarding where their further efforts are most likely to be helpful in bridging the gaps that now exist in conducting accurate assessments of natural resource damages resulting from oil spills.

Anderson, B.W.; Ohmart, R.D.; Gore, J.A. (ed.) (1985)

Riparian revegetation as a mitigating process in stream and river restoration

The Restoration of Rivers and Streams: Theories and Experience. Center for Environmental Studies, Arizona State University, Tempe, AZ 85287, USA, pp. 41-80.

Butterworth Publishers, Stoneham, MA (USA)

ABSTRACT
This chapter discusses only the streamside vegetation and excludes discussion of submerged and emergent aquatic vegetation. It summarizes the results of field studies of riparian habitats on the lower Colorado River and efforts to develop from field-collected data plant community designs that would house as many vertebrate species as possible and support high densities of wildlife. The ultimate challenge was to implement the design (plant and grow the vegetation). If efforts are successful and costs reasonable, the designs and methodologies could be used in habitat improvement, mitigation, and operational enhancement in totally managed river systems where native revegetation has been curtailed or stopped.

Anonymous (1977)

Oil kills North Sea birds

Mar. Pollut. Bull. 8(8):173

ABSTRACT
An oil pollution incident which affected the Royal Society for the Protection of Birds' (ROSPB) reserve at Bempton, Yorkshire, in February 1977 was repeated when oiled birds started coming ashore there again on 8 April 1977. They were mainly Guillemots with a few Razorbills. Eventually 520 were found dead along the shore, 555 came ashore alive, and another 400 were seen out at sea. Some 380 of the survivors were transferred to the RSPCA rehabilitation center at Taunton, of which 10% died on the way. An oil slick was reported in Lloyds List to have been seen offshore on 10 April but later aerial surveys by the RAF drew a blank. The oil which caused these two incidents has been investigated by the analytical branch of British Petroleum. Four specimens from the February incident are all similar, and consist of a fuel oil composed of a non-paraffinic residue diluted with a gas-oil, possibly of Nigerian origin. One specimen from the April incident was a weathered crude oil containing more vanadium, nickel and sulphur than is usual in North Sea crudes, in a ratio similar to the heavier Middle East crudes except that the sulphur level was rather high. It would appear that both incidents were caused by illegal discharges from ships, one probably from a merchant ship and one from a tanker not yet using load on top techniques.

Anonymous (1988)

North Sea oil: Linking price and exploration

Pet. Times, Vol. 8, No. 13, pp. 2-3

Price report.

ABSTRACT
Debate surrounding the issue of "oil price" tends to obscure the links between this, and exploration and production. North Sea activity is exemplary: during 1987, drilling in the UK sector of the North West European Continental Shelf (NWECS) was 50 per cent higher than in 1986, when upstream activities were shaken by the oil price collapse. Not only did those oil companies participating in North Sea projects suffer. The governments concerned, especially of Norway, the Netherlands, and the UK also experienced a drastic loss of revenue in Norway alone, an estimated fall of Nkr34 billion in 1986 compared with the previous year. The following review of the future potential for development of the North Sea represents and attempt to restore the inherent relationship between exploration, production and future oil price.

Anonymous (1986)

Dredged material management: Beneficial use initiative

Info. Exch. Bull. U.S. Army Corps of Engineers, Waterways Experimental Station, Vol. D-86-3, p. 1.

ABSTRACT
Beneficial uses refers to the concept that dredged material can be disposed in a manner that is economically and environmentally acceptable and also accrues natural resource benefits to society. In a landmark action, the Corps of Engineers and the National Marine Fisheries Service have signed a cooperative agreement to study the practicality of a national program for restoring and creating fisheries habitat. A large-scale test and evaluation of the nearshore placement of dredged sand for erosion control and protection from storm waves is being planned. Dredged material is being used to establish marsh in the Upper Mississippi River and to develop clam habitats in Puget Sound.

Anonymous (1978)

Oiled seabirds get in the swim

New Scientist 78(1100):213

ABSTRACT
Volunteers helping to save bird victims of oil-tanker disasters take note: 'the degree of oiling has little impact on the bird's chances of survival and should not be used as a criterion for euthanasia'. And: "routine prophylactic use of corticosteroids, antibiotics, tranquilizers and other medications may actually be harmful to oiled birds." These practical hints make up a large chapter in a very readable, slender handbook entitled Saving Oiled Seabirds, prepared by the International Bird Rescue Research Center in Berkeley, California, under a grant from the American Petroleum Institute. Its methods are based on seven years of work with thousands of oiled bids, an extensive literature review and consultation with numerous scientists and veterinarians. The authors stress the importance of keeping the birds warm at all times and recognizing the signs of hypothermia (lowered body temperature). It may be several days before the birds can undergo the additional stress of being cleaned - with mineral oil and a mild detergent - and it must be kept warm and quiet until then. Regular feeding schedules, particularly adapted to wild birds in captivity, constant room temperatures, noise levels and lighting and adequate bedding and pen space demand proper facilities. These are listed in an appendix for anyone wishing to set up such a rehabilitation center. For example there must be a pool nearby because all birds must undergo an active swimming programme to waterproof their feathers. (Complete article)

Anonymous (1988)

Basic research for Japanese ocean farming

World Fish., Vol. 37, No. 7, p. 46.

ABSTRACT
Details are given of the marine-techno-policy developed for fishery management purposes in Yamaguchi Prefecture, describing in particular the construction of steel artificial fish reefs and seabed afforestation.

Anonymous (1986)

Dredged material management: Beneficial use initiative

Info. Exch. Bull. U.S. Army Corps of Engineers, Waterways Experimental Station, Vol. D-86-3, p. 1.

ABSTRACT
Beneficial uses refers to the concept that dredged material can be disposed in a manner that is economically and environmentally acceptable and also accrues natural resource benefits to society. In a landmark action, the Corps of Engineers and the National Marine Fisheries Service have signed a cooperative agreement to study the practicality of a national program for restoring and creating fisheries habitat. A large-scale test and evaluation of the nearshore placement of dredged sand for erosion control and protection from storm waves is being planned. Dredged material is being used to establish marsh in the Upper Mississippi River and to develop clam habitats in Puget Sound.

Anonymous (1987)

Oil spill containment and recovery

Water Waste Treat., Vol. 30, No. 2, p. 40

ABSTRACT
It is often the specific problems raised by the oil exploration and production industry and associated marine operators that act as a catalyst generation new equipment and techniques. Vikoma International of Cowes, with its twelve years of experience of oil spills and equipment design and manufacture, plays a significant part in the industry's ability to respond to problems identified, especially where "oil"/water contamination problems are concerned.

Anonymous (1979)

Alaska pipelines first oil spills

New Scientist, 84(1176), 96.

ABSTRACT
For the first time ever, a major spill of crude oil has polluted an arctic river. A buried section of the Alaskan pipeline ruptured in June, releasing 2000 barrels of crude oil into the Atigun river. Five days after this incident, another stretch of buried pipeline also ruptured, although in this case, the spill was contained. On 10 June oil was seen flowing from a rupture in a buried section of the pipeline in the Atigun Pass in the Brooks Range north of the Arctic Circle. The pipeline was temporarily closed down, but at least 2000 barrels of crude oil had already spilled into the upper Atigun River. At least 43 km of the river was affected in this, the first major crude oil pollution of an arctic river. The long-term effects are being studied. Following the spill, the water level in the Atigun River dropped, leaving a coating of oil about 35 cm wide on the vertical banks of the main channel. Much of the adjacent low ground vegetation and riparian willow stands were soaked with oil and will take some time to recover. About 24 km of the main and tributary channels downstream from the rupture were saturated with oil which, in places, soaked into the sand, gravel and silt substrate to a depth of some 30 cm. Absence of fish and a scarcity of invertebrates after the spill indicate a considerable adverse impact on the aquatic resources. Five days later on 15 June another rupture in a buried section of the pipeline was discovered near pump station 12 in a relatively flat part of the Chugach Mountains in the south of Alaska. Fortunately the oil was contained before any reached the nearby Little Tonsina River, but about 1.5 hectares of land was contaminated.

Anonymous (1986)

Oil recovery specialist battles against the black stuff

Water Waste Treat., Vol. 29, No. 2, p. 36

ABSTRACT
Pollution of waterways has been increasing during recent years, despite advances in technology for preventing pollution and improved cleaning materials. Chemical companies, factories and farms all pollute rivers to some extent but the accumulated effect can be disastrous with thousands of fish being killed and ecosystems damaged beyond natural recovery. But the biggest pollution problem for rivers comes in the form of a sticky, black liquid lethal to both aquatic life, birds and many other animals - oil. Companies specializing in this area are developing more effective methods for mopping up oil spills and for prevention of spills both on large and small scales. One specialist in this field is Oil Pollution Environmental Control Ltd (OPEC).

Anonymous (1979)

Pollution control plan

Ship Boat Int., 32(10), 59.

ABSTRACT
A SKr. 150 million ($35,000,000) package of legal, organizational and preventive measures aimed at drastically reducing oil and chemical pollution in Swedish waters and on Swedish coasts within the span of five years has been recommended in a report on the risks inherent in sea transport submitted to the Government. Four overriding goals are proposed in the report: deliberate discharge must be eliminated and accidental discharge reduced to an absolute minimum, with total discharge being cut by at least half within five years discharge must be detected at once and damage kept to a minimum the culprits must be made to pay for the damage they have caused, while the preventive apparatus must be better coordinated and more knowledge must be accumulated of the various factors involved. The report contains more than 40 proposals on new measures. A new coastal tanker fleet with double hulls and improved design should be built, and special navigation fees and appropriate fiscal measures resorted to so as to render environmental safety measures financially expedient. Kr24 million should be invested in the development of new techniques for oil containment, and the Coast Guard Service and the National Administration of Shipping and Navigation should be merged. Steps should be taken to improve preparedness in the event of an oil disaster. The necessary outlay should be recouped through the imposition of a special levy of Kr1 per ton of imported oil, the report proposes. This would correspond to <1% of current oil prices, it is added.

Anonymous (1979)

The use of filters for oily water separation

Environmental Pollution Management 9(3), 80-81, Coden: EVPMBX

ISSN: 0367-150X

No abs.

ABSTRACT
Pressure sand filters designed to remove oil from tanker deballast water are described. Each filter has a removable, corrosion-resistant floor to support the filter media and to simplify assembly and maintenance. Particular attention has been paid to the design of the distribution and collection system to ensure effective cleaning during backwash. The filters are designed for 11 bar pressure and are ebonite lined. The entire deballast filtration scheme, which is intended to cater to tankers with a turnaround of 10 d, has a throughput of 250 m^3/hr. Tankers discharge their oil-polluted deballast water (typically containing 100 mg/L of oil) into a 90,000 m^3 holding tank, from which it is sent to a tilted-plate oil separator. After treatment, the water contains <15 mg/L of oil, and no SS >10 mu. The separator consists of a compact, specially designed plate pack installed in a concrete sump. Separated oil is removed by an adjustable skimmer and returned to the oil processing plant. The heart of the plant is the bank of Serck's "hiperfilters," which operate on the downflow, dual media principle. Each filter consists of a pressure vessel containing media so selected and arranged that high fluxes can be achieved without sacrificing weight or effluent quality. These systems are customarily designed for each application. The filter is cleaned periodically by backwashing with various combinations of air or gas scour and bed fluidization and expansion which completely restore performance. With an inlet oil concentration of <=600 ppm, continuous or sporadic, the unit should reliably meet present international standards and future standards. (illustrations, no references)

Anonymous (1971)

Second annual report of the Advisory Committee on Oil Pollution of the Sea

Unknown

Second Annual Report. University of Newcastle upon Tyne, Dept. of Zoology, Research Unit on the Rehabilitation of Oiled Seabirds, Advisory Committee on Oil Pollution of the Sea, England. 38 pages. Price: #0.50

Anonymous (1974)

Fifth annual report

Unknown

University of Newcastle upon Tyne, Department of Zoology, Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. Annual Report, 28 pp.

Anonymous (1973)

Oil and penguins don't mix

Unknown

National Geographic Magazine. Washington, DC, 143(3):384-397, March 1973

Anonymous (1972)

Recommended treatment of oiled seabirds

Unknown

Report. University of Newcastle upon Tyne, Dept. of Zoology, Research Unit on the Rehabilitation of Oiled Seabirds, Advisory Committee on Oil Pollution of the Sea, England. 11 pages.

Price: #0.25

Recommended Treatment of Oiled Seabirds.

Ardizzone, G.D.; Bombace, G. (1983)

Artificial reef experiments along a Tyrrhenian sea coast

Journee d'Etudes sur les Aspects Scientifiques Concernant les Recifs Artificiels et la Mariculture Suspendue, Cannes, 7 Decembre 1982, pp. 49-51.

(Seminar on Scientific Aspects of Artificial Reefs and Floating Mariculture in the Mediterranean, Cannes, December 7, 1982.)

Inst. Zool., Univ. Roma, Rome, Italy

ABSTRACT
Data are presented concerning studies undertaken on artificial reefs along the Tyrrhenian coast. The first example describes the protection of Posidonia beds from trawling activities by the placing of artificial reefs (concrete blocks), and the second concerns the construction of artificial reefs in an eutrophic zone near the Tiber River mouth.

Armstrong, D.A.; Incze, L.S.; Armstrong, J.L.; Wencker, D.C.; Dumbauld, B.R. (1981)

Distribution and abundance of decapod crustacean larvae in the S.E. Bering Sea with emphasis on commercial species

Washington Univ., Seattle, USA

Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1981. Volume 2. Receptors - Benthos.

Publisher(s): NOAA/OMPA, Boulder, CO (USA), pp. 365-596

Report Number: NOAA-OMPA-AR-81-2

ABSTRACT
This project was established to provide information on larval decapods to those considering ramifications of oil and gas development and to aid them in devising management policy to mitigate possible impacts. The sections of this report describe the general methods and materials used in the program. Next are several sections that review pertinent literature on the biology and fishery (if applicable) of major decapod groups and present results obtained thus far. The commercial king and Tanner crabs are discussed respectively, followed by other crabs, shrimp and hermit crabs. While the latter three groups are not commercially important (an exception is the horsehair crab, Erimacrus isenbeckii), they may be of major ecological importance as predators and prey within the benthic community and must not be overlooked in predictions of oil impact.

Armstrong, N.E. (1982)

Spill cleanup

Dept. Civil Eng., Univ. Texas, Austin, TX, USA

Part 3, Biological measures. In: Hazardous Materials Spills Handbook

McGraw-Hill Book Co., NY

ABSTRACT
The National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 1510) delineates five classes of actions that comprise the elements of spill control. The actions are Phase I-discovery and notification; Phase II-evaluation and initiation of action; Phase III-containment and countermeasures; Phase IV-cleanup, mitigation, and disposal; Phase V-documentation and cost recovery. The time to implement any of these phases will depend on the location of the spill, the material spilled, the magnitude of the spill, and so forth. Employment of a biological countermeasure imposes special constraints on the activities in Phases III and IV and requires that its use be carefully considered in Phase II. To understand these special constraints, the requirements of a general countermeasure and the information needed to judge the suitability of a biological countermeasure must be discussed.

Armstrong, N.E.; Gloyna, E.F.; Wyss, O. (1984)

Biological countermeasures for the control of hazardous material spills

Dept. Civil Eng., Univ. Texas, Austin, TX, USA

NTIS, Springfield, VA (USA)

ABSTRACT
The possibility of accidental spills of hazardous substances poses a constant threat to the waters of the nation. Effective ways to control such spills and to mitigate their effects include physical and chemical techniques, but biological countermeasures have not been considered feasible to date. Determining the feasibility of this countermeasure have not been considered feasible to date. Determining the feasibility of this countermeasure was the primary focus of this study. Using the hazardous compounds phenol and methanol as test substances, treatability studies were performed using acclimated bacteria to estimate their growth kinetic and substrate removal rates and the effects of those coefficients of environmental variables such as temperature, pH, and salinity in ranges found typically in fresh and estuarine waters. Biological countermeasures were shown to be a feasible method for hazardous material spill removal within certain limitations imposed by the toxicity of the material to bacteria and its initial concentration.

Army Engineer District, Mobile, AL (USA) (1984)

Exploration and production of hydrocarbon resources in coastal Alabama and Mississippi

NTIS Order No.: AD-A154 316/4/GAR. Final generic environmental impact statement, 1006 pp.

Report Number: COESAM/PD-EE-84-009

ABSTRACT
An analysis has been undertaken of the physical biological and socioeconomic effects of hydrocarbon exploration and production activities in coastal Alabama and Mississippi and adjacent Federal waters of the Gulf of Mexico. The analysis consists of two parts: effects and generic unit actions, and cumulative effects of postulated hydrocarbon-related activities in the region over the next 30 years. Four subregions are considered in the analysis: the forested and seasonally-flooded Mobile-Tensaw River Delta, the shallow coastal estuaries of Mobile Bay and Mississippi Sound, and the Alabama and Mississippi state waters of the Gulf of Mexico. The main short-term adverse environmental effects would be turbidity resulting from well site and pipeline construction activities, and the temporary loss of habitat and biological productivity during pipeline construction and during the drilling period at well sites that are eventually abandoned as dry holes. Long-term adverse environmental effects include the reduction or loss of biological productivity and the alteration of habitat value at producing well sites and along wetland pipeline corridors, which would continue for many years until a well field is abandoned.

Army Engineer District, New Orleans, LA (USA) (1985)

New Orleans to Venice, Louisiana: Hurricane Protection Project

NTIS Order No.: AD-A154 055/8/GAR. Final supplemental EIS (Appendices), 176 pp.

ABSTRACT
The New Orleans to Venice, Louisiana, Hurricane Protection project is intended to provide protection of the developed areas of Plaquemines Parish along the Mississippi River. The project would enlarge the locally constructed back levee from City Price to Venice, Louisiana, and bring the existing levee from Phoenix to Bohemia up to grade. The proposed construction involves the hydraulic pumping of sand from the Mississippi River and clay from select borrow areas in the adjacent marshes. Surface material obtained from the borrow areas, as well as suspended materials from the dredging operation, will be retained in a ponding area and the effluent released into the marsh. Approximately 3,000 acres of wetland will be permanently impacted, and 11,000 acres temporarily affected. It is proposed that the wetlands permanently lost be mitigated by the creation of marsh on the Delta National Wildlife Refuge.

Artificial reefs (1986)

Technology, Vol. 8, No. 6

Publisher(s): PCARRD, Los Banos (Philippines), 16 pp.

Received July 1989.

Report Number: ISSN 0115-7787

ABSTRACT
Discarded tires and bamboos have been used for constructing artificial reefs. These materials may be dropped at the bottom of the sea to form a jumbled mass or assembled into geometric forms. Tires last longer than bamboos, which stay intact for about 3 years. From a 10-tire reef which costs P2,483.94, a fishermen earns a net income of P10,500 and P1,300 in the fourth and fifth year of operations in addition to the income derived from his fishing activities outside the artificial reef. If he uses a 10-bamboo reef with a production cost of P1,762.64, he obtains a net profit of P8,600 and P10,300 in the second and third year of operations.

Ash, C.; Garrett, C.; Gray, S. (1989)

Prevention and Cleanup of Petroleum Contamination of Ground Water Florida's Super Act

Fla. Dept. Environ. Regulation, Tallahassee, FL 32399-2400

Fla Sci 52 (4). 225-229. CODEN: FLSCA

Aska, D.Y. (1981)

Artificial Reefs

Proceedings of a Conference Held September 13-15, 1979, in Daytona Beach, Florida

Florida Sea Grant College, Gainesville (USA)

Rep. Fla. Sea Grant Program

Publisher(s): FSG, Gainesville, FL (USA), 235 pp.

Report Number: FSG-R-41

ABSTRACT
The Conference on Artificial Reefs, held in Daytona Beach, Florida on September 13-15, 1979, dealt with a variety of perspectives on artificial reefs as an improvement on the natural habitat of fish, in various coastal areas. Subjects considered were: site selection, construction materials, economical and social aspects as well as planning and management for multiple use of such resources. Procedures for obtaining construction and use permits and relevant regulations are also given consideration.

Atlas, R.M.; Horowitz, A.; Busdosh, M. (1978)

Prudhoe crude oil in arctic marine ice, water, and sediment ecosystems: Degradation and interactions with microbial and benthic communities

J. Fish. Res. Board Can.

Presented at the Symposium on Recovery Potential of Oiled Marine Norther Environments Halifax (Canada) 10 Oct 1977.

Dept. Biol., Univ. Louisville, KY 40208, USA, 35(5), 585-590

ABSTRACT
A variety of in situ models were used to simulate oil spills in different arctic ecosystems. Numbers of oil-degrading microorganisms were found to increase after oil contamination. Oil contamination of sediment resulted in mortality of indigenous invertebrates. Recolonization of oil-contaminated sediments began shortly after oil contamination but benthic communities were significantly different in oil-contaminated sediment compared with the control, 2 months after oil contamination. Petroleum hydrocarbons were degraded slowly. Ice greatly restricted losses of light hydrocarbons. Following initial abiotic losses, biodegradation of oil was limited and did not significantly alter the relative percentages of hydrocarbons in the residual oil. The authors concluded that petroleum hydrocarbons will remain in arctic ecosystems for prolonged periods after oil contamination.

Atlas, R.M. (September, 1978)

Potential interaction of microorganisms and pollutants from petroleum development

In: Marine Biological Effects of OCS Petroleum Development. Wolfe, D.A., ed.
NOAA-TM-ERL-OCSEAP-1, NOAA ERL, Boulder, CO (USA), pp. 156-166.

Presented at the Formal Scientific Review of Biological Effects Studies, Seattle, WA (USA), Nov 29, 1977.

Louisville Univ., Dept. Biol., Louisville, KY, USA

NOAA Tech. Memo.

ABSTRACT
As a result of data gathered ancillary to reconnaissance and fate of oil studies, some limited results have been found on the effects of oil on microorganisms. It was found that hydrocarbons are degraded very slowly. Persistence from a moderate oil spill must be thought of in terms of years instead of days, or months. Under certain conditions, such as under ice the physical evaporative losses of light hydrocarbons, many of which are highly toxic, are greatly restricted. Similarly, losses of light hydrocarbons in sediment appear to be restricted due to adsorption. Components, such as naphthalene, are found still present weeks after spillage under ice. The implication of this finding is that low molecular weight oil components will reside for prolonged periods under certain conditions in Alaska ecosystems. In contrast to sediment and under ice, volatile components are lost within days from open water spillages. The residual oil recovered from these studies had the same composition of the oil in terms of component classes as the freshly spilled oil.

Axiak, V.; George, J.J. (1987)

Behavioral responses of a marine bivalve (Venus verrucosa) to pollution by petroleum hydrocarbons

Math. and Sci. Dept., Univ. Malta, Msida, Malta

Water Air Soil Pollut., Vol. 35, No. 3-4, pp. 395-410.

ABSTRACT
The effects of exposure to petroleum hydrocarbons (PHC) on the burrowing behavior, valve activities and siphonal and foot reactions of the clam, Venus verrucosa were investigated in a series of laboratory experiments. Such exposure did not significantly alter the burrowing activities of this species. The foot, siphons and mantle folds failed to respond both to low and high concentrations of PHC. After 130 days of exposure to 100 μg/L of water-accommodated fractions of oil, both the response time and the recovery period of the siphonal response to light stimuli were significantly prolonged. Increased valve activities were also recorded. The biological significance of such altered behavior and activities is discussed.

Baden, S.; Hagerman, L. (1981)

Ventilatory Responses of the Shrimp Palaemon adspersus to Sublethal Concentrations of Crude Oil Extract

Mar. Biol. Lab., DK-3000 Helsingoer, Denmark

Mar. Biol., Vol. 63, No. 2, pp. 129-133

ABSTRACT
P. adspersus Rathke was exposed to the water soluble fraction (WSF: 50; 100; 200 ppb) of North Sea crude oil. The ventilatory behavior, measured with impedance techniques, was followed for 2 wk and in a subsequent recovery period for 5 wk. Exposure to WSF caused a gradual increase in arrhythmic scaphognathite activity. After 6 d of exposure to 200 ppb shrimps spent more than 50% of the time beating arrhythmically, persisting and sometimes increasing to 100% during the remainder of the exposure period. In the 100 and 50 ppb groups, the proportion of time spent beating arrhythmically increased gradually with exposure time reaching 30 and 20% respectively. The disturbances in ventilatory behavior when exposed to WSF is considered to be due to damage to gill membranes or to nerve tissue, especially to the neurons in the suboesophageal ganglion controlling scaphognathite activity.

Badin, P.; Boucher, D. (1983)

Evolution a moyen terme du meiobenthos et des pigments chlorophylliens sur quelques plages polluees par la maree noire de l'Amoco Cadiz

(Medium-term evolution of meiobenthos and chlorophyll pigments on some beaches polluted by the Amoco Cadiz oil spill)

Univ. Bretagne Occidentale, Lab. Oceanogr. Biol., 6 Avenue Le Gorgeu, 29283 Brest Cedex, France

Oceanol. Acta, Vol. 6, No. 3, pp. 321-332.

ABSTRACT
The ecological monitoring undertaken after the "Amoco Cadiz " oil spill (16 March 1978), on the beaches Brouennou and Corn ar Gazel (mouth of Aber Benoit) and Kersaint (near Portsall), was continued monthly until November 1980. Chlorophyll pigments were found to have suffered little, quantitatively, from the direct effect of pollution, but the study of temporal variations in meiofaunal densities revealed disturbances in seasonal cycles. Other factors, e.g., hydrodynamic fluctuations and macrofaunal predation, may have acted as regulating mechanisms on the evolution of the populations. The effects of pollution are particularly evident in certain faunistic imbalances, as the study of harpacticoid copepods showed. However, particular evolutionary trends between and within ecological groups of species implied that recovery was nearly complete, at least on exposed beaches.

Baehr, A.L. (1985)

Immiscible contaminant transport in soils with an emphasis on gasoline hydrocarbons

Univ. Delaware, Newark, DE, USA

Diss. Abst. Int. Pt. B - Sci. & Eng, Vol. 46, No. 3

ABSTRACT
A generalized mathematical model, incorporating the physical, chemical and biological processes which collectively describe the transport of a reactive and immiscible contaminant in soils and groundwater is presented. The problem is one of multiphase transport, that is, the contaminant can be transported as solutes in water, vapors in air and as unreacted constituents in an immiscible phase. Additionally, it may be adsorbed onto soil surfaces. Conservation principles lead to a system of nonlinear partial differential equations governing the phenomenon. The portion of a spill remaining in the unsaturated zone after efforts to recover the spilled product have ceased may pose a long term threat to underlying groundwater.

Baker, J.M. (1975?)

The Field Studies Council Oil Pollution Research Unit

Field Studies Council, UK,

Presented at Inst of Petroleum/Field Studies Council Meeting on Marine Ecology and Oil Pollution, Scotland, Apr 21-23, 1975, P17 (3). The original document is available from Bowker.

ABSTRACT
The history and current status of the Oil Pollution Research Unit of the Field Studies Council, U.K., are reviewed. OPRU's involvement in restoring the seriously polluted Milford Haven port to some ecological balance is traced. Monitoring of the port's rocky shores and salt marshes is combined with field surveys and laboratory work to discover the nature of the toxic substances polluting the waters and shores of Milford Haven. The development of new techniques for measuring the effects of oils and dispersants on the behavior of various animal and fish species in the area is described.

Bakke, T. (1986?)

Experimental Long Term Oil Pollution in a Boreal Rocky Shore Environment

Norwegian Inst for Water Research, Norway

Env Canada 9th Arctic Marine Oil Spill Technical Seminar, Edmonton, Jun 10-12, 1986, P167(12). The original document is available from Bowker.

ABSTRACT
A large-scale mesocosm experiment performed during 1979-85 in eastern Norway investigated the effects of continuous sublethal exposure to diesel oil in a cold, temperate, rocky shore community. Two basins were exposed continuously to oil at mean levels of 130 and 30 mg/l, respectively, during 1982-84, while two basins served as controls. Communities were then followed for recovery for one year. Oiling effects ranged from population collapse, reduced growth and recruitment, reduced primary production, and accumulation of hydrocarbons in algae and animals, to cyto- and biochemical stress indications. Effects were mostly dependent on season. Most responses returned to normal after the recovery period.
(1 diagram, 1 photo, 29 references, 1 table)

Banner, A. (1979)

Mitigation under the Corps regulatory program

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979.

Fish and Wildl. Serv., Vero Beach, FL, USA

Gen. Tech. Rep. U.S. Dept. Agric.

US Dept. Agriculture Fort Collins, CO (USA)

Report Number: p 396-399

ABSTRACT
The Fish and Wildlife Service often requires mitigation for private development in wetlands needing Federal permits (River and Harbor Act, Clean Water Act). Cumulative impact of small projects and expansion of jurisdiction to freshwater wetlands has made this program increasingly important. Mitigation for permitted work (and restoration of violations) is like project mitigation in using simplified HEP, and off site or structural enhancement, but avoids long-term management.

Bartha, R.; Atlas, R.M. (1977)

The microbiology of aquatic oil spills

Dept. Biochem. and Microbiol., Rutgers Univ., New Brunswick, NJ 07103, USA

Adv. Appl. Microbiol., No. 22, 225-266.

ABSTRACT
The microbiology of accidental or routine oil discharges into aquatic environments is reviewed under the following headings: (1) Sources and behavior of oil pollutants (2) Effects of petroleum hydrocarbons on microorganisms (3) Microbial emulsification and degradations of petroleum hydrocarbons and (4) Microorganisms and oil pollution abatement. A quantitative recovery of an oil slick is almost never feasible, and for some or most of the spill microbial degradation remains the principal mechanism of removal.

Bay, R.R. (1976?)

Rehabilitation Potentials and Limitations of Surface Mined Lands

USFS

Presented at Wildlife Management Inst 41st North American Wildlife & Natural Resources Conf, Washington, DC, Mar 21-25, 1976, P345 (11)

ABSTRACT
Many minerals and fossil fuels are close enough to the earth's surface to be extracted by surface mining techniques. However, landforms can be changed by removal of thick seams of minerals. Besides affecting the immediate surface resources of agricultural land, range, or forests, such disturbances can influence resource management far removed from the mine site. Aquifers may be altered, alkaline seeps created, and streams polluted, thus affecting fisheries far downstream. Wildlife populations may be greatly affected if key seasonal range or migration routes are destroyed. Complete ranching and forestry operations may be changed by even a small disturbed acreage in a strategic area. The development and continuation of some mining operations may depend on their potential for successful land rehabilitation. Reclamation activities in the west are discussed. (3 photos)

Beck, R.; Shore, R.; Scriven, T.A.; Lindquist, M. (1981)

Potential Environmental Problems of Enhanced Oil and Gas Recovery Techniques

Energy Resources Co., Inc., Cambridge, MA

NTIS, Springfield, VA

ABSTRACT
This report provides: (a) an identification of and analysis of available data regarding EOR/EGR related pollutants; (b) and assessment of potential environmental impacts and an identification of possible controls; and (c) recommendations as to research needs. The following processes were studied; steam injection, in situ combustion, carbon dioxide miscible flooding, micellar/polymer flooding, alkaline flooding, improved water flooding, advanced hydraulic fracturing, chemical explosive fracturing, and directional drilling. The existing EOR/EGR environmental impact information (published and unpublished) is critically reviewed and summarized. The effect of EOR/EGR processes on air quality, groundwater quality, water quantity, noise levels, and secondary impacts is the main area of analysis.

Begley, S.; Drew, L.; Hager, M. (1989)

Smothering the waters

Newsweek, Apr 10, P54(4)

ABSTRACT
The spill of 240,000 barrels of oil from the Exxon Valdez tanker in Alaska's Prince William Sound on March 24, 1989, is the worst in North American history. Thousands of marine mammals, birds, and fish have been coated with the oil, jeopardizing fisheries. Exxon's spill prevention and cleanup efforts were criticized for being inadequate in the ecologically delicate region. Cleanup efforts by the company and local citizens are described. Investigations are underway into the cause of the spill; Captain Joseph Hazelwood was legally drunk when he was tested more than 10 hours after the wreck. (1 diagram, 5 photos)

Beillois, P.; Desaunay, Y.; Dorel, D.; Lemoine, M. (1979)

Effets de la pollution consecutive a l'echouage de l'Amoco Cadiz: Etat des ressources chalutables Baies de Morlaiz et de Lannion

(Pollution effects after the Amoco Cadiz grounding: Conditions of fishery resources in the Bays of Morlaix and Lannion)

Institut Scientifique et Technique des Peches Maritimes, Nantes, France

Report Number: 32 p

ABSTRACT
The Bay of Lannion is a nursery zone for the flatfishes and is considered as a very important fishing ground on the northern coast of Finistere. After the important mortalities in Spring 1978 when the Amoco Cadiz oil spill occurred, fishermen's trawling in summer and Autumn 1978 gave poor results: the numbers of fish were low and some had necroses. Stocks restorations vary with the species. The authors suggest that protection measures be taken for fishing and sand extraction.

Bell, J.M. (1981?)

Industrial Waste

Purdue Univ. et al. Industrial Waste 36th Conf Proceedings, Lafayette, IN, May 12-14, 1981 (1008)

ABSTRACT
All aspects of industrial waste treatment, recovery, and disposal are covered in the 36th Annual Industrial Waste Conf., held at Purdue Univ. on May 12-14, 1981. Chemical wastes, coal, coke, and power plant wastes, hazardous and toxic wastes, food wastes, and refinery wastes are discussed for their treatability through chemical, biological, and physical treatment. Explosive, agricultural, plating, metal, mining, paper, textile, steel, and tannery wastes are also studied. The industrial perspective on pretreatment of wastes is evaluated in light of existing federal laws and regulations. (Numerous diagrams, graphs, references, tables)

Bell, P.R.; Greenfield, P.F.; Nicklin, D.J. (1983?)

Chemical and Physical Characterization of Effluent Streams from the Processing of Australian Oil Shale

Univ of Queensland, Australia

Colorado School of Mines Oil Shale 16th Sym, Golden, CO, Apr 13-15, 1983, P477 (10). The original document is available from Bowker.

ABSTRACT
Three effluent streams produced during the recovery and processing of oil shales in Australia have been characterized. The chemical and physical properties of spent shale, leachates from spent shale, and retort water are described. Australian spent shales have lower pH values and alkalinities compared with Colorado spent shales. The mineralogy of leachable salts is discussed, and the leaching of major anions and cations during unsaturated flow through spent shale columns is analyzed. Straight chain carboxylic acids were the most dominant class of compounds identified in retort waters. Treatment options for upgrading retort waters are surveyed. (4 graphs, 11 references, 7 tables)

Belsky, J. (1982)

Diesel Oil Spill in a Subalpine Meadow: 9 Years of Recovery

Syracuse Univ

Canadian J Botany, 60(6):906. The original document is available from Bowker.

ABSTRACT
The effects of a diesel oil spill on two subalpine meadow communities near Mt. Baker, WA, were charted. The area was inundated by a spill of 26,000 l of diesel. The impacts of the spill on vegetation and community recovery for a 9-yr period after the spill are discussed. Two growing seasons after the spill, plant cover decreased from a cover of almost 100% to 1%, with most species dying. Carex nigricans appeared on bare soil after one year. (20 references, 2 tables)

Bender, M.E.; Shearls, E.A.; Murray, L.; Huggett, R.J. (1980)

Ecological effects of experimental oil spills in eastern coastal plain estuaries

Virginia Inst. of Marine Science, Div. of Environmental Sciences and Eng., Gloucester Pt., VA 23062

Environment International 3(2), 121-133, Coden: ENVIDV

ABSTRACT
In a natural estuarine marshcreek habitat (Cub Creek, Virginia), 5 experimental units were constructed, each having a surface area of =810 m^2, containing 695 m^2 of marsh, 100 m^2 of open water, and 15 m^2 of intertidal mud flat. Fresh South Louisiana crude (570 L) was added to each of the 2 downstream experimental enclosures =3 hr into flood tide and was completed in 1 hr. The weathered oil was similarly applied to the upstream units 3 d later. The weathered oil was not visible 1 wk after the spill except as coatings on marsh grass blades, while the fresh crude remained for >3 wk. Plankton populations recovered within 1 wk, and fish mortalities, which were most pronounced in the weathered oil unit, ceased after 10 d. Reductions in standing crops of marsh grasses were most pronounced the year following the spills, when peak biomass in the control exceeded the spill units by a factor of 3. Recovery progressed further in the second year, with peak biomass in the oiled units being =70% of the control. The third year following the spill, recovery was nearly complete. Benthic populations were dominated numerically by oligochaetes. Significant reductions in populations of this organism and in populations of polychaetes and amphipods were demonstrable for 3 yr. (MS) (illustrations, numerous references)

Bender, M.E.; Shearls, E.A.; Ayres, R.P.; Hershner, C.H.; Huggett, R.J. (1977)

Ecological effects of experimental oil spills on eastern coastal plain estuarine ecosystems

Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977.

Virginia Inst. Mar. Sci., Gloucester Point, VA 23062, USA

Publisher(s): American Petroleum Inst., Washington, DC (USA), p.505-509

Report Number: API-Publ--4284

ABSTRACT
Five segments of a mesohaline marsh located off the York River in Virginia were physically isolated from the surrounding area, except for allowing subtidal flow, and dosed with fresh and artificially weathered South Louisiana crude oil. The experimental design and field site utilized in this study are described. The mini-ecosystems each contained about 695 m^2 of marsh, 140 m^2 of open water and 15 m^2 of intertidal mud flat. In Sept., 1965, three barrels (570 l) of each of the experimental oils were spilled into replicate systems. Overall, the artificially weathered oil was shown to have as great an ecological impact on the communities as the fresh crude. Phytoplankton and fish populations all showed greater declines following the spills in the weathered oil systems. Phytoplankton production declined immediately after both oil spills but had recovered to control values within seven days. Species composition was not affected by the oils, while periphyton biomass, as measured by adenosine triphosphate (ATP), increased after both treatments. Marsh grass production was reduced in both spill units. Benthic animals, showing population declines after both oil spills, included nereid polychaetes, insect larvae and amphipods. Oligochaete populations decreased shortly after the fresh crude spill, returned to normal within 30 days, and then declined again relative to the control in both treatments 11 weeks after the spill. Mortalities of fish, Fundulus heteroclitus, held in live boxes were noted only in the weathered treatment systems.

Bendock, T.N. (no date)

Beaufort Sea estuarine fishery study

Alaska Dept. Fish and Game, Sport Fish Div., Fairbanks, AK, USA

In: Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Volume 4: Biological Studies.

Publisher(s): NOAA Environmental Research Laboratories, Boulder, CO (USA), Outer Continental Shelf Environmental Assessment Program

Contract No. 03-5-022-69.

Report Number: p 670-729

ABSTRACT
Petroleum exploration and development is rapidly increasing throughout the near shore areas of the Beaufort Sea. The demands by industry for construction material, gravel sources, fresh water and transportation avenues are substantial. Alterations of the physical environment resulting from water and gravel removal or the construction of roads, pads and causeways are imminent. Information on the biology of fish inhabiting these waters is necessary prior to evaluating the ultimate effects these activities have on the resource. The objectives of this study are to determine the distribution and relative abundance of the various species of fish inhabiting the near shore environs of the Beaufort Sea. By correlating important life history data with the knowledge of habitat needs, it is hoped to obtain base line information that can be used to direct the activities of people and industry in the proposed lease area.

Berge, J.A.; Johannessen, K.I.; Reiersen, L.-O. (1983)

Effects of the water soluble fraction of North Sea crude oil on the swimming activity of the sand goby, Pomatoschistus minutus (Pallas)

Inst. Mar. Biol. and Limnol., Univ. Oslo, Oslo, Norway

J. Exp. Mar. Biol. Ecol., Vol. 68, No. 2, pp. 159-167.

ABSTRACT
Experiments were performed to test the effects of the water soluble fraction of North Sea crude oil (WSF) on the swimming behavior of sand gobies, P. minutus (Pallas). In clean sea water a normal activity pattern was noted with an "off bottom activity" in the dark and an "on bottom activity" in the light. After 1 to 2 days of exposure to WSF of oil (0.1 to 1.0 ppm) the "off bottom" activity was suppressed, and there was an increased mortality. A 50% survival was found after 6 days exposure to WSF. Gradual restoration of clean sea water to the surviving fish re-established the normal activity pattern, although some fish still died.

Bergman, H.L.; DeGraeve, G.M.; Anderson, A.D.; Farrier, D.S. (1980)

Effects of Complex Effluents From In Situ Fossil Fuel Processing on Aquatic Biota

Dept. Zool. & Physiol., Univ. WY

First Annl. Oak Ridge Nat. Lab. Life Sci. Symp., Oak Ridge, TN, Sep. 25-28, 1978.

In: Synthetic Fossil Fuel Tech. -- Potential Health & Environ. Effects, pp. 204-211.

Ann Arbor Sci. Publ., Inc., 230 Collingwood, P.O. Box 1425, Ann Arbor, MI 48106

ABSTRACT
In situ processes for advanced fossil fuel recovery elicit major concerns about contamination of surface and groundwater with potential effects on water uses and aquatic biota. Acute and limited-chronic toxicity bioassays were conducted to determine the effects of process waters produced from two in situ technologies being developed by DOE's Laramie Energy Technology Center: (1) Omega-9 retort water from the Rock Springs Site 9 in situ oil shale processing experiment; and (2) Hanna-3 condenser water from the Hanna underground coal gasification experiment. The acute TL sub(50) dilution (50% toxicity level) for oil shale retort water was about 0.5% for rainbow trout and fathead minnows (96-h) and for Daphnia pulex (48-h), and the threshold effect dilutions for limited-chronic bioassays with rainbow trout were 0.3% for egg hatchability and 0.1% for fry growth; the principal solutes affecting the acute toxicity were probably inorganic.

Berkner, A.B.; Smith, D.C.; Williams, A.S. (1977)

Cleaning agents for oiled wildlife

Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977.

International Bird Rescue Res. Cent., Aquatic Park, Berkeley, CA 94710, USA

Publisher(s): American Petroleum Inst., Washington, DC (USA), p.411-415

Report Number: API-Publ--4284

ABSTRACT
Attempts to save oiled wildlife cannot be successful unless appropriate treatment is given. One of the more critical areas of rehabilitation is the selection and correct use of a suitable cleaning agent. The advantages and limitations of detergents and solvents are discussed with respect to the types of wildlife affected, the types of oil involved, and the available equipment and facilities. Seven commercial detergents out of 22 tested are ranked in order of their effectiveness in removing 8 specific types of oil. Optimal concentrations and available toxicity data are also given. Solvents that have been successfully used are listed along with other solvents that appear promising on the basis of their composition and physical parameters. Further evaluations of cleaning agents and additional basic research are still needed.

Berkner, A.B. (1979?)

Wildlife Rehabilitation Techniques: Past, Present, and Future

Intl Bird Rescue Research Center, CA

Presented at the US Fish & Wildlife Service Pollution Response Conf, St. Petersburg, May 8-10, 1979, P127 (7). The original document is available from Bowker.

ABSTRACT
past research concerning oiled bird rehabilitation, the present status of recovery techniques, and future research needs are discussed. The cleaning of oiled birds prior to 1970 was mainly limited to external problems. A variety of cleaning agents, including butter and castor oil, were tested. Recent research efforts have also investigated the effects of oil ingestion, and methods of rehabilitating affected waterfowl. The U.S. Fish and Wildlife Service is presently charged with supervising bird cleanup operations. Additional research needs include the development of contingency planning and the cooperation of skilled professionals. (22 references)

Berliner, N. (1989)

The year of the spills

Environ. Action, V21, N2, P12(4). The original document is available from Bowker.

ABSTRACT
During 1984-88, some 32 million gal of oil were discharged into us waters by tankers and other vessels. This figure represents three times the amount of oil spilled by the Exxon Valdez in March 1989 in Alaska. Of the 15,260 incidents reported, some 15,100 were classified as small, less than 10,000 gal, reflecting the magnitude of smaller oil spills in the U.S. Environmentalists are calling for additional safety features, training, and standards to reduce the frequency and severity of such spills. The content of many congressional bills proposed to accomplish this goal is being debated, with liability issues serving as the key area of contention. (3 photos)

Beynon, L.R.; Goedjen, H.; Lilie, R.H.; Aston, G.H.R.; Sibra, P. (c. 1983)

Field Guide to Inland Oil Spill Clean-Up Techniques

Concawe, The Hague (Netherlands).

Corp. Source Codes: 074766000

Report No.: CONCAWE-10/83

104p

Journal Announcement: GRAI8412

NTIS Prices: PC E06/MF E01

Country of Publication: Other

ABSTRACT
Contents: Clean-up strategy; (Objectives, integrated clean-up operations, emergency measures, communications, action trees); Clean-up methods; (Oil in soil, oil on moving water, oil on static water, oil in urban areas, effects of ice and snow); Temporary storage; (Temporary storage); Transport/final disposal/restoration of site; (Transport, final disposal, restoration); Emergency equipment lists. (Color illustrations reproduced in black and white.)

Bigot, L.; Picard, J.; Roman, M.L. (1987)

Consequences pour les milieux naturels des interventions humaines sur le littoral sableux du delta du Rhone

(*Consequences of human interventions on natural sand areas of the seashore in the Rhone Delta*)

Colloque Int. de la Societe d'Ecologie et de la Societa Italiana di Ecologia Marseille-Luminy (France) 5 Jun 1986

Fac. St. Jerome, Lab. Biol. Anim. (Ecol.), rue Henri Poincare, 13397 Marseille Cedex 13, France

Bull. Ecol., vol. 18, no. 2

Ecologie Littorale Mediterraneene. (Mediterranean Littoral Ecology.) Bellan, G., coord., pp. 209-212

Report Number: ISSN 0395-7217

ABSTRACT
After a study on beaches and dunes subjected to the Rhone River's influence, the consequence of human intervention become apparent. In the study area human activities have induced: the receding of beach creating a need for angle breakwaters, hydrocarbon deposit as far as in the dunes, the pollution of superficial waters in the Rhone's estuary.

Biol. Sci. Dept., Florida Int. Univ., Miami, FL 33199, USA (1979)

Mitigation of estuarine fisheries nurseries: Seagrass restoration

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats Fort Collins, CO (USA) 16 Jul 1979.

Gen. Tech. Rep. U.S. Dept. Agric.

US Dept. Agriculture Fort Collins, CO (USA)

Report Number: p 667-669

ABSTRACT
Thousands of square miles of fisheries nurseries have been destroyed by man's activities in estuaries. A new method of seeding the dominant subtropical and tropical seagrass Thalassia in large-scale submerged restoration efforts demonstrates rapid regrowth (4-5 years), large animal population recolonization, and cost-effectiveness over plugging.

Bjoerge, A. (1986)

Status of marine mammal habitat protection in Norway

Council Meeting of the International Council for the Exploration of the Sea, Copenhagen, Denmark, October 9, 1986.

Minist. Environ., P.O. Box 8013 Dept, N-0030 Oslo 1, Norway

Publisher(s): International Council for the Exploration of the Sea, Copenhagen (Denmark), 8 pp.

Only available from the author. Marine Mammals Comm.

Report Number: ICES-CM-1986/N:4

ABSTRACT
Fifteen areas in Norway and five areas in Svalbard of significance to marine mammals (Odobenus rosmarus, Halichoerus grypus, Phoca vitulina, Phoca hispida, Erignathus barbatus) are protected pursuant to the Norwegian Nature Conservation Act and the Svalbard Act. Whales occasionally occur in protected areas. However, no large offshore whale sanctuary is established. Examples of protected marine mammal habitats and behavioral adaptations of marine mammals in protected areas are described. Interspecific competition for haul out and breeding sites between common and grey seals is discussed.

Blake, S.B.; Lewis, R.W. (1982?)

Underground Oil Recovery

Engineering Enterprises, Inc., OK

EPA et al. Aquifer Restoration & Ground Water Monitoring 2nd Sym, Columbus, OH, May 26-28, 1982, P69 (8). The original document is available from Bowker.

ABSTRACT
The effective recovery of spilled hydrocarbons present in the groundwater table requires specialized procedures and equipment. Product migration and spill evaluation considerations are surveyed. The design and placement of monitoring wells and techniques for sampling and product detection are also examined. Recovery alternatives, such as interceptor trenches and recovery wells, are reviewed. Pumping arrangements and recovery selection are also covered. (5 diagrams, 4 references)

Bodennec, G.; Glemarec, G.; Grizel, M.; Kaas, H.; Legrand, R.; Le Moal, V.; Michel, P.; Miossec, P.; et al. (1983)

Impact des hydrocarbures sur la faune et la flore marines

(Oil pollution impact on marine fauna and flora)

Cent Oceanol. Bretagne, BP 337, 29273 Brest Cedex, France

Rapport Collectif. (A Collective Report.)

Michel, P., ed. Pages 105-182

Contract CEE/ISTPM: BG/82/614 (629).

ABSTRACT
The oil pollution impact on marine organisms is reviewed on the pelagos (bacteria, phyto- and zooplankton), and on benthic organisms (immediate mortality, alteration of physiological processes, modification of inter specific equilibrium, restoration processes). The impact on seaweed harvesting and fisheries is evaluated, as well as the impact of cleaning operations: dispersants toxicity and mechanical cleaning of beaches and marshes.

Bodin, P. (1988)

Results of ecological monitoring of three beaches polluted by the Amoco Cadiz oil spill: Development of meiofauna from 1978 to 1984

Univ. Bretagne Occidentale, Fac. Sci., Lab. Oceanogr. Biol., U.A. 711 CNRS, 6 Ave., Le Gorgeu, F-29287 Brest Cedex, France

Mar. Ecol. Prog. Ser., Vol. 42, No. 2, pp. 105-123

ABSTRACT
Following the Amoco Cadiz oil spill, time-series sampling of the meiofauna was carried out from 1978 to 1984 in the intertidal zone of 3 sandy beaches on the northern Finistere coast (Brittany, France). Quantitative analysis documented 2 principal phases in the development of the main taxa (Nematoda and Copepoda). First came a degradation phase leading to impoverishment in density and diversity of the populations. This first phase could be subdivided into several stages corresponding mainly to the toxicity period and, on one beach (Kersaint), to a summer "bloom." Then came a recovery phase corresponding to a quantitative and qualitative reconstitution of the meiofauna. Each phase lasted a greater or lesser time according to station exposure and the considered taxon. A qualitative analysis of harpacticoid copepods illustrated the development of population diversity and "ecological groups."

Bodin, P.; Boucher, D. (1983)

Evolution a moyen terme du meiobenthos et des pigments chlorophylliens sur quelques plages polluees par la maree noire de l'Amoco Cadiz

(Medium-term evolution of meiobenthos and chlorophyll pigments on some beaches polluted by the Amoco Cadiz oil spill)

Univ. Bretagne Occident., Lab. Oceanogr. Biol., 6 Ave. Le Gorgeu, 29283 Brest Cedex, France

Oceanol. Acta, Vol. 6, No. 3, pp. 321-332

ABSTRACT
The ecological monitoring undertaken after the Amoco Cadiz oil spill (16 March 1978), on the beaches Brouennou and Corn ar Gazel (mouth of Aber Benoit) and Kersaint (near Portsall), was continued monthly until November 1980. Chlorophyll pigments were found to have suffered little, quantitatively, from the direct effect of pollution, but the study of temporal variations in meiofaunal densities revealed disturbances in seasonal cycles. Other factors, e.g., hydrodynamic fluctuations and macrofaunal predation, may have acted as regulating mechanisms on the evolution of the populations. The effects of pollution are particularly evident in certain faunistic imbalances, as the study of harpacticoid copepods showed. However, particular evolutionary trends between and within ecological groups of species implied that recovery was nearly complete, at least on exposed beaches.

Bodin, P.; Boucher, D. (1982)

Evolution a moyen-terme du meiobenthos et du microphytobenthos sur quelques plages touchees par la maree noire de l'Amoco-Cadiz

(Mid-term evolution of meiobenthos and microphytobenthos on beaches touched by the Amoco Cadiz oil spill)

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill, Charleston, SC (USA), 17 Sep, 1981, and Brest (France), 28 Oct, 1981.

Univ. Bretagne Occidentale, Lab., Oceanogr. Biol., 6 Ave Le Gorgeu, 29283 Brest Cedex, France

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission

Gundlach, E.R.; Marchand, M., eds. Pages 245-268

ABSTRACT
The ecological follow-up undertaken after the Amoco Cadiz oil spill, on the beaches Brouennou and Corn ar Gazel (mouth of Aber Benoit) and Kersaint (near Portsall), was continued until November 1980. Chlorophyll pigments have suffered little quantitatively from the direct effect of pollution, but the study of temporal variations in the meiofaunal densities revealed disturbances in seasonal cycles. Other factors, e.g., hydrodynamic fluctuations and macrofaunal predators, could act as regulating mechanisms on the evolution of the populations. The effects of pollution are particularly obvious in some faunistic imbalances, as the study of harpacticoid copepods showed. However, particular evolutionary trends between and within ecological groups of species implied that recovery was nearly complete, at least on exposed beaches. The conclusions drawn to date are tentative because of the lack of reference data, and it is intended to continue the survey annually in spring.

Bohme, V.E.; Brushett, E.R. (1977?)

Oil spill control in Alberta

Energy Resources Conservation Board, Calgary, Alta. T2P 0T4, Canada

1977 Oil Spill Conference, New Orleans, LA, Mar. 8-10, 1977

American Petroleum Institute. Publication 4284, pp. 91-94

ABSTRACT
The Energy Resources Conservation Board is responsible for the administration of the oil and gas industry. The board's policies and regulations relating to spill prevention, oil spill contingency planning, containment, and cleanup are broad and flexible to permit industry a relatively high degree of freedom to operate in Alberta. While each company is held responsible for containment and cleanup of its own spills, the Board supports the oil spill cooperative concept in spill equipment maintenance, contingency plan preparation, and spill response training. Careful containment and cleanup of oil and salt spills will minimize soil and vegetation damage. This, followed by comprehensive evaluation of spill effects, enables implementation of more effective rehabilitation programs. (from AA) (illustrations, references)

Bokn, T. (1987)

Effects of Diesel Oil and Subsequent Recovery of Commercial Benthic Algae

Norwegian Inst for Water Research, Norway

Hydrobiologia, N151-152, P277(8). The original document is available from Bowker.

ABSTRACT
A commercial species of seaweed growing along the Norwegian coast was subjected to a low continuous dosage of diesel oil in an experimental field mesocosm. The lengthwise growth of the two species of interest was inhibited, and large mortality rates were documented over the three-year test period. A diesel oil concentration averaging 130 mg/l caused continuous inhibition in both species, while a concentration averaging 30 mg/l caused periodical inhibition. After the exposure period, the plants displayed complete recovery during the following oil-free growth season. (6 graphs, 14 references, 5 tables)

∴ c/a important

Bolan, M.P.; Nieswand, G.H.; Singley, M.E. (1978)

Towards a statewide composting program in New Jersey

Rutgers Univ., Cook College, New Brunswick, NJ 08903

Compost Science/Land Utilization 19(5), 30-35, Coden: CSLUDU

ABSTRACT
Most of the 230,000 dry tons of sludge produced each year in New Jersey are currently dumped at sea, but this disposal option will be banned after 1981. Present regulations and institutional setups mitigate against the adoption of a sludge-solid wastes codisposal strategy. A state study is investigating sludges and bulking agents, their sources, composting sites, and potential uses and use limitations. Use of composted New Jersey sludge is complicated by high heavy metal concentrations which seem to preclude direct application to agricultural lands. A sludge compost certification program would be essential. (FT) (illustrations, references)

Boland, R.W. (1979)

Statewide fish habitat investigation: Stream habitat evaluation

Montana Department of Fish, Wildlife and Parks, Helena, MT (USA). Ecological Services Div.

Job Progress Report. Montana Department of Fish and Game

MDFG Helena, MT (USA)

Report Number: 15 p

ABSTRACT
A total of 125 Notices of Construction was received and reviewed during the report period. Measures requested to mitigate damage to streams and fish habitat are briefly described in tables. Fish and wildlife information for environmental assessments was provided to the State Department of Highways on request. Environmental impact assessments submitted for all State highway projects were reviewed and commented on. Engineering consultation services have been contracted and have helped with hydraulic questions.

Bombace, G. (1979)

Esperienze di creazione di barriere artificiali in medio Adriatico (SE Conero - Ancona)

[*Experiments on artificial reefs in the central Adriatic (SE Conero, Ancona)*]

1st Convegno Scientifico Nazionale del Progetto Finalizzato "Oceanografia e Fondi Marini" Rome (Italy) March 5, 1979

Atti del Convegno Scientifico Nazionale (Roma 5-6-7 Marzo 1979)

[Proceedings of the National Scientific Meeting (Rome 5-6-7 March)], Vol. 1, pp. 185-198

ABSTRACT
Some theoretical and practical aspects relating to artificial reefs are discussed. Data on an experimental artificial reef made in the Adriatic sea (off Conero promontory, Ancona) by the Fisheries Technology Laboratory are given. The artificial reef was constructed by sinking in the sea concrete blocks, appropriately structured and in a pyramid-like arrangement. Results achieved are summarized as follows: (1) Build-up as much as several hundreds tons of new biomass of mussels and oysters (obtained by recycling organic material). (2) Decrease of natural mortality for species which stick eggs and egg capsules inside the hollows of the reef. (3) Protection of species sheltered in the reef. (4) Attraction and concentration of pelagic species (thigmotropism) which feed close to the reef. (5) Reduction of contentions among trawling and artisanal fishermen, the latter setting their gears (traps, trammel nets etc.) close to the reef, out of danger from trawling. On the basis of results the area of artificial reefs has been extended.

Bombace, G. (no date)

Aspetti teorici e sperimentali concernenti le "barriere artificiali"

(Theoretical and experimental aspects relating to artificial reefs)

Atti del 9o Congresso della Societa Italiana di Biologia Marina, Lacco Ameno d'Ischia, 19-22 Maggio 1977.

(Proceedings of the 9th Congress of the Italian Society of Marine Biology, Lacco Ameno d'Ischia, Italy, 19-22 May 1977)

Lab. Tecnol. Pesca, C.N.R., Ancona, Italy

Cinelli, F.; Fresi, E.; Mazzella, L., eds. Pages 29-41.

ABSTRACT
In the present report some theoretical and practical aspects relating to artificial reefs are discussed. Data on an experimental artificial reef made in the Adriatic Sea (off Conero promontory, Ancoma) by the Fisheries Technology Laboratory are given. Results achieved so far may be summarized as follows: build-up of as much as several hundreds tons of new biomass of mussels and oysters decrease of natural mortality for species which stick eggs and egg capsules inside the hollows of the reef attraction and concentration of pelagic species that feed close to the reef and reduction of contentions between trawling and artisanal fishermen, the last setting their gears (traps, trammel nets etc.) close to the reef, out of danger from trawling.

Bombace, G.; Rossi, V. (1986)

Effects socio-economiques consecutifs a la realisation d'une zone marine protegee par des recifs artificiels dans la zone de Porto Recanati

(Socio-ecological effect following the construction of a marine area protected by artificial reefs in the Porto Recanati zone)

Tech. Consult. of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association with Artificial Reefs Ancona (Italy) 17 Mar 1986

Inst. Ric. Pesca Marit., CNR, Molo Mandracchio, 60100 Ancona, Italy

FAO Rapp. Peches., No. 357 (FAO Fish. Rep.)

Report of the Technical Consultation of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association with Artificial Reefs, Ancona, Italy, 17-19 March 1986. pp. 157-164.

Report Number: ISBN 92-5-0024550-X

ABSTRACT
During 1974-75 artificial reefs were constructed off Porto Recanati in order to protect the area and enable repopulation. Economic effects regarding increased production and aquaculture potential are considered briefly and details given of a fishery cooperative formed in 1981 and its activities.

Bondev, I.A.; Simeonov, S.Y. (1979)

Effect of Contamination on the Dynamics of the Higher Swamp Vegetation in the Poda Locality Near Bourgas Bulgaria

Inst. Bot., Bulg. Acad. Sci., Sofia, Bulgaria

Ekologiya (Sofia) 0 (5). (Recd. 1980). 3-10. CODEN: EKOLD

ABSTRACT
The dynamics of the higher vegetation was followed up depending on the contamination and cleansing of the water ecosystems. The discharge of industrial waste water from an oil-chemical plant during 1963-1972 caused an intensive contamination of the water basin with oil and oil products. The chemical analysis revealed a chemical need of oxygen (CNO) of up to 1825.0 mg/l, oil products up to 470.0 mg/l, phenol up to 365.0 mg/l, pH 6.9-11.7 and dissolved O_2 0.0 mg/l. Due to the contamination, the phytocenoses of Phragmites communis Trin. completely disappeared in the basin. The construction of water filtration station in the oil-chemical plant near Bourgas in 1972 created favorable ecological conditions in the basin. The chemical analysis showed a decrease in CNO to 100-125 mg/l, oil products to 0.8-12.4 mg/l, phenol to 0 mg/l, and an increase in the dissolved O_2 to 1.87-3.52 mg/l. Owing to this, there was a rapid restoration of the phytocenoses of P. communis. For a short period of time (1973-1976) they displayed a great development and spread in the region studied. P. communis appeared which initially occupied the coastal zone and then penetrated into the basin itself. Gradually the species Bolboschoenus maritimus (L.) and Typha angustifolia L. came into existence, and at present, 3 types of cenosis of P. communis are already formed: P. communis; P. communis with B. maritimus; and, P. communis with T. angustifolia and B. maritimus. In the control (unpolluted) parts of the formation of P. communis, the 3 types of phytocenoses were spread but another type was also available, P. communis with T. angustifolia L.

Bonsdorff, E. (1981)

The Antonio Gramisci Oil Spill Impact on the Littoral and Benthic Ecosystems

Inst. Mar. Biol., N-5065 Blomsterdalen, Norway

Mar. Pollut. Bull., Vol. 12, No. 9, pp. 301-305

ABSTRACT
On 27 February 1979 the tanker Antonio Gramsci grounded off Ventspils (USSR) in the Baltic Sea. Some 5000-6000 t of crude oil were spilled, and drifted towards the archipelago of Stockholm (Sweden) and Aaland (Finland). About 500 t oil was mechanically recovered in Aaland area. The immediate effects were small in the uppermost littoral (the Cladophora belt), but in the lower littoral (the Fucus belt) severe effects were recorded. Meiofaunal densities decreased in crustacean and mollusc species, but remained stable for the total community. Macrofaunal long-term changes could not be linked to the oil spill.

Botero, A.J.; Garzon, F.J.; Gutierrez, M.G. (1981)

Establecimiento y desarrollo de la comunidad ictica en un arrecife artificial construido con llantas de desecho

(Establishment and development of a fish community in an artificial reef made from scrap tires)

Inst. Nac. Recurs. Nat. Renov. Ambiente, Apartado 13458, Bogota, Colombia

Bol. Mus. Mar. Bogota, No. 10, pp. 63-81.

ABSTRACT
This report presents the results of the analysis of some ecological parameters of the fish community that inhabits an artificial reef built with 158 scrap tires located in the Castillo Grande Peninsula, Cartagena Bay, Colombia. The colonization patterns adopted by the 33 observed fish species (grouped into 18 families), is presented. An analysis of the food and spatial distribution and a discussion on the possibilities of the species migration from neighboring reefs is given. Also additional information about artificial reefs and their value as useful instruments to preserve and increase marine resources is described.

Boucher, G.; Cabioch, L.; Chamroux, S.; Dauvin, J.C. (1983)

Veille ecologique des cotes bretonnes: Etude du macrobenthos de la meiofaune et des bacteries en baie de Morlaix

(Ecological survey of the coasts of Britanny: Study of macrobenthos, meiofauna, and bacteria in the Bay of Morlaix)

Stn. Biol., 29211 Roscoff, France

Publisher(s): Station Biologique, Roscoff, France, 57 pp.

Contracts CNEXO 81-6597 and 82-2606.

ABSTRACT
In the ecological survey programme of the coasts of Brittany, the Bay of Morlaix has been studied since 1978 (date of the Amoco Cadiz oil spill): (1) In the sheltered estuarine site (le Tourduff), the bacterial microflora, the microphytobenthos and the meiofauna have been observed: the seasonal variations can be very important, and the maximum biological activity occurs in the first centimeters of the sediment (2) In the subtidal zone of the Bay of Morlaix, the macrofauna is still recovering from the oil spill in 1982, with the apparition of opportunistic species.

Boucher, G.; Chamroux, S.; Riaux, C. (1984)

Changes in physicochemical and biological characteristics of a sandy stretch of sublittoral sand polluted by hydrocarbons

Stn. Biol. de Roscoff, Pl. Georges Tessier, Roscoff 29211, France

Mar Environ Res 12(1):1-24. CODEN: MERSD

ABSTRACT
Fluctuations of, an interactions between, some physical, chemical and biological parameters were investigated in a sublittoral fine sand environment heavily polluted by hydrocarbons of the Amoco Cadiz spill (March, 1978). Monthly core samples were taken by SCUBA diving for 40 mo. from the time of the oil spill until July, 1981. Analyses of 18 parameters in 31 samples were used to identify the major factors influencing the recovery of the ecosystem. The acute phase of pollution in 1978 was characterized by high nematode densities, a bacterial bloom and a high chlorophyll a/phaeopigments ratio. This perturbation led to a change in the remineralization process and a dystrophic crisis appeared during the summer of 1979, which corresponded to a sharp decrease in all biological parameters in the sand. All chemical and biological parameters at the surface layer of the bottom sediments were lowered by the hydrodynamic effects of winter storms. Spearman rank correlation analysis demonstrated significant relationships, especially between bacterial density and temperature, hydrodynamism, chlorophyll a and aliphatic hydrocarbons. Granulometric properties of the sediments were weakly correlated with other physical and biological parameters because of continuous resuspension of fine particles by tidal currents. The compactness of the sand (dry weight) was also correlated with bacteria, nematodes and aromatic hydrocarbons. No correlation was observed between physical parameters and total N. Ammonium was well correlated with phaeopigments and even with chlorphyll a after the disappearance of the hydrocarbons from the sediments. Nitrate was weakly correlated with chlorophyll a. Organic N never showed a correlation with biological parameters. The most significant effects of aliphatic hydrocarbons were to lower the nematode densities, the chlorophyll a/phaeopigments ratio and the concentration of chlorophyll a for several years after the spill and resulted in a bacterial bloom at the time of acute pollution.

Brand, D. (1973)

Dry cleaning's helpful if ocean slick leaves oily bird unflappable

Unknown

Wall Street Journal 1:25, April 13, 1973. New York.

Brenk, V. (1987)

Des Forschungskonzept das Umweltbundesamtes zu Meeresverschmutzung durch den Transport wassergefaehrdender Stoff auf See

(The concept of research for sea pollution by the transport of hazardous material on sea from the Federal Environmental Agency)

Tagung der Arbeitsgruppe zur Meereskundlichen Untersuchung von Oelunfaellen Loccum (FRG), 18 Sep 1985

Umweltbundesamt, Bismarckplatz 1, 1000 Berlin 33, FRG

Texte., No. 6, (1987).

Meereskundliche Untersuchung von Oelunfaellen. Tagung Der Arbeitsgruppe Zur Meereskundlichen Untersuchung von Oelunfaellen in Loccum, 18-20 September, 1985, pp. 45-57.

(Marine Research Investigations of Oil Accidents. Meeting of the Working Group of Marine Research Investigations on Oil Accidents in Loccum, 18-20 Sep., 1985.)

ABSTRACT
This is a description of the reasons why the Federal Environmental Agency initiated different research and development projects. For the combat against oil pollution it is important to know all reactions and consequences of an oil spill. It is necessary to assess the different methods recovering the oil. Further knowledge of this matter has to be acquired. The applications and the limitations of clean-up techniques, and the ecological consequences of spreading dispersants are considered. Likewise the ecological damage by oil pollution because of the ship operations, waste and pollution by other materials is discussed.

Breslin, V.T.; Roethel, F.J.; Schaeperkoetter, V.P. (1988)

Physical and chemical interactions of stabilized incineration with the marine environment

Mar. Sci. Res. Cent., State Univ. New York, Stony Brook, NY 11794, USA

81st APCA Annual Meeting & Exhibition Dallas, TX (USA), June 19-24, 1988, p. 22

ABSTRACT
This paper presents the results of a research program designed to examine the feasibility of stabilizing particulate incineration residues for artificial reef construction. Particulate incineration residues were combined with Portland cement to form solid blocks using conventional block making technology. The resultant stabilized incineration residue (SIR) blocks were used to construct an artificial habitat in Conscience Bay, Long Island Sound, New York. Divers periodically returned to the site to monitor the interaction of SIR blocks with the marine environment.

Broman, D.; Ganning, B.; Lindblad, C. (1983)

Effects of high pressure, hot water shore cleaning after oil spills on shore ecosystems in the northern Baltic proper

Dept. Zool., Univ. Stockholm, S-106 91 Stockholm, Sweden

Mar. Environ. Res., Vol. 10, No. 3, pp. 173-187.

ABSTRACT
The use of high pressure, hot water hosing techniques in oil spill clean-up operations on rocky and stony-gravelly shores drastically reduces the shore vegetation and macrofauna. The negative effects are more substantial than on oiled shores cleaned by raking and scraping. After one year the hot water cleaned shores were not restored completely. On rocky shores the high pressure, hot water technique is very efficient in terms of freeing the rocks from oil. However, due to its detrimental effects on shore organisms this type of oil spill clean-up operation can only be recommended for bird or wildlife protection areas. The cleanup method is inefficient on stony-gravelly shores due to penetration of oil into the ground and sediment and direct killing of shore organisms.

Bromley, M. (1985)

Wildlife management implications of petroleum exploration and development in wildland environments

Intermountain Research Station, Forest Service, Ogden, UT (USA)

Gen. Tech. Rep., Intermountain Research Station, 48 pp.

NTIS Order No.: PB86-121290/GAR.

Report Number: FSGTR/INT-191

ABSTRACT
The report describes: petroleum exploration, development, and production potential environmental disruptions effects of disruptions on wildlife behavior, habitat, and populations and strategies for minimizing and mitigating adverse effects. The section on impacts includes a detailed outline/index referring to an annotated bibliography. Major wildlife groups discussed are ungulates, carnivores, waterfowl, raptors, songbirds, shore birds, and furbearers. Fish and other aquatic organisms are not covered.

Bronfman, A.M.; Aldakimova, A.Y.; Makarova, G.D.; Tolokonnikova, L.I. (1976)

Distinctive features of self purification of water and sediments of a shallow sea as exemplified by the Sea of Azov Russian-SFSR USSR

Okeanologiya 16 (1). 91-97. CODEN: OKNOA

ABSTRACT
The spatial and seasonal changes in self-purification of the sea from oil products and detergents were studied in the Azov Sea. Farther from the coastal pollution source the self-purification is performed by different biological agents in succession. Four typical zones with specific self-purification were established. Contrary courses of pollution and self-purification processes characterize the pelagic and benthic regions of the sea. The peculiar seasonal dynamics of the self-purification processes in the shallow highly-productive area predetermine a steady accumulation of toxic matter in the benthic regions. [Bacteria and saprophytic microorganisms are mentioned.]

Broome, S.W.; Seneca, E.D.; Woodhouse, W.W., Jr. (1988)

Tidal salt marsh restoration

Dept. Soil Sci., NC State Univ., Raleigh, NC 27695

Aquat Bot 32 (1-2). 1-22. CODEN: AQBOD

ABSTRACT
Coastal salt marshes occur in the intertidal zone of moderate to low energy shorelines along estuaries, bays and tidal rivers. They have ecological value in primary production, nutrient cycling, as habitat for fish, birds and other wildlife and in stabilizing shorelines. Disturbance by development activities has resulted in the destruction or degradation of many marshes. Awareness of this loss by scientists and the public has led to an interest in restoration or creation of marshes to enhance estuarine ecosystems. Recovery of marshes after human perturbation such as dredging, discharges of wastes and spillage of petroleum products or other toxic chemicals is often slow under natural conditions and can be accelerated by replanting vegetation. The basic techniques and procedures have been worked out for the propagation of several marsh angiosperms. Factors which affect successful revegetation include elevation of the site in relation to tidal regime, slope, exposure to wave action, soil chemical and physical characteristics, nutrient supply, salinity and availability of viable propagules of the appropriate plant species. Marsh restoration technology has been applied at a variety of locations to vegetate intertidal dredged material disposal sites, stabilize shorelines, mitigate damage to natural marshes and to revegetate one marsh destroyed by an oil spill. Contractual services for marsh establishment are now available in some regions. Further research is needed to determine the success of marsh restoration and creation in terms of ecological function, including the faunal component.

Brown, D.J.S.; Baxter, A. (1984)

August 1980 oil spill clean-up project -- Bahrain report summary of task force operations

Bahrain Pet. Co., Ltd., Awali, Bahrain

UNEP Reg. Seas Rep. Stud., No. 44

Combating Oil Pollution in the Kuwait Action Plan Region, pp. 125-146

ABSTRACT
The paper is a comparison of several reports relating to the clean-up operations which took pace in Bahrain after a major pollution of the beaches by oil (the original source of which was not known). Task force operations involving up to 800 civilians and defence force personnel are described under the following headings: Organization, local resources, government directives, surveillance, liaison with other governments, oil containment and collection, dispersant applications, rehabilitation of beaches, rehabilitation of sea bed and analysis of spill samples.

Brown, J.; West, G.C. (1970)

Tundra Biome Research in Alaska - The Structure and Function of Cold-Dominated Ecosystems

Tundra Biome Analysis of Ecosystems College Alaska

Corp. Source Codes: 406821

Sponsor: Cold Regions Research and Engineering Lab., Hanover, N.H.

Report No.: 70-1

157 pp.

NTIS Prices: PC A08/MF A01

ABSTRACT
The objective of the Tundra Biome Program is to acquire a basic understanding of tundra, both alpine and arctic, and taiga. Collectively these are referred to as the cold-dominated ecosystems. The program's broad objectives are threefold: To develop a predictive understanding of how the wet arctic tundra ecosystem operates, particularly as exemplified in the Barrow, Alaska, area; to obtain the necessary data base from the variety of cold-dominated ecosystem types represented in the United States, so that their behavior can be modeled and simulated, and the results compared with similar studies underway in other circumpolar countries; to bring basic environmental knowledge to bear on problems of degradation, maintenance, and restoration of the temperature-sensitive and cold-dominated tundra/taiga ecosystems.

Brown, R.D. (1981)

Health and Environmental Effects of Synthetic Fuel Technologies: Research Priorities

METRE Div., MITRE Corp., McLean, VA

NTIS, Springfield, VA

ABSTRACT
This report is an assessment of the health and environmental effects research priorities related to coal gasification and liquefaction and oil shale development. It reflects the subjective judgements of well chosen research scientists in relevant disciplines. These scientists reviewed the results of workshops conducted in 1978 on coal gasification and liquefaction and oil shale, background information on related Federal research, and comments by relevant Federal agencies. The scientists prepared a listing of current research needs according to major areas of concern. These were categorized as to generic, region-specific, or process specific research. For the latter category, various scales of development were addressed for two exemplary processes: SRC (solvent refined coal) II and above ground oil shale retorting. Subjective judgements were used to prioritize the research tasks and assess the adequacy of current research.

Brown, C.H. (1978?)

The role of the U.S. Fish and Wildlife Service in responding to oil spills

USFWS, National Oil and Hazardous Substances Spill Coordinator, Washington, DC 20240

Proceedings of the Energy/Environment '78: A symposium on energy development impacts, Los Angeles, CA, Aug. 22-24, 1978. Edited by J. Siva-Lindstedtp. 321 pp.

Abs. only

ABSTRACT
Continual dependency of the US on the use of petroleum products as primary source of energy has resulted in an increasing threat to the quality of fish and wildlife habitats and their associated populations. The USFWS has developed its "Pollution Response Plan for Oil and Hazardous Substances" to reduce potential impacts of oil spills on fish and wildlife resources and to quantify unavoidable damages. Oil spill response requires a team approach, mandated by the Federal Water Pollution Control Act Amendments and the "National Contingency Plan for Oil and Hazardous Substances" published by the CEQ. The USFWS Pollution Response Plan is a key element in the fulfillment of the team approach to spill response. The USFWS plan provides a mechanism for identifying sensitive fish and wildlife populations and habitats likely to be impacted by oil spills. Methods for limiting impacts of spills on these habitats and populations during spill response are identified. Techniques for rehabilitating impacted populations and quantifying damages are provided. The implementation of the USFWS plan has facilitated the reduction in potential damages to fish and wildlife habitats and populations through prespill planning and coordination with other agencies and the private sector. (AM)

Brown, W.J.; Denham, F.R. (December, 1980)

An Economic Evaluation of a Mobile Rotary Kiln Designed For the Cleanup of Oil Contaminated Beaches

Stevenson & Kellogg, Ltd., Toronto

Env Canada Report, (131). The original document is available from Bowker.

ABSTRACT
A rotary kiln has been proposed as a method for restoring oil-polluted beaches by burning the oil out of the sand. This kiln would overcome many of the handicaps encountered in utilizing other cleaning methods. The kiln can handle a wide range of oil types, oil concentrations, and particle sizes. Kiln operating methods are described; the resulting variable operating costs are shown to be lower than those of the major alternative method, dumping the polluted sand in landfills. A probabilistic model, constructed to estimate the utilization of the kiln, showed it to be sufficient to recover the capital cost as compared with the dumping option. (7 diagrams, 4 graphs, 3 maps, 28 references, 32 tables)

Brown, C.H. (1978)

The role of the U.S. Fish and Wildlife Service in responding to oil spills

In: Proceedings of Energy/Environment '78: A Symposium on Energy Development Impacts. Lindstedt-Siva, J., ed. Society of Petroleum Industry Biologists, Los Angeles, CA (USA), August 22, 1978.

Dept. Interior, US Fish & Wildlife Service (ES), National Oil & Hazardous Substances Spill Coordinator, Washington, DC 20240, USA

Report Number: p. 321

ABSTRACT
The USA's continual dependency on the use of petroleum products as a primary source of energy has resulted in an increasing threat to the quality of fish and wildlife habitats and their associated populations. The Fish and Wildlife Service has developed its 'Pollution Response Plan for Oil and Hazardous Substances' to reduce potential impacts of oil spills on fish and wildlife resources and to quantify unavoidable damages. Oil spill response requires a team approach as has been mandated by the Federal Water Pollution Control Act Amendments and the "National Contingency Plan for Oil and Hazardous Substances" published by the Council on Environmental Quality. The Service's Pollution Response Plan is a key element in the fulfillment of the team approach to spill response. The Service's plan provides a mechanism for identifying sensitive fish and wildlife populations and habitats that are likely to be impacted by oil spills. Methods for limiting impacts of spills on these habitats and populations during spill response are identified. Also, techniques for rehabilitating impacted populations and quantifying damages are provided. The implementation of the Service's plan has facilitated the reduction in potential damages to fish and wildlife habitats and populations through pre-spill planning and coordination with other agencies and the private sector.

Brownlee, M.J.; Mattice, E.R.; Levings, C.D. (1984)

The Campbell River Estuary: A report on the design, construction and preliminary follow-up study findings of intertidal marsh islands created for purposes of estuarine rehabilitation

Department of Fisheries and Oceans, Vancouver, B.C. (Canada), Pac. Reg

Can. Manuscr. Rep. Fish. Aquat. Sci., No. 1789, 63 pp.

Report Number: ISSN 0706-6473

ABSTRACT
This report focuses on the cooperative efforts of agency staff, members of industry and the public in developing and constructing a new log-handling facility and rehabilitating an industrialized estuarine area of approximately 32 hectares that had been intensively utilized for log handling activities for over 75 years. Preliminary follow-up study results indicate that the intertidal islands are stable, 93% of the 23,302 marsh cores transplanted are growing, invertebrate colonization is still incomplete, juvenile wild chinook (Oncorhynchus tshawytscha) and chum (O. keta) salmon utilize the islands and catches are proportional to the abundance of salmon fry in the estuary. Hatchery reared juvenile salmon do not make extensive use of the islands. Migratory bird use of the islands has been recorded.

Brush, T.; Lent, R.A.; Hruby, T.; Harrington, B.A.; Marshall, R.M; Montgomery, W.G. (1986)

Habitat use by salt marsh birds and response to open marsh water management

Biol. Dept., Marycrest Coll., 1607 W 12th St., Davenport, IA 52804, USA

Colonial Waterbirds., Vol. 9, No. 2, pp. 189-195.

ABSTRACT
The authors examined the numerical responses of salt marsh birds in Massachusetts to modified open marsh water management (OMWM), a habitat alteration technique to control salt marsh mosquitoes without destroying habitat quality for pool-using birds. This management had little overall effect on bird populations in two 3-ha plots monitored for three years after manipulation. Shorebirds increased at first, probably owing to use of spoil resulting from construction activities but then decreased to pre-alteration numbers. Other pool-using birds (herons, terns and kingfishers) were not affected by management. Results indicate that open water marsh management, as modified in Massachusetts, has little immediate adverse or beneficial effect on salt marsh birds in marshes that have been previously ditched.

Bubela, B. (1985)

Effect of biological activity on the movement of fluids through porous rocks and sediments and its application to enhanced oil recovery

Baas Becking Geobiological Lab., Canberra, Act 2601, Australia

Geomicrobiol J 4 (3). 313-328. CODEN: GEJOD

ABSTRACT
Movement of fluids through geological porous media is an important factor in ore genesis, crude oil genesis, and in oil recovery from oil reservoirs. Such a movement may be beneficially affected by biological in situ activity. We have shown that once bacteria have been introduced into a porous medium, they are able to penetrate into their environment and multiply without decreasing significantly the rock's permeability. The limiting bacterial concentration, which may cause plugging, depends on the bacterial size, pore size, and pore size distribution of the reservoir rock. Microorganisms may, under anaerobic conditions, affect the composition of crude oil by increasing its asphaltenic fraction. In simulated systems microorganisms increased the recovery of the oil in place approximately five times. A bacterial consortium was more effective than a single pure bacterial strain.

Buhite, T.R. (1979)

Cleanup of a cold weather terrestrial pipeline spill

Presented at the 1979 Oil Spill Conference Los Angeles, CA (USA) 19 Mar 1979.

Alyeska Pipeline Service Co., Anchorage, AK, USA

Proc. Oil Spill Conf.

American Petroleum Institute Washington, DC (USA)

Report Number: pp. 367-369

ABSTRACT
On February 15, 1978, sabotage of the Trans-Alaska Pipeline near Fairbanks resulted in a large terrestrial crude oil spill. Rapid response of trained personnel limited the spread of oil to an area of 2.1 acres. A 63-day cleanup effort led to the recovery of most of the crude oil which was later re-injected into the pipeline system at three different locations. The remaining crude was subsequently burned at the spill site and the area was fertilized. The intent of this paper is to examine the implementation of the pipeline oil spill contingency plan for that area and the associated problems in and advantages of dealing with oil recovery under typical northern latitude winter conditions.

Buhrer, H. (1979)

Der Einfluss von Kohlenwasserstoffen auf dit Okologie der Bakterien in aeroben Seediment

(Influence of hydrocarbons on ecology of bacteria in aerobic lake sediment)

Inst. fuer Gewaesserschutz und Wassertechnol., Eidgenoessischen Technischen Hochsch., Zuerich, Switzerland

Schweiz. Z. Hydrol. Rev. Suisse Hydrol. Swiss J. Hydrol., 41(2), 315-355.

ABSTRACT
Two different hydrocarbon loadings of sediment cores were analyzed 4 times during 21 days. Applied methods were: direct count, isolation of more than 100 colonies on a diluted plate-count agar and estimation of 42 attributes (282 levels), followed by a single link clustering and calculation of the information basing on attribute level (i.e., negative entropy). Loading of 100 g fuel oil/m^2 sediment caused a depletion of germs and information. Full restoration could not be observed. When 10 g fuel/m^2 was applied there was no significant effect, but if algae were supplied too, the effect was similar to using 100 g/m^2. An extrapolation of the results gives a tolerance of hydrocarbon loading for Lake Constance or Lake Zug of 10 to 20 times the load present, but effects on fishes on fishfood were not considered.

Butler, J.N.; Levy, E.M. (1978)

Summary and overview: Long-term fate of petroleum hydrocarbons after spills - compositional changes and microbial degradation

Session 1. Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977.

Chairmen, Div. Appl. Sci., Harvard Univ., Cambridge, MA 02138, USA, 35(5), 604-605.

J. Fish. Res. Board Can.

ABSTRACT
A body of information as a result of scientific investigations associated with tanker accidents and from the Bravo blowout is brought together at a symposium in Halifax. Session 1 demonstrated that the potential for recovery exists but may take many years. Every spill incident studied in nearly unique. The rate of recovery depends on the amount and type of oil, and on energy to drive physical, chemical, biological, and geological processes that disperse and degrade oil. Wind and wave energy disperse the oil droplets evaporation removes volatile hydrocarbons but is severely hampered under arctic ice and microorganisms degrade oil to carbon dioxide though the rate and extent of biodegradation is often limited by the supply of nutrients.

Butler, A.C.; Sibbald, R.R. (1986)

Isolation and Gas Chromatographic Determination of Saturated and Polycyclic Aromatic Hydrocarbons in Mussels

Natl Inst for Water Research, South Africa

B Env Contam & Tox, V37, N4, P570(9). The original document is available from Bowker.

ABSTRACT
An analytical technique was demonstrated for the detection of trace quantities of petroleum hydrocarbons in mussels. The approach incorporates saponification, pentane extraction, and silica gel cleanup. Analyses are performed for the isolation and quantification of polycyclic aromatic hydrocarbons and the saturated hydrocarbon fraction. Application to fortified mussel tissues reveals that the percentage recovery of saturated compounds varies in the 78-111% range. Results for polycyclics and saturated fractions are tabulated.

Butler, W.H. (1985)

Multiple Land Use: An Essential Part of Environmental Planning

Dinara Ltd., Australia

APEA J, Vol. 25, No. 1, P311(5). The original document is available from Bowker.

ABSTRACT
The Australian petroleum industry has been involved in environmental planning and has developed an awareness of multiple land use over the last 25 years. The range of uses includes reserves, heritage areas, agriculture, urban and suburban development, and mining. To achieve multiple use requires restoration of the environment to its pre-development state as quickly as possible. Restoration and land management philosophies employed are examined. (1 map, 3 photos, 3 references)

Cadena, F.C. (1988)

Treatment of Water Supplies Contaminated with Toxic Pollutants Using Tailored Soils

(Technical rep.)

New Mexico Water Resources Research Inst., Las Cruces.

Corp. Source Codes: 057238000;

Sponsor: New Mexico State Univ., Las Cruces, NM; Water Resources Div., Geological Survey, Reston, VA

Report No.: WRRI-235

63 pp.

Prepared in cooperation with New Mexico State Univ., Las Cruces, NM. Sponsored by Water Resources Div., Geological Survey, Reston, VA.

NTIS Prices: PC A04/MF A01

Country of Publication: United States

ABSTRACT
Restoration of aquifers affected by petrochemicals may be accomplished by flushing the aquifer through natural soils that have been previously tailored with tetraalkylammonium (TAA) molecules. The modified soils can be selectively tailored to preferentially adsorb targeted hazardous substances. This innovative process for the removal of BTX (benzene, toluene and xylenes) from ground waters contaminated by gasoline and other petrochemical spills is expected to be both economically and technically feasible. The adsorptive properties of TAA tailored soils for the selective removal of hazardous organic pollutants found in waters contaminated by petrochemical spills was investigated. Effectiveness of the tailoring agents was evaluated by comparing adsorption isotherms of BTX on treated and untreated soils. Column studies were performed to estimate kinetic properties of the tailored and untailored natural soils. Modelling of pollutant transport in the column studies was used to obtain engineering design parameters.

Cairns, J., Jr.; Dickson, K.L.; Herricks, E.E. (1977)

Recovery and restoration of damaged ecosystems

Virginia Polytechnic Inst. and State Univ., Biology Dept., Blacksburg, VA 24061

International Symposium on the Recovery of Damaged Ecosystems Blacksburg, VA, March 23-25, 1975, 531 pp.

Publisher(s): University Press of Virginia, Charlottesville, VA

Abs. Price: $20

ABSTRACT
Papers are presented on case histories, theories, and important questions related to the restoration and recovery of damaged ecosystems. Emphasis is on the nature of recovery processes for various ecosystems, identification of the elements common to the recovery process for all ecosystems, and the prospects for accelerated recovery and restoration by human intervention and management. The recovery of streams and lakes by natural and artificial methods, the reintroduction of plants and wildlife to damaged ecosystems, the role of fire in the natural growth of forests, environmental factors in surface mine recovery, the effects of oil spills, the recovery of forests and tundra and taiga surfaces, the recovery of cities, and the political problems inherent in environmental protection legislation are discussed. (from Preface) (illustration, references for various papers)

Cairns, J., Jr.; Buikema, A.L. (1984)

Restoration of habitats impacted by oil Spills: Workshop summary

Restoration of Habitats Impacted by Oil Spills Symposium Blacksburg, VA (USA) 9-11 Nov 1981

Dept. Biol., Univ. Cent. Environ. Stud., Virginia Polytech. Inst. and State Univ., Blacksburg, VA 24061, USA

Restoration of Habitats Impacted by Oil Spills

Cairns, J., Jr., and Buikema, A.L., eds. Pages 173-180

Report Number: ISBN 0-250-40551-2

ABSTRACT
Before general strategies for the recovery or restoration of damaged ecosystems can be discussed, a number of problems must be considered when attempting to restore ecosystems to original condition. These problems include the following: inability to define the "original condition" of ecosystems long exposed to societal stresses: inability to define long-term or genetic changes in populations that may preclude restoration to a previously known original condition: lack of understanding of the natural variability in ecosystems, lack of knowledge of ecosystem recovery processes and need to consider the cost/benefit ratio of restoring an ecosystem to its original condition or the return of selected amenities (e.g., recreation) at a substantial reduction in costs.

Campbell, D.A. (1981)

Enhanced Oil Recovery and Its Environmental and Economic Implications in the United States

D.A. Campbell Co., Inc., Los Angeles, CA

Environ. Conserv Vol. 8, No. 1, pp. 5-18

ABSTRACT
This survey has described the foreseeable environmental and economic impacts of enhanced oil-recovery (EOR) on U.S. oil production between 1980 and 2000. It has indicated that EOR production may be expected to rise from the approximately 4% of total U.S. oil production in 1980, to the projected approximations of 10.5% in 1985, 18.5% in 1990, 23% in 1995, and perhaps 30% in 2000. These percentages are substantial, particularly as this form oil production has been, up until recently, quite limited. Many of the processes are still in the laboratory stage of development-particularly chemical and microbiological processes.

Campbell, J.S.; Lewis, A.W. (1978)

Tidal propagation and pollutant dispersion in the Bandon estuary

Presented at the Seminar on Coastal Pollution Assessment, Cork (Eire), 20 Apr 1978.

Civil Eng. Dept., University Coll., Cork, Eire

In: Coastal pollution assessment: Development of estuaries/coastal regions and environmental quality.

Downey, W.K.; Uid, G. Ni, comps.

National Board for Science and Technology Dublin (Eire)

Report Number: p 188-200

ABSTRACT
The prediction of pollutant dispersion must be assessed accurately if pollution is to be minimized by proper management of rivers and estuaries. The complexities due to bathymetry, three-dimensional flow, boundary conditions and variability of roughness mitigate against simple analytical solutions. Whilst physical models are appropriate they are expensive, whereas the current spectacular reduction in real computing costs makes mathematical modelling an increasingly attractive proposition. Mathematical models based upon the finite element method (F.E.M.) also have some particular advantages over their physical counterparts changes in outfall discharge, boundary conditions or estuary shape are dealt with by a simple data modification. In the paper, mathematical models are developed in which the spatial variations are discretized using the F.E.M. and the temporal dimension is dealt with by a time marching scheme. Results from a one-dimensional finite element model of the tidal propagation characteristics of the Bandon estuary are given. Some recently acquired measurements of velocity, temperature and salinity are included. Details are given of a depth-averaged two dimensional finite element model for the prediction of pollutant concentrations which is currently being developed in U.C.C.

Canevari, G.P. (1979)

The restoration of oiled shorelines by the proper use of chemical dispersants

Presented at the 1979 Oil Spill Conference, Los Angeles, CA (USA), 19 Mar 1979.

Exxon Res. Eng. Co., Florham Park, NJ, USA

Proc. Oil Spill Conf.

American Petroleum Institute Washington, DC (USA)

Report Number: p 443-446

ABSTRACT
This paper reviews the shortcomings of the expensive mechanical cleanup methods and presents the overall mechanism and technique for restoration using chemical agents. Although the use of chemicals in intertidal zones has not been well accepted by some environmental and regulatory groups, there is limited documentation that use of these agents results in less environmental damage and more rapid and economical shoreline restoration than mechanical alternatives. In support of this argument, an actual instance wherein an extensive Tampa, Florida shoreline had been oiled by a spill from the S/S Delian Apolon and subsequently chemically restored, is described. Detailed biological sampling of the biota in the environs of the work area was conducted by Texas A and M University. Data from an oiled area, oiled and chemically cleaned area, and a control (as is) area are supplied in the presentation. The implications and feasibility of simply allowing the oil to weather/biodegrade in areas where this would be permissible are discussed, as are the proper, as well as improper, applications of chemical agents for shoreline restoration.

Capuzzo, J.M.; Derby, J.G.S. (1982)

Drilling fluid effects to developmental stages of the American lobster

Woods Hole Oceanogr. Inst., Woods Hole, MA, USA

NTIS, SPRINGFIELD, VA

PB82-220740

ABSTRACT
Laboratory experiments were conducted to evaluate the impact of drilling operations for oil exploration on populations of the American lobster (Homarus americanus). The effects of used, whole drilling fluids on the larval stages of the lobster were assessed in continuous flow bioassay experiments.

Capuzzo, J.M. (1981)

Crude Oil Effects to Developmental Stages of the American Lobster

(Technical rep.)

Woods Hole Oceanographic Institution, MA.

Corp. Source Codes: 015160000

Sponsor: Bureau of Land Management.; Washington, DC.

Report No.: WHOI-81-75

108 pp.

NTIS Prices: PC A06/MF A01

Country of Publication: United States

Contract No.: DI-AA551-CT9-5

ABSTRACT
The physiological effects of South Louisiana crude oil on larvae and juveniles of the American lobster, Homarus americanus, have been investigated in continuous flow bioassay systems. Disruption in the energetics of larval development has been observed and correlated with a shift in the normal patterns of lipid utilization and storage in larval lobsters. Hydrocarbon turnover appears to be rapid and little accumulation, except of the higher molecular weight constituents, is observed. Recovery of larval and early postlarval stages is not immediate upon transfer to uncontaminated seawater and the normal pattern of energy storage and utilization is only slowly restored. Postlarval lobsters are less sensitive to crude oil-seawater mixtures than the larval stages and no disruption in energetics has been observed. Reductions in respiratory activity and bioaccumulation of both aliphatic and aromatic compounds, however, have been observed in postlarval lobsters exposed to oil contaminated sediments. This suggests that postlarval lobsters have longer retention times and slower turnover rates of petroleum hydrocarbons than the larval stages and persistence of petroleum hydrocarbons in sediments may present a chronic contamination problem to benthic stages of the American lobster.

Cardamone, M.A.; Taylor, J.R.; Mitsch, W.J. (1984)

Wetlands and coal surface mining: A management handbook with particular reference to the Illinois Basin of the Eastern Interior Coal Region

Water Resources Inst, Kentucky Univ., Lexington (USA)

Res. Rep. KY Univ. Water Resour. Res. Inst., 116 pp.

NTIS Order No.: PB85-214682/GAR, RR-154.

Report Number: USGS/G-844(23)

ABSTRACT
The report outlines management operation for protecting wetlands during the surface mining of coal, particularly for the portion of the Eastern Interior Coal Region that is found in Kentucky, Indiana, and Illinois. The main issues addressed in this manual include: basic information for identifying wetlands wetland values, and methods used for values assessment how coal mining can affect wetlands a method for addressing wetland protection needs and some prevention and mitigation actions reclamation alternatives, including wetland restoration and the creation of wetlands as alternative ecosystems on mined areas, and general legal and regulatory information concerning wetland protection and surface mining of coal.

Carlisle, J.G., Jr. (1976)

Artificial modification of the ecosystem

1. Artificial reefs. 2. Offshore oil drilling platforms. Joint Oceanographic Assembly, Edinburgh (UK), September 13, 1976.

Mar. Resour. Reg., Calif. Dept. Fish Game, C.5, 131, 350 Golden Shore, Long Beach, CA 98092, USA

ABSTRACT
(1) The premise is well accepted that greater numbers of fishes as well as invertebrates and plants are concentrated on rocky coasts, reefs and banks rather than on unbroken, sandy or muddy ocean bottom. It has also long been known that shipwrecks often provide excellent fishing in otherwise non-productive areas. On this basis, various state, local and private agencies in the USA and other countries have created a larger number of artificial fishing reefs utilizing a variety of materials including rock, concrete shelters, old cars, tires, ships, etc. When California initiated a scientific study of this type of ecosystem modification in the marine environment in 1958 practically no scientific information on the effectiveness of artificial fishing reefs was available. Artificial reefs proved very effective in concentrating marine life and in recent years this type of habitat development has greatly accelerated. (2) Another type of ecosystem modification which acts in the same way as artificial reefs, as collecting and concentrating devices for marine life, is the use of oil drilling platforms and islands. These structures have been placed off the coasts of many countries and are now being built in greatly increasing numbers to provide petroleum and natural gas for an energy hungry world. At the time California began experimenting and studying artificial reefs, a study was also begun to evaluate the effects of offshore oil drilling installations on the marine environment and marine life.

Carr, R.S.; Linden, O. (1984)

Bioenergetic responses of Gammarus salinus and Mytilus edulis to oil and oil dispersants in a model ecosystem

Battelle New England Mar. Res. Lab., 397 Washington St., Duxbury, MA, USA

Mar. Ecol. (Prog. Ser.), Vol. 19, No. 3, pp. 285-291

ABSTRACT
As part of a multifaceted study to assess the impact of oil and oil dispersants on a model littoral ecosystem in the Baltic Sea, bioenergetic (O:N ratio) measurements were made for 2 of the predominant species, the mussel Mytilus edulis and the amphipod Gammarus salinus . In addition, ammonia excretion and respiration rate measurements for G. salinus and byssal thread production rates and spawning frequency observations for M. edulis were made. Four days after the start of the exposure, significant effects on byssal thread production rates and spawning frequency were observed for the oil/dispersant treatment. After 12 d the oil/dispersant group apparently had recovered whereas the oil-only group was exhibiting abnormal spawning behavior.

Carter, J.; Lamarra, V. (1983)

Environmental management - A data based ecosystem approach from the oil shale industry

Ecosyst. Res. Inst., Logan, UT 84321, USA

J. Environ. Manage., Vol. 17, No. 1, pp. 17-34

ABSTRACT
The central problem in the preparation of the Detailed Development Plan for the White River Shale Project was the preparation of a long-term environmental management/monitoring program. The major difficulty encountered was analyzing and interpreting six years of environmental data in a manner which would allow the management of the White River Shale Oil Corporation to make logical and correct decisions about program needs and which would reflect environmental processes occurring in the region of development. This difficulty was overcome by use of a conceptual ecosystem model as the organizing principle for the analysis. Use of the model has allowed the establishment of statistically valid quantitative relationships and pointed out areas of insufficient data or lack of co-ordination. The ongoing program is designed to complete the important ecosystem relationships which will be used to guide the long-term monitoring program and aid in evaluation project impacts and mitigation.

Castle, R.W. (1977)

Restoration of oil-contaminated shorelines

Presented at the Oil Spill Response Workshop, Metairie, LA (USA), February 15, 1977.

URS Co., San Mateo, CA 97702, USA

In: Proceedings of the 1977 Oil Spill Response Workshop

Fore, P.L, ed.

Publisher(s): U.S. Fish and Wildlife Service, Biological Services Program NSTL Station, MS.

Report Number: p 105-112

ABSTRACT
With the possible exception of the use of heavy equipment for sandy beach cleaning, a definitive and effective state-of-the-art for restoration of oil-contaminated shorelines is nonexistent. However, common sense applications of the knowledge and resources that are presently available can provide acceptable interim actions. Each restoration situation has its own peculiarities and requirements. If several basic assumptions are adhered to, the best practical restoration decisions should result. These assumptions include: any activity will have some effect on the environment. The restoration procedure and supporting activities (i.e., access, disposal, etc.) must not result in more environmental damage than that caused by the oil itself. The restoration procedure should remove (or move to a position where recovery is possible) a maximum amount of contaminant with a minimum amount of disturbance, modification, or removal of the habitat. Extensive efforts resulting in low recovery yields are generally antiproductive and should be avoided. In some cases, no action at all is a viable alternative.

CEQ Report (1974)

OCS Oil and Gas - An Environmental Assessment. The original document is available from Bowker

CEQ Report, Apr 74, V5 (190)

ABSTRACT
The primary biological effects of potential oil discharges resulting from hypothetical oil production activity on the Atlantic/Alaskan outer continental shelf are evaluated. Although emphasis is on impacts and recovery from large-volume infrequent accidental oil spills, small volume continuous discharges of hydrocarbons are also considered. Effects of oil releases from offshore platforms and spills occurring at coastal terminals are assessed. An attempt is made to identify regional differences relevant to pending development decisions, including: (1) oil spill probabilities; (2) physical environmental characteristics-spill trajectories and the fate of oil in marine subsystems; and (3) biological factors relevant to oil effects. Research requirements for oil discharge impacts are defined. (Numerous graphs, maps, references, tables)

Chamberlain, G. (1989)

Technology Tackles the Oil Spill

Design News, Jun 19, 89, P90(6). The original document is available from Bowker.

ABSTRACT
Several systems deployed in response to the 10 million gal of oil spilled off the coast of Valdez, AK, by the Exxon Valdez tanker on March 24, 1989, helped officials keep track of the spill's spread. In addition, oil containment equipment and absorbent materials, some used for the first time, were tested under real spill conditions. A USCG aircraft provided the daily surveillance of the spill, using a side-looking airborne radar; these images became the primary tools for monitoring the extent of the spill. A computer mapping system combined data from the flyovers, sampling station instruments, and individual sitings to document the movement and location of polluted waters. A new containment boom developed by Minnesota Mining & Mfg. Co. survived several days of continuous booms, while others performing the same task were destroyed. (1 diagram, 1 map, 6 photos)

Champ, M. (1985)

NOAA's Scientific Support Coordinators (SSC) and Hazardous Materials Response Project

Workshop on Response to Hazardous Chemical Spills in the Great Barrier Reef Region, Townsville (Australia), August 3, 1984

Craik, G.J.S., ed. Pages 33-41

NOAA

GBRMPA Workshop Series, No. 6

Report Number: ISBN 0-642-52409-2

ABSTRACT
An account is given of the role and functions of NOAA Scientific Support Coordinators in the field of hazardous materials spills. The following activities are discussed: 1) rapid assessment of adverse effects and mitigation strategies 2) assessment of damage 3) hazardous substance assistance and research 4) notification and activation and 5) contingency planning assistance.

Chauvin, D.J. (1980)

Impact of non-toxic mud on Gulf Coast drilling

Flo Trend Systems Inc., Houston, TX, USA

Pet. Eng. Int., 52(10), 34, 38, 42

ABSTRACT
The development of non-toxic oil muds will contribute to the oil industry's efforts to comply with the Resource, Conservation and Recovery Act of 1976 and avoid environmental damage while eliminating the expense of diesel oil and asphaltines found in most oil muds. Oil muds for spotting purposes are a necessity in critical drilling conditions. Therefore, development of an oil mud which was not toxic even for human ingestion and one that was not toxic to fish life, even in large quantities, was almost automatic. Recently, a non-toxic oil mud was developed and tested by several oil companies. The trial tests were conducted using the non-toxic spotting fluid at varying depths and densities. Case histories taken from these initial tests with non-polluting oil mud are reported.

Chemical Week

Biotechnology: Research that Could Remake Industries

The original document is available from Bowker.

Chemical Week, OCT 8, 80, V127, N15, P23 (8)

ABSTRACT
The emergence of techniques for recombining dna may herald the birth of new and efficient energy production methods and agricultural systems. Gene-splicing experiments conducted with various plants and microorganisms have resulted in pest-resistant crops and trees, energy-conserving hydrogen production, and innovative methods of oil recovery. Secretive plugging, secreting acid, and evolving carbon dioxide can replace conventional oil recovery methods; these techniques are facilitated by microbial production.
(9 photos)

Choi, D.R. (1984)

Ecological succession of reef cavity-dwellers (coelobites) in coral rubble

Comp. Sedimentol. Lab., Rosenstiel Sch. Mar. and Atmos. Sci., Univ. Miami, Fisher Island Stn., Miami Beach, FL 33139, USA

Bull. Mar. Sci., Vol. 35, No. 1, pp. 72-79

ABSTRACT
Ecological succession of reef cavity-dwellers (coelobites or cryptic organisms) in interstices of coral rubble in the Florida Reef Tract was established by the stratigraphic analysis method. Colonization begins with encrusting foraminifers, boring bivalves and serpulid worms. Most of the bryozoans and sponges appear next along with solitary bryozoans and non-boring bivalves. This community development is climaxed by overgrowth of the rubble by a tunicate. Rubble formed by a shipwreck in the shallow reef margin (about 1.5 m of water) showed that the succession was completed within 3 years. Generally, the earlier colonizers are solitary in form and have broader tolerance to various environments, but they are taken over by colonial organisms in the later stages due to competitive superiority of the colonial forms. Ecological succession was clearly observed in coelobite community development. This may be due to the unique habitat of coelobites, which is relatively free from physical disturbance and predation.

Christoffel, D. (1982)

NZ's role in mineral exploitation in Antarctica

Dept. Phys., Victoria Univ., Wellington, New Zealand

N.Z. Eng., Vol. 37, No. 7, pp. 3,5

ABSTRACT
It is inevitable that commercial exploration and exploitation of Antarctic mineral resources will commence within the next decade. It has already started in subtle ways despite the present moratorium on such operations. The most likely resource to be investigated and tapped is offshore oil; the most likely region to be exploited is the Ross Sea which lies within New Zealand claimed territory. The authors are here considering an Antarctic venture taking place in New Zealand claimed territory which is many times larger than the entire "think big" dream. How can New Zealand ensure that it will get its share of the cake of Antarctica? Firstly, New Zealand must keep a high profile in Antarctica over the next few years. This means stepping up our research program, not reducing it as at present. The authors believe that New Zealand particularly needs to carry out marine biological and geophysical work.

Church, G.J. (1989)

The Big Spill

Time, Apr 10, V133, N15, P38(4)

ABSTRACT
The events that conspired to make the Exxon tanker Valdez oil spill an unprecedented environmental disaster are reviewed. Captain Hazelwood, who had already had his automobile driving license revoked three times for drunk driving, turned over command of the oil tanker to an unqualified third mate. Radar communication with the Coast Guard was lost, and the third mate was unable to navigate safely without their supervision. Weather conditions spread the oil, and emergency response by industry was much slower than they claimed it would be in the event of an accident. Captain Hazelwood has since been fired, and criminal investigations of the spill are underway by the federal government. (6 photos)

Clark, R.B. (1978)

Oiled seabird rescue and conservation

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977.

Dept. Zool., Univ. Newcastle upon Tyne, UK, 35(5), 675-678.

J. Fish. Res. Board Can.

ABSTRACT
Attempts were made to clean and rehabilitate nearly 8000 oiled birds (mainly auks Alcidae) following the wreck of the Torrey Canyon. This was an almost total failure and a Research Unit on the Rehabilitation of Oiled Seabirds was established in Newcastle upon Tyne to devise effective treatment methods. This has involved a study of the mechanism of water-repellency in seabird plumage and led to the development of cheap, effective cleaning methods and full recovery of the birds within 2-3 wk of capture. These methods have been used successfully on small numbers of birds by amateurs and also operationally on larger numbers by the Research Unit. There have been only few ringing returns but at least some of the cleaned birds became reintegrated with the breeding populations after release. Even with appropriate organization and facilities it is doubtful whether the rescue and treatment of oiled birds can make a material contribution to seabird conservation, but there is often strong public pressure for the treatment of oiled birds and the development of suitable techniques makes this possible.

Clark, R.B. (1978)

Oiled seabird rescue and conservation

Univ. of Newcastle upon Tyne, Dept. of Zoology, Newcastle upon Tyne, NE1 7RU, England

Symposium on recovery potential of oiled marine northern environments Halifax, N.S., Canada, Oct. 10-14, 1977

Recovery potential of oiled marine northern environments: Symposium papers. Edited by J.C. Stevenson. In: J. Fish. Res. Board Can. 35(5), 675-678, Coden: JFRBAK

ABSTRACT
Following the Torrey Canyon spill, efforts to rehabilitate 8000 oiled seabirds (primarily auks) failed. The subsequently established Research Unit on the Rehabilitation of Oiled Seabirds (RUROS) developed treatment procedures which allowed full recovery of oiled birds within 2-3 wk of capture. Successful rehabilitation depends on the availability of facilities which offer shelter, warmth, food, an abundant supply of hot water for cleaning, and large pens for bathing during recuperation. Birds are cleaned with a 40degC, 1% solution of RUROS 1972a liquid detergent, given access to clean water for preening and recuperation, and ringed before release. There have been only few ringing returns but at least some of the cleaned birds became reintegrated with the breeding populations after release. Even with appropriate organization and facilities it is doubtful whether the rescue and treatment of oiled birds can make a material contribution to seabird conservation. (AM) (references)

Clark, R.C., Jr.; Patten, B.G.; DeNike, E.E. (1978)

Observations of a cold-water intertidal community after 5 years of a low-level, persistent oil spill from the General M.C. Meigs

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977.

Environ. Conserv. Div., Northwest and Alaska Fish. Cent., Nat. Mar. Fish. Serv., Seattle, WA 98112, USA, 35(5), 754-765

J. Fish. Res. Board Can.

ABSTRACT
A rich and productive intertidal community was exposed continually for over 5 yr to small quantities of a Navy Special fuel oil from the unmanned troopship General M.C. Meigs that came aground on the Washington coast in January 1972. Observations of animal and plant populations and their petroleum hydrocarbon uptake patterns showed early evidence of contamination and the persistence of the oil spill throughout the study period. Abnormal and dead urchins, and loss of algal fronds and pigment were observed in localized areas near the wreck for at least 1 yr. Within 2 months of the accident, paraffinic hydrocarbons had been taken up by prominent members of the community and continued to appear in certan species even after 5 yr. Although changes were seen in certain species during the early days of this persistent low-level pollution incident, the community balance in this rocky, intertidal ecosystem does not appear to have been markedly altered.

Clark, R.B. (1982)

Biological effects of oil pollution

Water Science and Technology, Vol. 14, No. 9-11, p. 1185

NOTE: Proceedings of the Eleventh Biennial Conference of the International Association on Water Pollution Research and Control, Cape Town 29th March--2nd April 1982

Clark, J.R. (1976)

Assuring ecological soundness in coastal energy developments

Address not stated

Trans. North Am. Wildl. Nat. Resour. Conf., 41, 356-360

ABSTRACT
The coastal energy developments spectrum consists of electricity production, oil, natural gas, etc. The products originate with, or are transferred to, the coastal zones. The effects of recovery, shipment and distribution processes on land, water and air are very different. The author has simplified his argument by choosing 2 major aspects of coastal energy development, with particular emphasis on the siting of facilities for nuclear power production and developments for outer continental shelf (OCS) oil. These 2 energy developments have major, but distinctly different, impacts on the environment. With a nuclear plant the main ecological problem is the effect of heated water used in cooling the plant. In connection with OCS facilities a broad spectrum of environmental impact has to be considered. Pollution effects of persistent or accidental spills, or discharges, have to be minimized. The physical alterations to the shore line, the land, the water, the wetlands and other vital areas are considered. Also the surrounding water basin has to be used for spoils disposal. Withdrawal of ground water from the surrounding land may be critical eg, a 500,000 barrel a day refinery required 22 million gallons of water/d for processing, this is enough to supply a city of 1/4 million people. The author then outlines the proposed guidelines for the impact of these developments on the environment, and discusses in relation to, the requirements of most federal and state siting agencies.

Cole, T. (1978)

Preliminary ecological-genetic comparison between unperturbed and oil-impacted Urosalpinx cinerea (Prosobranchia: Gastropoda) populations: Nobska Point (Woods Hole) and Wild Harnor (West Falmouth), Massachusetts

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977

Boston Univ. Mar. Program, Mar. Biol. Lab., Woods Hole, MA 02543, USA, 35(5), 624-629

J. Fish. Res. Board Can.

ABSTRACT
Catastrophes, whether natural or man-made, impinge on populations of organisms by increasing mortality, thus reducing population numbers. Recent theoretical studies indicate that demographic and genetic changes may result from such events. The 1969 oil spill at Wild Harbor offered an opportunity to obtain empirical data on this relationship between ecology and genetics. The organism studied was the oyster drill Urosalpinx cinerea (Say, 1822). Monthly samples (April to September) were collected for each of 3 yr (1973-75) from the recolonizing population at Wild Harbor and from a long-standing population at Nobska Point. Genotypes at two allozymic loci (ODH and LAP) were determined. Demographic information was obtained by mark-recapture experiments during 1973-75. Analyses of population dynamics indicated that a reasonably functioning population has been reestablished at Wild Harbor. However, genetic structure (as revealed by genotypic distributions) of Wild Harbor drills exhibited generally greater year-to-year variation than did Nobska organisms. This may have resulted from genetic change caused by gene migration from different co-adapted gene complexes and from stochastic 'founder' effects. More information on the interdigitation of ecology and genetics is needed, however, before implications of these findings are fully realized.

Cole, J. (1979)

Scientists Gauge Extent of Recovery after an Oil Spill

Smithsonian, V10, N7, P68 (7). The original document is available from Bowker.

ABSTRACT
A team of scientists from Bowdowin College in Portland, ME, has been conducting long-term oil spill investigations to determine the long-term impact of oil spills and slow oil leaks on the marine environment and to gauge the extent of recovery after an oil spill. The study system-an interdisciplinary approach combining chemical analysis and biological research-is described. Results of investigations of the Tamano oil leak in Portland, ME, and of the Amoco Cadiz oil spill off the shores of France, are discussed.
(8 photos)

Cole, T.J. (1978)

Preliminary Ecological - Genetic Comparison between Unperturbed and Oil-Impacted Urosalpinx Cinerea (Prosobranchia: Gastropoda) Populations: Nobska Point (Woods Hole) and Wild Harbor (West Falmouth), Massachusetts

Boston Univ Marine Program

J. Fish. Res. Board Can. 35(5), P624 (6)

ABSTRACT
Catastrophes impinge on populations of organisms by increasing mortality. Both demographic and genetic changes may result from such events. The Wild Harbor, MA, oil spill of 1969 provided an opportunity to obtain empirical data on the relationship between genetics and ecology. The organism studied was the oyster drill Urosalpinx cinerea. Genotypes at two allozymic loci were determined. A reasonably functioning population has been reestablished at wild harbor. However, genetic structure of wild harbor drills exhibited generally greater year-to-year variation than that of organisms at Nobska Point, MA. This variation may be due to gene migration from different coadapted gene complexes. (27 graphs, 20 references)

Cole, J.; Greene, R.; Bowman, B.; Friedman, P. (1979)

Programmatic Environmental Impact Statement for DOE's Enhanced Oil Recovery RD&D Program

Energy & Env Analysis, VA

Presented at DOE Enhanced Oil & Gas Recovery & Improved Drilling Technology 5th Sym, Tulsa, Aug 22-24, 79, V3, PE-3 (13). The original document is available from Bowker.

ABSTRACT
Energy and Environmental Analysis, Inc., is providing support to DOE in the preparation of a draft Programatic Environmental Impact Statement for DOE's Enhanced Oil Recovery RD&D Program. The enhanced recovery processes that are assessed are: steam injection, in situ combustion, carbon dioxide injection, micellar-polymer flooding, and improved waterflooding. Potential environmental impacts characteristic of each process are discussed. The three most significant potential environmental impacts from enhanced oil recovery are: air quality impacts from emissions from oil-fired boilers used in the steam injection process; the potential for groundwater contamination from the micellar-polymer process; and the impact of enhanced recovery methods on water supply. (1 diagram, 7 references, 1 table)

Cook, C.B.; Knap, A.H. (1983)

Effects of crude oil and chemical dispersant on photosynthesis in the brain coral Diploria strigosa

Bermuda Biol. Stn. for Res., Ferry Reach 1-15, Bermuda

Mar. Biol., Vol. 78, No. 1, pp. 21-27.

ABSTRACT
An eight-hour exposure of D. strigosa (Dana) to a mixture of Arabian Light crude oil (19 ppm) and the chemical dispersant "Corexit 9527" (1 ppm) in a flowing seawater system reduced photosynthesis by symbiotic zooxanthellae by 85%, while either oil or dispersant alone had no effect. The greatest effect of crude oil plus dispersant occurred in the incorporation of photosynthetic products into lipids. Synthesis of wax esters and triglycerides, the major storage lipids, was particularly affected. Total carbon fixation was restored within 3-5 h after treatment, and lipid synthesis was restored within 5-24 h after exposure.

Cooke, T.S. (1978)

Outer continental shelf oil spill impact on southern California resources

In: Proceedings Energy/Environment '78: A Symposium on Energy Development Impacts, Los Angeles (USA), August 22, 1978.

Lindstedt-Siva, J., ed. Page 257.

Bureau of Land Management, 300 N. Los Angeles St., Los Angeles, CA 90012, USA

Society of Petroleum Industry Biologists Los Angeles (USA)

ABSTRACT
The southern California Bight is a unique area. A very high population density, high military use, high recreational use, upwelling and the associated high biological productivity combined with the high mineral resource potential makes a very complex situation. Twenty one oil refineries situated in the southern California area process over 1,335,000 barrels of crude oil per day, not including oil that is passed through to other destinations. Existing state tideland reserves yet to be recovered are estimated at over 633 million barrels. Existing federal OCS leases in the Santa Barbara Channel have estimated recoverable reserves of 610 million barrels of oil and the 56 tracts leased in OCS Sale No. 35 could have as much as an estimated 711 million barrels of oil. The proposed OCS Sale No. 48 involves 217 tracts for future leasing that contain an estimated 715 million barrels of oil. Oil and gas not produced locally must be imported. Because of the activity, there is a high probability of oil spills impacting various resources in California, even though the area already has a high background level of oil and grease in the waters. Each day local sewage outfalls contribute over 1152 barrels of oil and grease in addition to the 91 barrels daily input through rivers, creeks and drains. There are several natural seeps: at Coal Oil Point alone, 1465 seeps have been mapped contributing between 25 and 400 barrels of crude oil per day. Against the existing and potential oil pollution, industry and government have organized 3 major oil spill cooperatives and a number of smaller groups that can provide over 35 major oil spill skimming devices and 20 miles of oil spill containment boom. This paper identifies the above sources of existing and potential pollution, discusses probable trajectories if a spill should occur, identifies key resource categories and presents a new methodology for analyzing the impact of a spill.

Corbett, C.R. (1982)

State of affairs in spill response for U.S. waters

Oceanology International Exhibition and Conference, Brighton (UK), March 2-5, 1982, pp. OI82 9.1.

Marine Environ. Protect. Div., U.S. Coast Guard Headquart., Washington, DC 20593, USA

ABSTRACT
The preservation of the marine environment has long been a goal of the United States. While a key to attainment of that goal is, of course, pollution prevention, an adequate response mechanism to spills when they do occur is essential. The federal spill response mechanism in the United States, which responds to both oil and hazardous polluting substance spills, is designed to discover spills through surveillance, provide for timely notification of all those concerned, and provide for clean-up, mitigation, and disposal should the discharger be unknown or be inadequate to the task. Funds are presently provided through the National Pollution Revolving Fund established by the Federal Water Pollution Control Act (FWPCA) in Section 311 and in the case of chemical spills by the recently enacted "Superfund", or more precisely, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

Costa, D.P.; Kooyman, G.L. (1981)

Effects of oil contamination in the sea otter, Enhydra lutris

Scripps Inst. Oceanogr., Physiological Res. Lab., La Jolla, CA 92093, USA

Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Volume 10: Biological Studies.

Publisher(s): NOAA/OMPA, Boulder, CO (USA), pp. 65-107

Report Number: NOAA-OMPA-FR-81-10

ABSTRACT
The objective of the study was to measure effects of crude oil contamination on sea otters through studies on the changes in the animal's physiology and behavior before and after contact with oil. A second objective was to attempt to rehabilitate the otters after crude oil contamination. The study has shown that small amounts of crude oil contamination have large effects on the metabolic rate of sea otters. Light oiling of approximately 25% of the animals' pelt surface area resulted in a 1.4X increase in metabolic rate while immersed in water at l5 degree C. Furthermore, when the oil was removed by detergent, the animal's metabolic rate increased 2.1X while immersed in water at 15 degree C. Of the three animals studied, two contracted pneumonia and one died. Studies upon free ranging sea otters have established that under certain conditions, sea otters can sustain low levels of oil contamination when 20% or less of the body surface is oiled. Rehabilitation of oil-fouled sea otters would be very costly requiring holding facilities to keep the animals for at least two weeks. Even if adequate facilities were available, the success rate of rehabilitating oil-fouled sea otters is likely to be rather low.

Cowell, E.B.; Baldwin, A.H. (1974?)

North Sea Oil & Gas Recovery Technology & Environmental Protection

Presented at the 9th World Energy Conference, DET, September 22-27, 1974, p. 3.1-4 (24)

Cox, G.V.; Cowell, E.B. (1979)

Mitigating oil spill damage - ecologically responsible clean-up techniques

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), July 16, 1979

Chemical Manuf. Assoc., Washington, DC, USA

Gen. Tech. Rep. U.S. Dept. Agric.

U.S. Dept. Agriculture, Fort Collins, CO (USA)

Report Number: p. 121-128

ABSTRACT
Effective mitigation requires preplanning experience, ecological input to planning and the event, and a thorough understanding of political and social demands in oil spills clean-up programs. Attention to public safety should receive primary attention before the ecological and social considerations. The clean-up techniques and their results are analyzed.

Crabtree, A.F. (1979)

Pipelines in Streams and Wetlands

Ecolibrium, Winter 79, V8, N1, P13 (4). The original document is available from Bowker.

ABSTRACT
The effects of pipeline construction on streams and wetlands in norther Michigan were studied by the Michigan Public Service Commission. Long-term effects on stream development were linked to the choice of crossing point for the pipeline, bank restoration following construction, and post-construction cleanup. The long-term impact of strip clearing in wetlands was found to be more damaging than short-term construction impacts. Utility and state agency recommendations for minimizing environmental damage caused by pipeline construction include: seeking alternative routes away from streams and wetlands wherever possible; choosing crossing points at a stream's narrowest width; and crossing shrub swamps in wetlands instead of conifer swamps. Solicited comments from governmental agencies, conservation groups, and industries are included.

Craig, P.C.; Haldorson, L. (1979)

Beaufort Sea barrier island-lagoon ecological process studies: Ecology of fishes in Simpson Lagoon, Beaufort Sea, Alaska

LGL Limited, Nanaimo, B.C., Canada

Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1979. Vol. 6: Effects.

Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA). Outer Continental Shelf Environmental Assessment Program

Report Number: p. 363-470

ABSTRACT
Ongoing petroleum activities at Prudhoe Bay and the recent construction of the trans-Alaska pipeline demonstrate the nature of demands industry makes on Arctic water and gravel resources, and the subsequent disruptions of habitat and inevitable oil spills. As part of the program to assess the environmental impacts of offshore petroleum development, it is necessary to understand the utilization of nearshore habitats by anadromous and marine fish populations. The present study examines nearshore fishes and their ecological role in a barrier island-lagoon complex along the Beaufort Sea coast to evaluate in what ways petroleum development may affect fish populations. It appears that nearshore waters are used in the winter by some marine species for feeding and/or spawning, and that selected nearshore sites are used by anadromous fish for feeding and overwintering. In summer, with the exception of shallow-water areas that freeze solid or become hypersaline, the nearshore coastal environment supports year-round populations of fish, though numbers, species composition and distribution differ between summer and winter periods.

Crow, P. (1980)

EPA sees problems with muds, brines environment study.

National Press Building, WA 20045, USA

Oil Gas J., 78(44), 42

ABSTRACT
The new Resource Conservation and Recovery Act requires EPA to study 'the adverse affects, if any, of drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas or geothermal energy on human health and the environment.' The research will include the sources and volumes per year of the discarded muds and brines, present disposal practices, potential danger to human health and the environment from the surface runoff or the leachate, problem situations, and alternatives to the current disposal methods including their costs and the resulting impact on energy exploration and production.

Cuiec, L. (1987)

Wettability and oil reservoirs

North Sea Oil and Gas Reservoirs Seminar Trondheim (Norway) 2-4 Dec 1985

Inst. Francais Pet., Rueil-Malmaison Cedex, France

North Sea Oil and Gas Reservoirs, pp. 193-208

Report Number: ISBN 0-86010-865-1

ABSTRACT
In the first part of this paper, general considerations about wettability are given, including: definition importance of this parameter on the behavior of a porous-medium/fluid-1/fluid-2 system and methods of evaluation. Various aspects of problems that arise for petroleum engineers because of this parameter are examined. First, the problem of obtaining representative samples from the standpoint of surface properties is addressed. Obtaining such samples is indispensable for performing meaningful laboratory experiments. The causes of changes in the surface properties of reservoir samples between the field and the laboratory will be reviewed. The use of the wettability restoration procedure will be described.

Culley, J.L.B.; Dow, B.K.; Presant, E.W.; MacLean, A.J. (1982)

Recovery of productivity of Ontario soils disturbed by an oil pipeline installation

Land Resour. Res. Inst., Agric. Canada, Ottawa, Ont. K1A 0C6, Canada

Can. J. Soil Sci., Vol. 62, No. 2, pp. 267-279

ABSTRACT
Measurement of soil properties and field-crop yields on cropland traversed by the Sarnia-Montreal oil pipeline indicated that pipeline installation detrimentally affected both crop yields and soil physical-chemical properties in the first year after construction. After 5 yr, relative yields improved although reductions still persisted at most row-cropped sites. However, alfalfa yields at two sites appeared to be unaffected by pipeline construction. Soil mixing and compaction on the right-of-way were most prevalent on medium- to fine-textured soils. Compaction did not appear to be a problem at a coarse-textured site. Soil chemical data indicated that spoil (subsoil) materials from the trench were spread across the right-of-way at most sites. Diluted soil organic matter levels in the right-of-way adversely affected nitrogen status. Medium- to fine-textured right-of-way soils had reduced porosities and hydraulic conductivities, but increased strengths compared with undisturbed adjacent soils.

Cundell, A.M.; Mitchell, R. (1977)

Microbial succession on a wooden surface exposed to the sea

Lab. Appl. Microbiol., Div. Eng. Appl. Phys., Harvard Univ., Cambridge, MA 02138, USA

Int. Biodeterior. Bull., 13(3), 67-73.

ABSTRACT
The microbial succession on wood discs placed in an embayment at Fort Lauderdale, Florida for 12 wk was studied using a scanning electron microscope. Bacteria, pennate diatoms, stalked diatoms and ameoboid and ciliated protozoa were the dominant microorganisms observed in the succession. Green macroalgae, wood-digesting invertebrates and barnacles were well established after 6 wk. The mechanism of attachment of the bacteria and their role in the settlement of the later organisms in the succession were investigated. Cellulolytic bacteria were a major component of the heterotrophic population.

Cushman, R.M.; Goyert, J.C. (1984)

Effects of a synthetic crude oil on pond benthic insects

Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830, USA

Environ. Pollut. (A Ecol. Biol.), Vol. 33, No. 2, pp. 163-186

ABSTRACT
The authors describe the effects on pond benthic insects of a synthetic (coal-derived) crude oil at doses equivalent to 375, 75 and 15 ml oil m super(-3) pond water. Total insect abundance and abundance by taxon, total biomass and biomass by taxon, number of taxa, and species diversity based on abundance and biomass were all used as measures of community-level stress. The highest dose caused immediate and drastic effects, evident in all indices of stress. These effects were observed at concentrations of total phenols and oil:water ratios lower than those found to be toxic in laboratory acute bioassays. Populations of the midge Chironomus decorus in one of the medium dose ponds were stimulated, apparently an indirect effect of toxicity of the oil to the macrophyte Elodea canadensi . Three months after the dosing, there was some recovery of the pond insects, even at the highest doses examined.

Dauvin, J.-C. (1987)

Evolution a long terme (1978-1986) des populations d'amphipodes des sables fins de la Pierre Noire (Baie de Morlaix Manche occidentale) apres la catastrophe de l'Amoco Cadiz

[*Long term evolution (1978-1986) of the amphipod populations of the fine sand community of Pierre Noire (Bay of Morlaix, western English Channel) after the Amoco Cadiz disaster*]

CNRS-LP 4601 et Univ. Pierre et Marie Curie (Paris VI), 29211 Roscoff, France

Mar. Environ. Res., Vol. 21, No. 4, pp. 247-273.

ABSTRACT
Greatly reduced in 1978 by the Amoco Cadiz oil spill, the amphipod populations of the fine sand community of Pierre Noire in the Bay of Morlaix have not yet fully recovered 8 years after the population. The sublittoral sandy-mud benthic communities in the western part of the English Channel show a discontinuous distribution, occurring in isolated zones which are localized in estuaries and bays. The amphipods form insular populations. This insular distribution delays their re-introduction to the fine sand community of Pierre Noire. Moreover, the biological and demographic characteristics of the species entail limited periods of recolonization and increase in population.

Davidson, J.W. (1976)

Environmental difficulties encountered in shale oil production

USAF Aerospace Fuels Vandenberg Air Force Base, CA93437

Alternate Fuels Symposium. Mimeographed Papers. (n.p.)

Davis, R.W.; Williams, T.M.; Thomas, J.A.; Kastelein, R.A.; Cornell, L.H. (1988)

The effects of oil contamination and cleaning on sea otters (Enhydra lutris). 2. Metabolism, thermoregulation, and behavior

Sea World Res. Inst., Hubbs Mar. Res. Cent., 1700 S. Shores Rd., San Diego, CA 92109, USA

Can. J. Zool., Vol. 66, No. 12, pp. 2782-2790.

ABSTRACT
The purpose of this study was to develop a method to clean and rehabilitate sea otters (Enhydra lutris) that might become contaminated during an oil spill and to determine which physiological and behavioral factors were important in restoring the insulation provided by the fur. Tests were conducted on 12 sea otters captured in Alaska and brought to the Sea World Research Institute in San Diego. Under base-line conditions in water at 13 degree C, average metabolic rate was 8.0 W/kg, core body temperature was 38.9 degree C, and whole body thermal conductance was 10.7 W(m super(2) multiplied by degree C). Otters spent 35% of their time grooming, 45% resting, 10% swimming, and 10% feeding. The squalene concentration on the fur averaged 3.7 mg/g fur. Oiling increased thermal conductance 1.8 times. To compensate for the loss of insulation and maintain a normal core body temperature (39 degree C), the otters increased average metabolic rate (1.9 times) through voluntary activity and shivering

the time spent grooming and swimming increased 1.7 times. Using Dawn detergent, the authors were able to clean the oiled fur during 40 min of washing and rinsing. Squalene was removed by cleaning and did not return to normal levels in the oiled area after 7 days.

Davis, W.P.; Hoss, D.E.; Scott, G.I.; Sheridan, P.F. (1984)

Fisheries resource impacts from spills of oil or hazardous substances

Proceedings of the Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), November 9-11, 1981.

US EPA, Environ. Res. Lab., Gulf Breeze, FL 32561, USA

Cairns, J., Jr.; Buikema, A.L., eds. Pages 157-172

Report Number: ISBN 0-250-40551-2

ABSTRACT
Oil pollution is a potential impact to fisheries resources for three reasons (Wardley-Smith 1976): a direct (lethal or sublethal) effect to fisheries stocks may occur, oil may render the fisheries products unacceptable to the consumer, and fishing operations may be directly affected by the presence of oil. These reasons may be extended to other hazardous or toxic materials. Examples have been documented for each of these reasons. High mortalities occurred among oysters in the estuaries of Brittany, France during the 1978 Amoco Cadiz spill. Oysters and other fisheries resources elsewhere have acquired hydrocarbon taint from spills or seepages. The vast areas covered by oil released from the Ixtoc I well blowout near Campeche, Gulf of Mexico in 1979 caused shrimpers and other fishermen to change location of their operations.

de Jong, E. (1980)

The effect of a crude oil spill on cereals

Univ. of Saskatchewan, Dept. of Soil Science, Saskatoon, Saskatchewan S7N 0W0, Canada

Environmental Pollution. Series A: Ecological and Biological, 22(3), 187-196

ABSTRACT
A break in an oil pipeline near Moose Jaw, Saskatchewan, Canada, in Jan. 1974 caused oil to travel underground over a distance of =850 m. Oil moved upwards through cracks in the frozen soil, especially during recovery attempts. The contamination in the affected area varied considerably both horizontally and vertically. Oil contamination and damage to the soil structure due to the clean-up efforts caused serious yield decreases during the next summer. In subsequent growing seasons, oil was the major factor in reducing yields. Total above-ground dry matter and grain yield were affected similarly by oil pollution; even very small amounts of oil (<0.2% by wt) in the 0-30 cm or 0-90 cm depth reduced yields considerably. Oil reduced the available N content of the soil and markedly reduced water uptake by wheat from contaminated layers or from below such layers. Problems in reclaiming soils with oil contamination below the topsoil are discussed. (AM FT) (illustrations, references, abstract)

Dean, R.G.; Maurmeyer, E.M. (1988)

Predictability of characteristics of two embayments

Proceedings of Coastal Sediments '77: Fifth Symposium of the Waterway Port Coastal and Ocean Division of ASCE, Charleston, SC, November 2, 1977. American Society of Civil Engineers, New York, NY (USA), p. 848-866.

Dept. Civ. Eng., Univ. Delaware, Newark, DE 19711, USA

ABSTRACT
Coastal structures may be placed along shorelines for a variety of reasons, including erosion mitigation, prevention of sand from shoaling a navigational channel, and the establishment of artificial recreational beaches. In practically all cases, the structure will result in a shoreline response that may be unexpected or predictable to a qualitative degree only. As concern over environmental issues increases, the need becomes greater for an improved general understanding of sediment transport processes and a capability for correctly assessing the impacts of shoreline modifications. This paper describes a study of two relatively small embayment features which are associated with the east jetty at Shinnecock Inlet on Long Island, New York. These features differ in that one is formed as a pocket beach due to a damaged section of the jetty. The second larger feature is more exposed and occurs as a 'spiral beach' feature originating at the bayward terminus of the jetty and extending to a small rock structure presumably placed to anchor this beach. Plane table surveys were conducted to establish geometric features of these two bays. The attempt to predict the three-dimensional geometry of the features incorporated results from a study of over 500 profiles of natural beaches and reasonable concepts of wave mechanics and sand transport. The aperture through which waves propagated to the small bay is sufficiently narrow that the directionality of the incident waves was regarded as not relevant. Waves from the ocean (through the inlet) and the bay were considered in predicting the platform characteristics of the larger feature. Comparison of predicted and actual geometries shows qualitative agreement. The predicted shape of the small bay was reasonably correct however, the size is too large by 20-85%. This is due, in part, to uncertainty of the 'effective' water depth for the computed platform and the base elevation which controls sand loss from the bay. It is concluded that improved platform predictions of the large bay would require better information of the wave climate at this site and of diffraction around the tip of a 'wide' structure.

Deis, D.R.; Dial, R.S.; Quammen, M.L. (1987)

The use of mitigation in environmental planning for port development

Proceedings of the 10th National Conference on Estuarine and Coastal Management: Tools of the Trade, New Orleans, LA (USA), October 12-15, 1986. Vol. 2. Lynch, M.P.; McDonald, K.L., eds. Pages 707-718.

Continental Shelf Assoc., 759 Parkway St., Jupiter, FL 33477, USA

ABSTRACT
This study consisted of four tasks: 1) review and evaluate past mitigation projects in the Tampa Bay area (2) prepare a list of feasibility options 3) identify and rank potential mitigation sites and 4) develop management and/or restoration recommendations. Auble et al. (1985), in a report on a workshop in which mitigation options to port development in Tampa Bay were suggested, discussed two classes of mitigation options: those designed to avoid, minimize, rectify, or reduce the adverse impacts of development, and those designed to compensate for unavoidable impacts. This document discusses the second class of mitigation options--those involving compensation for impacts where there is loss of habitat.

Dewling, R.T.; McCarthy, L.T. (1980)

Chemical treatment of oil spills

USEPA, 26 Federal Plaza, New York, NY 10007, USA

Environ. Int., 3(2), 155-162.

ABSTRACT
Chemical treatment methods have been used with varying degrees of success for mitigating the environmental effects resulting from oil spills. These methods include dispersing, herding, and gelling a floating oil slick sinking the oil burning the oil mass either on open waters or on the affected shoreline and applying film-forming chemical agents to protect shorelines from oil that eludes offshore cleanup. The latest technical information on the applicability and effectiveness of these approaches for treating and controlling oil spills is presented.

Dial, R.S.; Deis, D.R. (1986)

Mitigation options for fish and wildlife resources affected by port and other water-dependent developments in Tampa Bay, Florida

Continental Shelf Associates, Inc., Jupiter, FL (USA), 171 pp.

NTIS Order No.: PB87-140703/GAR.

ABSTRACT
Ten past restoration projects in Tampa Bay were evaluated. Habitats included Spartina marsh, mangrove forests, Juncus marsh, and subtidal habitat. In-kind losses of habitat occurred in all but one project. Permanent losses occurred in at least three projects. Restoration of Spartina and Juncus marshes was recommended. Seagrass restoration is not recommended at this time. Twelve sites, most less than 50 ha, were identified as potential restoration sites to give 344 ha of subtidal habitat to be made shallower and 176 ha of uplands to be scraped down. The report will be useful to decisionmakers concerned with wetland habitat loss and restoration in Tampa Bay, Florida, and other areas with similar habitats.

Diamant, A.; Tuvia, A.B.; Baranes, A.; Golani, D. (1986)

An analysis of rocky coastal Eastern Mediterranean fish assemblages and a comparison with an adjacent small artificial reef

Mar. Lab., P.O. Box 101, Victoria Rd., Aberdeen AB9 8DB, UK

J. Exp. Mar. Biol. Ecol., Vol. 97, No. 3, pp. 269-285.

ABSTRACT
The fish assemblages of two natural rocky habitats and a small artificial reef on the Mediterranean coast of Israel were studied. A total of 54 species belonging to 23 families was collected. Species similarity was greater between years at the same habitat than between sites. All habitats studied had a similar species diversity, but species richness and biomass were higher on the artificial reef. The results indicate that erection of artificial reefs on Israel's relatively barren inshore continental shelf could considerably increase the local fish production. Red Sea immigrant species were found to constitute only 7.4% of the collected fish, but on average, they contributed > 20% of the standing crop. During this study, a new Red Sea immigrant, the sweeper Pempheris vanicolensis Cuvier and Valenciennes, 1831, which was absent during the years 1975-1976, colonized the region. Recolonization of the defaunated artificial reef site was monitored, and 1 yr later the newly established assemblage was collected. The recolonization process and various factors influencing recruitment are discussed.

Diaz, R.J.; Boesch, D.F. (1977)

Habitat development field investigations, Windmill Point Marsh Development Site, James River, Virginia

Appendix C. Environmental impacts of marsh development with dredged material: Acute impacts on the macrobenthic community

Div. of Biological Oceanography, Virginia Inst. of Marine Science, Gloucester Point (USA)

Technical Report, U.S. Army Corps of Engineers, Waterways Experimental Station

Publisher(s): U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, VA (USA), November, 1977.

Contract No. DACW66-75-C-0053

Report Number: 158 p

ABSTRACT
Macrobenthos was sampled in a tidal freshwater portion of the James River, near Windmill Point, in the area of construction of a wetlands habitat from dredged materials. The benthic communities in the area of the habitat development site were dominated by the bivalve Corbicula manilensis the oligochaetes Limnodrilus spp. and Ilyodrilus templetoni and larvae of the insects Coelotanypus scapularis and Hexagenia mingo. The dominant organisms are generally eurytopic with respect to sediments many had higher densities in muddy sediments although Corbicula preferred sand. Most of the important species were highly opportunistic and thus the community was able to recover quickly from perturbations. This characteristic minimized the effects of habitat development. Acute impacts were detected at the habitat site where organisms were buried by construction and at the excavation where organisms were removed along with the sand and gravel used in construction of the dike. Long-term changes associated with the habitat were limited to areas of gross sediment alteration, such as at the excavation and dike perimeter. No other broad-scale effects, acute or long-term, could be detected that were attributable to the habitat construction.

Dibble, J.T.; Bartha, R. (1979)

Rehabilitation of Oil Inundated Agricultural Land a Case History

Texaco, Inc., P.O. Box 1608, Port Arthur, TX 77640, USA

Soil Sci 128 (1). 56-60. CODEN: SOSCA

Dicks, B.; Iball, K. (1981?)

Ten Years of Saltmarsh Monitoring – The Case History of a Southampton Water Saltmarsh and a Changing Refinery Effluent Discharge

Orielton Field Centre Oil Pollution Research Unit, UK

Presented at EPA/API/USCG 1981 Oil Spill Conf, Atlanta, Mar 2-5, 81, P361 (14). The original document is available from Bowker.

ABSTRACT
One of the largest refinery/petrochemical plants in the U.K. has been discharging effluents into the creek system of a Spartina anglica-dominated saltmarsh in Southampton since 1953. This resulted in extensive damage to the marsh system up to 1971. At that time, a program of effluent quality improvement was implemented, which has resulted first in recolonization of small areas of damaged marsh followed by extensive recovery. Monitoring results from 1969-79 describe the recolonization and recovery of the marsh system. (2 graphs, 27 maps, 12 references, 5 tables)

Dillmann, B. (1985)

Mitigation as affected by geographical factors

8th Biennial International Estuarine Research Conference, Durham, NH (USA), July 28, 1985

Wetland Manage. Spec., Inc., Smithfield, RI, USA

Estuaries, Vol. 8, No. 2B, p. 110A

Abstract only.

ABSTRACT
Mitigation is a compromise which in theory allows development to proceed while preserving environmental quality. Many obstacles stand between the mitigation ideal and the mitigation reality. Adverse impacts of poorly designed mitigation policies, such as inconsistent determinations on the part of regulatory agencies, political graft, and a tendency to preserve one ecosystem type at the expense of another are discussed. Coastal Zone Management Plans (CZMP) which prioritize areas based upon geographical criteria and desired use provide an ideal framework for mitigation. Suggestions for incorporating mitigation into a geographically prioritized management plan are discussed.

Ditton, R.B. (1981)

Social and Economic Considerations for Artificial Reef Deployment and Management

Proceedings of a Conference on Artificial Reefs, Daytona Beach, FL (USA), September 13-15, 1979. Aska, D.Y., ed. Pages 23-32.

Texas A&M Univ., Texas Agric. Exp. Stn., College Station, TX, USA

Report for the Florida Sea Grant Program

Report Number: FSG-R-41

ABSTRACT
Artificial reefs have traditionally been the business of the public sector. If private enterprise had the opportunity to construct artificial reefs in marine waters and charge an admission fee (for a discussion of the arguments, constraints and opportunities involved), we would likely see a great deal more attention paid to social and economic considerations. An apparent disparity in information needs and level of planning can be traced to the varying objectives of the private and public sectors--the private sector must pay attention to people--they are called customers--while the public sector can choose to an often does ignore people in their management activities. This is not done willfully but often is the result of management objectives which are not clearly stated and operationalized. For example, the specific purpose and mission of artificial reefs is not clear--are reefs to provide habitat, to improve fish populations, to improve people's fishing, to provide satisfying fishing experiences or all of the above. If managers are only concerned with improving fish stocks, people may be (and often are) of little direct concern.

Dolah, R.F. van; Wendt, P.H.; Wenner, C.A.; Martore, R.M.; Sedberry, G.R. (1987)

Environmental impact research program: Ecological effects of rubble weir jetty construction at Murrells Inlet, South Carolina

Volume 3. Community structure and habitat utilization of fishes and decapods associated with the jetties.

Army Corps of Engineers, Waterways Experimental Station, Vicksburg, MS (USA), 163 pp.

NTIS Order No.: AD-A187 676/2/GAR.

ABSTRACT
Quarrystone jetties at Murrells Inlet, South Carolina, were studied to: (a) identify changes in the distribution, abundance, and composition of fish and crab assemblages, (b) characterize the food habits of fish species, and (c) identify patterns in recreational fishing around the jetties. The jetties attracted fish species normally associated with reef structures, species commonly found around estuarine inlets, and species that seasonally migrate along the coast. The jetties also serve as nursery habitat for a variety of fish species. Considerable recreational fishing was observed around the jetties, with most activity observed on weekend days. The numbers of fishes and fish species caught by fisherman were greatest during the summer, and more fish captured around the jetty structures than in nonjetty areas.

Donaldson, E.C. (1979)

Environmental aspects of enhanced oil recovery

DOE, Bartlesville Energy Technology Center, Bartlesville, OK 74003

Environmental control symposium Washington, DC Nov 1978

ENERGY SOURCES 4(3), 213-229, Coden: EGYSAO

refs.

ISSN: 0090-8312

Abs.

ABSTRACT
Potential pollution hazards associated with enhanced oil recovery processes involve atmospheric emissions, water use, groundwater impacts, wastewater effluents, solid wastes, occupational safety and health, physical disturbances, and noise. In the waterflood process, oil is displaced by the injection of brines, and the surface processing of large quantities of water occurs. The process uses surface-active agents, caustics, organic polymer compounds, and micellar-polymer solutions, all of which increase the possibility of pollution. Thermal methods employed to improve oil production can result in air pollution from steam generators and the fluids produced. An environmental surveillance program instituted by the DOE is preparing a Programmatic EIS addressing these areas of concern. (SS)

Dorrler, J.S.

Energy Resource Extraction; Oil And Gas Production

EPA, NJ

Presented at EPA Natl Conf on Health, Env Effects, & Control Technology of Energy Use, Washington, DC, Feb 9-11, 76 (9). The original document is available from Bowker.

ABSTRACT
The EPA program for controlling discharges from oil and gas producing facilities emphasizes: development of new technology to prevent environmental damage during well, offshore platform, and transfer facility installation and operation; criteria for evaluation of onshore pipeline terminal and supporting facilities sites; and development of technology to prevent, control, and clean up oil spills. Current projects involve minimizing point source discharges, onshore impact of offshore operations, environmental impact of enhanced recovery methods in onshore production facilities, and prevention of cleanup of oil spills. Future projects are outlined; work on enhanced recovery techniques is expected to increase. (7 references, 4 tables)

Eidam, C.L.; Hancock, J.A.; Jones, R.G.; Hanson, J.R.; Smith, D.C.; Hay, K.G.; Mcneil, C.S.L. (1975?)

Oil Spill Cleanup

EPA

Presented at EPA/API/USCG Conf on Prevention & Control of Oil Pollution, San Francisco, Mar 25-27, 1975, P217 (52). The original document is available from Bowker.

ABSTRACT
Various aspects of oil spill cleanup are discussed, and several examples are presented. Topics include: waterborne debris in marine pollution incidents; disposal of oil spill debris; rehabilitation of oiled aquatic birds; research and planning on the status of oiled wildlife; and on-line computer systems for environmental emergency management. Case studies include: a USCG arctic oil pollution program; oil spill countermeasures in the beaufort sea; a review of the Casco Bay, ME, oil spill and cleanup; and a review and evaluation of the 1973 Oakland Estuary oil spill cleanup operation. (4 diagrams, 5 graphs, 4 maps, 27 photos, 144 references, 9 tables)

Eisenhart, R.W. (1984)

Tracking of hazardous substance spills to inland streams

The Biosphere: Problems and Solutions. Proceedings of the Miami International Symposium on the Biosphere, Miami Beach, FL (USA), April 23-24, 1984. Veziroglu, T.N., ed. Pages 415-435.

Div. Water Pollut. Control, Illinois EPA, Springfield, IL 62706, USA

Stud. Environ. Sci., No. 25

Report Number: ISBN 0-444-42424-5

ABSTRACT
Dangers to the biosphere occur from the consumption of waters that have become polluted by accidental discharges of hazardous substances into an aquatic environment. Prompt mitigation of spills and expeditious notification of downstream users is necessary to avoid excessive adverse environmental impacts. Arrival time of the leading edge of a pollutant plume at a sensitive area must be determined rapidly. It is imperative that every aspect of the plume's progress downstream be known and to determine rates of travel and dispersion. Downstream observers and authorities responsible for water intakes and sensitive environments must be identified and notified. Aids have been developed and incorporated into a handbook to facilitate manipulation of the data base for the Illinois River, which include tables, charts, maps, and diagrams.

Elouard, B.; Desrosiers, G.; Brethes, J.C.; Vigneault, Y. (1983)

Etude de l'habitat du poisson autour des ilots crees par des deblais de dragage lagune de Grande-Entree Iles-de-la-Madeleine

(A study of a fish habitat created around islets of dredged material Grande-Entree lagoon, Magdalen Islands)

Department of Fisheries and Oceans, Cap Diamant, Que. (Canada). Res. Branch

Rapp. Tech. Can. Sci. Halieut. Aquat., No. 1209F, 77 pp.

Report Number: ISSN 0706-6570

ABSTRACT
Rejecting the alternate harbour site at Leslie, the promoters of the Magdalen Islands salt mine opted for a site within the Grande-Entree lagoon. However, this solution involved some dredging operations from the proposed wharf to the lagoon entrance. In order to get rid of these dredged materials, some islets were created. The present study describes the new habitats created by the deposits of dredged materials. With the help of some statistical indices and analyses, this research presents the abundance and distribution of organisms on these newly created habitats as compared to control habitats. It seems that these islets were quickly recolonized and are presently relatively well balanced. The long-term stability of these environments is discussed and areas for future research are also proposed. (127 references)

Engelhardt, F.R.; Gilfillan, E.S.; Boehm, P.D.; Mageau, C. (1985)

Metabolic effects and hydrocarbon fate in Arctic bivalves exposed to dispersed petroleum

Proceedings of the 3rd International Symposium on Responses of Marine Organisms to Pollutants Plymouth (UK) 17 Apr 1985. Moore, M.N., ed. Pages 245-249

Canada Oil and Gas Lands Adm., Ottawa, Ont. K1A 0E4, Canada

Mar. Environ. Res., Vol. 17, No. 2-4

ABSTRACT
A number of experiments were carried out in the Canadian Arctic on Baffin Island with the purpose of defining the short- and long-term effects of exposure to dispersed crude oil on marine benthic invertebrates. The study reported here assessed metabolic responses by physiological and biochemical indices, and evaluated these in relation to exposure concentration. The overall objective of the study was to evaluate the potential for long-term survival of benthic communities in the Arctic following an oil spill. This objective was consistent with the goals of the larger Baffin Island Oil Spill (BIOS) program, which was implemented to evaluate the relative mitigating effectiveness of chemical dispersants, as compared to conventional oil spill counter-measures.

Environmental Protection Agency (1980)

Emergency Spills Research Strategy 1980-1984

EPA Report EPA-600/9-80-063, (20)

The original document is available from Bowker.

ABSTRACT
Results of EPA Municipal Wastewater and Spill Prevention Research Committee's planning efforts for emergency spills research and development are presented. Research focuses on prevention and control of oil and hazardous substance spillage. The responsibility of risk assessment and incineration at sea R&D program was allocated to the Solid Waste Committee. The emergency spills R&D program intends to disseminate technical information preventing the release of oil and hazardous substances into the environment and to diminish their environmental effects. R&D objectives under the oil and hazardous substances spills areas include: development, evaluation, and demonstration of new and improved equipment for prevention, identification, control, and removal of hazardous substances and oil released in the environment. Methodology for mollifying the effects of such releases are identified.

Erwin, K.L; Best, G.R. (1985)

Marsh community development in a central Florida phosphate surface-mined reclaimed wetland

8th Biennial International Estuarine Research Conference, Durham, NH (USA), July 28, 1985.

2077 Bayside Parkway, Ft. Myers, FL, USA

Estuaries, Vol. 8, No. 2B, p. 111A.

Abstract only.

ABSTRACT
Approximately 60 acres of freshwater marsh were created within a 366 acre reclamation project constructed in late 1982. Two restoration techniques, top-soiling and natural recolonization on overburden are being evaluated to determine the optimal method of establishing high diversity, late successional marsh ecosystems immediately after mining and recontouring. Six permanent line intercept transects have been established. After two complete growing seasons topsoiled areas have higher species richness and cover values than the overburden areas. Pontederia cordata is aggressive, increasing in % cover and its domination of the topsoiled marsh each successive growing season.

Erwin, K.L. (1979)

Restoration and revegetation of exploratory oil well sites in the wetlands of south Florida USA

Fla. Sci. 42(SUPPL 1):31, CODEN: FLSCA

Esquivel, I.F. (1986)

Direct retrospective analysis of the reef coral Porites compressa : Evidence for sexual versus asexual origins of reef coral populations

Coral Reef Population Biology

Jokiel, P.L.; Richmond, R.H.; Rogers, R.A., eds. Pages 234-239.

Dept. Oceanogr., Univ. Hawaii, Honolulu, HI 96822, USA

Sea Grant Coop. Rep. Hawaii Univ.

Report Number: UNIHI-SG-CR-86-01

ABSTRACT
An attempt was made to determine the relative importance of asexual versus sexual reproduction in the reef coral Porites compressa in two different physical environments of the same reef, namely, the reef flat and reef slope. X-radiography is introduced as a method for determining coral colony origin, i.e., whether an existing colony is a product of a previously established colony. Radiographic studies of coral heads revealed a greater percentage of sexually derived colonies on the reef slope while colonies formed from asexual fragmentation formed a greater percentage of young colonies on the outer reef flat. As suggested in previous studies, the difference in mode of reproduction is attributed to the distinct physical characteristics dominating in each habitat.

Farrington, J.W. (1985)

Oil Pollution: A Decade of Research and Monitoring

Woods Hole Oceanographic Inst

Oceanus, Fall 85, V28, N3, P2(11). The original document is available from Bowker.

ABSTRACT
Sources of petroleum hydrocarbon inputs to the marine environment are identified. These include oil spills, natural sources, and municipal and industrial wastes and runoff. The fate of petroleum inputs is discussed in terms of weathering, photodegradation, and biodegradation. Where oil has had an effect on living organisms, subsequent monitoring has shown biological recovery taking place.

Faucher, C. (1983)

Comparaison quantitative des populations benthiques des plages de St Efflam

(Quantitative comparison of benthic populations on St. Efflam beaches)

Lab. Oceanogr. Biol., Brest Univ., 29283 Brest Cedex, France

Etude de la Macrofaune du Microphytobenthos de la Meiofaune des Estrans et Etude des Chenaux des Abers, pp. 1-11

(Ecological Survey of Macrofauna, Microphytobenthos and Meiofauna of the Foreshore, and Survey of the Channels of the Abers Estuaries)

Report Number: Contract CNEXO82/2604

ABSTRACT
Benthic populations were surveyed on the St. Efflam beaches (Lannion Bay) during the 4 years after the Amoco Cadiz oil spill (1978). These beaches had been heavily polluted, and the mortality rate had been very high. Pollution-resistant species then appeared, and regressed when initial populations started to be restored, in 1979-1981. The western part of the beach was restored first. Some species have not yet reappeared (Lutraria, Mactra, Ensis, Echinocardium).

FEA Report (1977)

Strategic Petroleum Reserve Environmental Impact Statement

FEA Report, Dec 76-Jan 77 (4107)

The original document is available from Bowker.

ABSTRACT
draft and final environmental impact statements are prepared for the following petroleum early storage reserve sites: (1) Cote Blanche Salt Mine, St. Mary Parish, LA; (2) Central Rock Limestone Mine, KY; (3) Weeks Island Salt Mine, LA; (4) Bayou Choctaw Salt Dome, Iberville Parish, LA; (5) West Hackberry Salt Dome, Cameron Parish, LA; (6) Bryan Mound Salt Dome, Brazoria County, TX; and (7) Ironton Limestone Mine, OH. The purpose of the reserves is to mitigate the social and economic impacts of any future interruptions of oil imports to the U.S. petroleum will be stored underground in conventional mines or solution-mined salt cavities or aboveground in conventional tanks. The site-specific environmental impact statements identified particularly sensitive environmental parameters, such as water quality, air quality, and socioeconomic factors. Methods of controlling these impacts are recommended. Structural alternatives, including different storage methods, mine sites, shaft and oil recovery systems, and distribution systems, are discussed. (Numerous diagrams, drawings, graphs, maps, photos, references, tables)

Federle, T.W.; Vestal, J.R.; Hater, G.R.; et al. (1979)

Effects of Prudhoe Bay crude oil on primary production and zooplankton in arctic tundra thaw ponds

Univ. of Cincinnati, Dept. of Biological Science, Cincinnati, OH 45221

Marine Environmental Research 2(1), 3-18, Coden: MERSDW

ABSTRACT
The effects of Prudhoe Bay, Alaska, crude oil on the indigenous phytoplankton and zooplankton of tundra thaw ponds were studied under controlled conditions in situ during the summer of 1976. These effects were compared with uncontrolled oil spills on Pond Omega (1 yr previously) and Pond E (6 yr previously). In the uncontrolled spills, the phytoplankton species composition of both ponds remained appreciably different compared with control Pond C, although phytoplankton biomass did not differ greatly. Primary production remained low in Pond Omega but had recovered to control levels in Pond E. In controlled subpond experiments, oil decreased primary production about 90%-100% in 5 d but recovered to 40%-50% of the control level within 15 d. During that time, phytoplankton biomass decreased initially but recovered within 15 d. Oil shifted phytoplankton species composition from a predominance of cryptophytes to chrysophytes. Subponds containing 2 Daphnia middendorffiana and 1 Brachinecta paludosa/L of pond water were also affected by oil, causing zooplankton death within 3 or 4 d. After that time, changes in the phytoplankton species composition were similar to control subponds without zooplankton. Oil toxicity to zooplankton or experimental removal resulted in a loss of grazing pressure which eliminated the cryptophyte Rhodomonas sp. This species was still absent from Pond Omega, but was seen in Pond E for the first time, when zooplankton also reappeared after 6 yr. Oil perturbation of tundra thaw ponds causes a loss of zooplankton and a reduction in primary production. Phytoplankton primary production recovers somewhat but algal species composition remains changed because of the loss of zooplankton grazing pressure and the selective effects of oil. (AM) (illustrations, references, abstract)

Fedkenheuer, A.W.; Heacock, H.M.; Lewis, D.L. (1980)

Early Performance of Native Shrubs and Trees Planted on Amended Athabasca Oil Sand Tailings

Syncrude Canada, Alberta

Reclamation Review, V3, N1, P47 (9). The original document is available from Bowker.

ABSTRACT
Regulations enacted in Alberta Province, Canada, require that reclamation programs restore disturbed lands in such a way that productivity will be equal to or greater than it was prior to being mined. Consistent with these requirements, Syncrude Canada embarked on a project to restore and rehabilitate tar sand tailings with native shrubs and trees. Soil amendments were followed by the seeding of grasses and legumes; plots were subsequently planted with trees and shrubs. Results to date indicate over-winter survival was very satisfactory with most plant species. (1 map, 15 references, 5 tables)

Ferguson, C.C. (1978)

Economic benefits to the UK of North Sea Oil

Proceedings of the European Offshore Petroleum Conference and Exhibition, London (UK), October 24, 1978. Vol. 2. pp. 355-362.

Wood, Mackensie and Co., UK

Publisher(s): Society of Petroleum Engineers (UK), Ltd.

ABSTRACT
Economic study of the North Sea has applications for Government and industry. For Government, quantification of North Sea benefits influences policy in diverse areas such as taxation levels, exchange control and economic management in general. Loosening of economic restraints may benefit industry by reducing taxation levels, restoring business confidence and stimulating investment.

Flipse, J.E. (1980?)

Deep ocean mining pollution mitigation

Proceedings of the 12th Annual Offshore Technology Conference, Houston, TX (USA), May 5, 1980.

Texas A&M Univ., USA

ABSTRACT
During the investigation of possible financial penalties of deep ocean mining pollution mitigation the major threats to the marine environment were identified and means to minimize damage proposed. This paper defines the major threats: the benthic plume suspended particulate matter comprised of macerated marine biota and disturbed seabed sediments, and the surface plume of ingested benthic matter and abraded manganese nodule. Techniques for minimizing the disturbance of the seabed and limiting ingestion of benthic material in the dredge pipe and means for controlling the surface plume to limit possible damage to the euphotic zone of the water column are developed. The author concludes by recommending that the industry test and the scientific community evaluate the effectiveness of the proposed pollution mitigation approaches.

Flower, R.J. (1983)

Some effects of a small oil spill on the littoral community at Rathlin Island, Co. Antrim

Dept. Geogr., University Coll., London WC1, UK

Ir. Nat. J., Vol. 21, No. 3, pp. 117-120

ABSTRACT
The Ella Hewitt entered Church Bay in November 1962 to take shelter during stormy conditions; unfortunately she foundered and sank. As a consequence, small quantities of bunker oil began to pollute the southern shores of Rathlin. Most of the released oil came ashore. The beached oil caused severe but very local pollution being confined to the shore within the harbour in Church Bay. Results of the transect surveys indicate that the rocky-shore littoral community within the harbour had largely recovered from the effects of the oil spill and the dispersant within 7 months of the incident. Only the population of Actinia equina seemed to be still adversely affected after this period of time.

Foley, J.P.; Tresidder, S.J. (1977?)

The St. Lawrence River oil spill of June 23, 1976-are you ever truly ready?

USCG, Marine Safety Office, Buffalo, NY 14202

1977 Oil Spill Conference, New Orleans, LA, March 8-10, 1977

American Petroleum Institute Publication 4284, pp. 81-85

ABSTRACT
On June 23, 1976, tank barge Nepco 140 grounded near the eastern end of Wellesley Island releasing about 300,000 gal of No. 6 oil into the Saint Lawrence River. Over the following 3 d the oil spread 85 mi downstream and contaminated K300 mi of island and mainlands mainland shoreline. The cleanup lasted K16 wk at a cost of K$8,000,000. The need to reduce the affected area should be paramount to all other considerations in a spill such as this. The inability to mitigate the damage resulted not only in a time-consuming and expensive cleanup, but also in contamination to high residential development, wilderness shoreline, wildlife refuges, and marshland frontage. Previous incidents in similar areas did not provide complete information for pre-planning. It is essential that the predesignated on-scene coordinator implement an organization scheme to make the recovery effort as effective and as thorough as possible. Where environmental and economic impacts are severe, it is necessary for the coordinator to have planned both internal organizational needs and substantive needs for the physical recovery itself. (from AA)
(illustrations, no references, abstract)

Fonseca, M.S.; Kenworthy, W.; Phillips, R.C. (1982)

A cost-evaluation technique for restoration of seagrass and other plant communities

Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Southeast Fish. Cent., Beaufort Lab., Beaufort, NC 28516, USA

Environ. Conserv., Vol. 9, No. 3, pp. 237-242.

ABSTRACT
Coastal habitat loss must be reduced either through conservation or mitigative efforts. Implementation of mitigation depends largely on accurate cost-assessment of the projects that are involved. The authors center our discussion here on seagrass transplanting as an exemplary mitigative tool. The technology of restoring seagrass communities has received increasing attention in recent years. However, the methods used have had varying degrees of success, a largely unknown factor being the cost of the technique that is used. In this paper is presented a universal format that includes consideration of the essential factors in our cost-analysis, such as planning, planting, and monitoring activities, geographic location, tidal influence, labor, and materials (both expendable and non-expendable). Cost per (successfully established) shoot or seed or fruit is recommended as the best indicator of cost effectiveness for a given technique. Incorporation and presentation of this information is urged in future projects to motivate wider application of seagrass and other essential plant-community restoration.

Forget, C.A.; Sartor, J.D. (1971?)

Earthmoving Equip for Restoration of Oil-Contaminated Beaches

API/EPA Conf Jun 15-17, 1971, Washington, DC P505. The original document is available from Bowker.

Forster, M. (1985)

The sea and the law

IUCN Bull., Vol. 16, No. 7-9, p. 85.

Special Feature: Marine Conservation is for People

ABSTRACT
Protection of the marine environment in international law began in the 1920s, when concern first began to mount over the pollution of the sea by an increasingly oil-burning merchant fleet. Initially, pollution Conventions like the 1954 London Convention on the Prevention of the Pollution of the Sea by Oil, were essentially "clean beaches" Conventions. In the early 1970s, the International Maritime Organization (IMO) fathered a new Convention for the Prevention of the Pollution of the Sea from Ships (MARPOL), which set out to cover not only pollution by oil, but also noxious substances such as garbage and sewage. The problems prompted the international maritime community to rely on forms of legal compulsion, such as the imposition on shipowners of the obligation to pay compensation for damages. IMO has recently promulgated a Protocol to the Convention on Civil Liability for Oil Pollution Damage which would provide for the recovery of the costs of restoring the marine environment.

Foster, G.D.; Wright, D.A.; Means, J.C. (1987)

Organic toxicant distribution between sediments and biota in Chesapeake Bay habitats

Proceedings of the Tenth National Conference on Estuarine and Coastal Management - Tools of the Trade, New Orleans, LA, 12-15 October 1986. Volume 1.

Lynch, M.P.; McDonald, K.L., eds. Pages 377-384.

Chesapeake Biol. Lab., P.O. Box 38, Solomons, MD 20688, USA

ABSTRACT
The toxic chemical surveillance component of the Chesapeake Bay Water Quality Monitoring Program is an effort designed along with the other Bay monitoring studies to establish causality between habitat pollution by toxic chemical and a diminished health of benthic life. Sediments, Baltic clams (Macoma balthica), and clam worms (Nereis succinea) were collected from eight north and central stations in 1985 and analyzed for the presence of threatening trace organic contaminants. The surveillance program have been to characterize the geographical distribution of trace contaminants in the northern portion of the Bay by confirming the identity and quantifying 44 organic toxicants in sediments and biota, and to develop relationships between total toxicant concentrations in sediments and the monitoring organisms to estimate the bioavailability and bioaccumulation of sediment-associated chemicals.

Franco, P.J.; Giddings, J.M.; Herbes, S.E.; Hook, L.A.; Newbold, J.D.; Roy, W.K.; Southworth, G.R.; Stewart, A.J. (1984)

Effects of chronic exposure to coal-derived oil on freshwater ecosystems: 1. Microcosms

Environ. Sci. Div., ORNL, Oak Ridge, TN 37831, USA

Environ. Toxicol. Chem., Vol. 3, No. 3, pp. 447-463

ABSTRACT
Sixteen 67-liter freshwater microcosms were treated for 8 weeks with an unrefined coal-oil in amounts ranging from 0.03 to 7 ml per week. Phenols make up 95% of the water-soluble compounds in this oil, and dissolved phenol concentrations averaged < 0.01 mg/L in the lowest dose and 10 mg/L in the highest. The microcosms were severely damaged at the highest treatment level; macrophytes, zooplankton and insects were eliminated, and the ecosystems became anaerobic. Microcosms did not recover to pretreatment conditions within 5 months. At lower dosages there were temporary effects on ecosystem metabolism, water chemistry and community structure. The most sensitive indices - community respiration, production/respiration ratio, pH and cladoceran zooplankton numbers - were affected at phenol concentrations below the lowest observable effect concentration of a chronic Daphnia magna bioassay.

Frankiewicz, T.C. (1980)

Design and management for resource recovery

Vol. 1: Energy from Waste. Occidental Res. Corp.

Frankiewicz, T.C., ed.

Ann Arbor Science Publishers, Inc., Ann Arbor, MI, USA. XIV+209 pp. (illus.)

Report Number: ISBN 0-250-40312-9. 0 (0). CODEN: DMRRD

Fransway, D.F.; Wagenet, R.J. (1981)

Salt release and movement in processed oil shale

Dept. Environ. Qual., Land Qual. Div., Cheyenne, WY 82002 (USA)

J Environ Qual 10 (1). 107-113. CODEN: JEVQA

ABSTRACT
Salts present as a component of processed, discarded oil shale represent a potential environmental hazard and a detrimental influence in the reestablishment of vegetation on processed shale disposal sites. The saline characteristics of Paraho processed oil shale were investigated in 2-phase series of laboratory experiments. The 1st phase studied the release of salts from 2 naturally distributed shale particle sizes packed in lysimeters constructed of plastic pipe and subjected to 5 leaching situations. All lysimeters were instrumented with a porous-cup-vacuum system that allowed periodic non-destructive sampling of soil solution with depth and time. Electrical conductivity and specific ion concentrations were measured. The 2nd phase of the experiments involved subjecting 3 particle sizes of shale to a variety of shale/water ratios. The subsequent solutions were analyzed for electrical conductivity (EC) and concentrations of Ca, Mg, Na, K, Cl and SO_4. Lysimeter experiments demonstrated the highly soluble nature of the salts present in the Paraho processed shale. These salts were primarily composed of Mg, Na and SO4 and predominately in the precipitated form, existing external to the shale. The most efficient treatments for removing salt from the upper 60 cm of the shale were those in which large (approx. 0.5 pore volumes) pulses of water were applied. To reduce EC to acceptable levels (> 4.0 mmho/cm) required application of approx. 2 pore volumes of water. Results of the batch studies indicated a proportional relationship between dilution ratios and EC on a log-log scale. Similar EC and dilution ratio relationships were observed for the cation sums. Ion analysis showed Mg and Na to be as much as 93% of total water-soluble cations and SO_4 to be the dominant anion.

Fricke, A.H.; Hennig, H.F-K.O.; Orren, M.J. (1981)

Relationship Between Oil Pollution and Psammolittoral Meiofauna Density of Two South African Beaches

Nat. Res. Inst. Oceanol., Oceanogr. Dept., Univ. Cape Town, Rondebosch, South Africa

Marine Environ. Res., Vol. 5, No. 1, pp. 59-77

ABSTRACT
The effects of stranded oil from a tanker collision off the South African coast on the meiofauna ratio and density have been monitored over a period of 1 year on two sandy beaches. The perturbation of two beaches was judged against reference beach meiofauna density behavior. In the undisturbed beach, oil deposited in sediment depressed harpacticoid copepod numbers, while numbers of nematodes stayed similar to those of the reference levels. Removal of surface sand in the mechanically disturbed beach had a greater influence on the density of animals than oil. Both beaches showed recovery after six months, but evidence of pollution by oil of unknown origin was found.

Frink, J.; Dein, F.J.; Lauer, D.M. (1982)

Rehabilitation of ruddy ducks contaminated with oil

Tri-State Bird Rescue Res. Inc., Wilmington, DE 19899, USA

J. Amer. Vet. Med. Assoc., Vol. 181, No. 11, pp. 1398-1399.

ABSTRACT
Fifty-six ruddy ducks (Oxyura jamaicencis) contaminated with No. 6 fuel oil were retrieved from the Delaware River in Philadelphia, Pa, by state and federal wildlife officials on Apr. 5-6, 1980, and were transported to rehabilitation facilities in Pennsville, Salem County, NJ. They were moderately contaminated, primarily on the breast, legs, and beak, and many apparently had ingested oil. Medical care and cleaning techniques are discussed. Triage criteria are suggested for selection of birds most likely to respond to treatment.

Frink, L.S. (1982)

A New Approach to Oiled Bird Rehabilitation after Oil Spills on the East Coast USA

Rand, P.J., ed. Land and Water Issues Related to Energy Development. Proceedings of the 4th Annual Meeting of the International Society of Petroleum Industry Biologists, Denver, CO, USA, Sept. 22-25, 1981. Pages XIX+469. (Illus.)

Tri-State Bird Rescue, Delaware Audubon Society, Inc.

Ann Arbor Science Publishers, Woburn, MA, USA; Butterworths, Ltd., Sevenoaks, Kent, England

ISBN 0-250-40538-5. 0 (0). (Recd. 1983). P257-262. CODEN: 15239

Fryberger, J.S. (1975)

Investigation and Rehabilitation of a Brine-Contaminated Aquifer

Engineering Enterprises, OK

Ground Water, Mar-Apr 75, V13, N2, P155 (6). The original document is available from Bowker.

ABSTRACT
Faulty disposal of oil field brine through an evaporation pit and through a faulty disposal well resulted in contamination of 1 sq mi of an alluvial aquifer in southwestern Arkansas. Physical parameters of the contamination are defined, and some of the chemical changes that occur as the brine moves through the aquifer are explained. Costs of rehabilitation are compared with potential benefits. Rehabilitation is not economically justified. (1 diagram, 1 graph, 2 maps, 1 table)

Fucik, K.W.; Bright, T.J.; Goodman, K.S. (1984)

Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil

Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981.

Cairns, J., Jr.; Buikema, A.L., eds. Pages 115-134.

Continental Shelf Assoc., Inc., 4850 Fairlawn Ct., Boulder, CO 80301, USA

Report Number: ISBN 0-250-40551-2

ABSTRACT
The purpose of this chapter is to provide some guidelines for rehabilitating coral reef habitats that have been impacted by oil spills. The rehabilitation process is the final step of a spill response effort that also includes actions to contain, cleanup, assess damages, and mitigate damages from a spill. Because our ability to rehabilitate damaged coral reefs is limited, this ordering of events also represents priorities for actions to be taken when a reef is threatened by oil pollution. In view of these priorities, the objectives of this chapter are threefold: to identify reef areas particularly sensitive to oil pollution incidents and to suggest means to minimize the threat of such incidents, to suggest techniques for assessing the impacts of oil pollution incidents on coral reefs and their associated communities, and to provide guidelines for rehabilitating a reef after it has been impacted by oil pollution.

Fukuda, T. (1987)

Development of the techniques for marine macrophyte (Zostera marina) bed creation. 5. Shoot distribution and surrounding conditions

Bull. Fish. Exp. Stn., Okayama Prefect, No. 2, pp. 21-26.

ABSTRACT
Surrounding conditions were surveyed in the natural eelgrass (Zostera marina) bed. Areas in which eelgrass showed perennial life history and in which eelgrass showed seasonal change and annual life history, were compared.

Galbraith, D.M. (1978)

Reclamation and Coal Exploration: Peace River Coal Block, British Columbia, Canada

Canada Dept of Mines & Petroleum Resources, British Columbia

Presented at Intl Congress for Energy & Ecosystem (Pergamon) Ecol & Coal Resource Development Conf, Grand Forks, Jun 12-16, 78, V1, P444 (3)

ABSTRACT
Coal exploration and land reclamation activities at the Pace River, British Columbia, coal block are discussed. A booklet of guidelines, containing information on relevant legislation and reclamation techniques was published as an aid to the mine operator. Field crews were stationed in the coal field to study revegetation and restoration methods. An inventory of surface disturbance was conducted through the use of aerial photographs.

Ganning, B.; Reish, D.J.; Strughan, D. (1984)

Recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spills

Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981

Dept. Zool., Univ. Stockholm, S-106 91 Stockholm, Sweden

RESTORATION OF HABITATS IMPACTED BY OIL SPILLS.

Cairns, J., Jr.; Buikema, A.L., eds. Pages 7-36

Report Number: ISBN 0-250-40551-2

ABSTRACT
The authors use a modified definition where recovery comprises the return of the ecosystem to within the limits of natural variability. Natural variability may include alternative components of the ecosystem or even a modified one, but it is a natural and functional ecosystem for the area. Restoration in this context is the return of the ecosystem to within limits of natural variability by natural and/or artificial means. Discussion of the ecological effects of oil and possible cleanup actions in different types of habitats necessitates defining the types of oil. This discussion deals with three different "main types" of petroleum: (1) heavy black oil that includes most crude oils and heavy fuel oils, (2) light refined products such as diesel and light fuel oils, gasoline, etc., and (3) the water-in-oil emulsion called mousse. This division is based largely on physical characteristics because these tend to dictate the methods of cleanup and/or restoration.

Gannon, J.E.; Danehy, R.J.; Anderson, J.W.; Merritt, G.; Bader, A.P. (1986)

The ecology of natural shoals in Lake Ontario and their importance to artificial reef development

Artificial Reefs -- Marine and Freshwater Applications

D'Idri, F.M., ed. Pages 113-139.

Int. Joint Comm., 100 Ouellette Ave., Windsor, Ont. N9A 6T3, Canada

Report Number: ISBN 0-87371-010-X

ABSTRACT
A comparison was made of the benthos and fish populations of natural cobble shoals that have considerable vertical relief in Mexico Bay with that of a flat, "patio-like" bedrock shoal surrounded by a pavement of rounded cobbles on a flat, featureless terrain off Olcott, NY. Benthos and fish were overwhelmingly more dense on the Mexico Bay shoals than on the Olcott sites. Differences in substrate conditions, depth and exposure to fetch and upwelling appear to influence colonization. A small artificial reef under construction off Olcott also began to attract fishes. In a relatively short time, indicating that coarse aggregate and even minor vertical relief will attract fishes on an otherwise flat and featureless lake bed. Creating a diversity of micro- and macro-habitats should be considered as an important design criterion in developing ecologically compatible and functional artificial reefs. (36 references)

Gehu, J.M. (1981)

Suivi phytoecologique de l'impact de la maree noire sur les pres-sales de la cote nord-armoricaine

(Phytoecological survey of the Amoco Cadiz oil spill impact in the coastal salt-meadows of northern Brittany)

Inst. Eur. Ecol., Metz, France

Publisher(s): Institut Europeen d'Ecologie, Metz (France), 43 pp.

ABSTRACT
Salt-meadows of Brittany have been surveyed over three years after the Amoco Cadiz wreck (1978). This phytoecological survey shows that none of the 76 phanerogam species and none of the 37 spermaphytic vegetal associations observed in 1977 (before the oil spill) have disappeared. But, population numbers have decreased. Ile Grande, Guisseny, and the Horn estuary were the most heavily polluted sites. When there was no cleaning treatment, the oil cover hardened, and only a few species could survive restoration can only occur when the hardened oil disappears. In the cleaned sites, humus and the plants roots were removed with the oil and no vegetation could be restored, except in brackishwater environments. Since 1981, a communities restructuration has been observed.

Getter, C.D.; Cintron, G.; Dicks, B.; Lewis, R.R., III; Seneca, E.D. (1984)

The recovery and restoration of salt marshes and mangroves following an oil spill

Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981.

Cairns, J., Jr.; Buikema, A.L., eds. Pages 65-114.

Res. Plan. Inst., Inc., 925 Gervais St., Columbia, SC 29201, USA

Report Number: ISBN 0-250-40551-2

ABSTRACT
This chapter reviews briefly those portions of these studies that are relevant to determining the effects of oil on marine wetlands. Also, the literature and our personal experiences with oiled marine wetlands are synthesized to allow an evaluation of methods of protection, cleanup, and restoration attempts that have been carried out in marine wetlands. This chapter accomplishes these two objectives by: providing a brief review of the effects of oil spills and related cleanup activities on salt marshes and mangrove ecosystems reviewing methods of protecting marine wetlands from being oiled reviewing successful means of cleaning marine wetlands following oil spills reviewing and presenting techniques that have proven successful in restoring marine wetlands damaged by oil spills and/or cleanup operations establishing a set of criteria and discussing guidelines for decisions on means of protecting susceptible areas, and for cleaning and restoring oiled marine wetlands.

Giddings, J.M. (1982)

Effects of the Water-Soluble Fraction of a Coal-Derived Oil on Pond Microcosms

ORNL

Archives Env Contam & Tox, Nov 82, V11, N6, P735 (13)

ABSTRACT
Two 80 1 pond microcosms were treated with the water-soluble fraction of a crude coal liquefaction product and responses were monitored for nine weeks. A large portion of the dominant macrophyte community was destroyed by the treatment, as were filamentous algae and benthic diatoms. Snails emigrated from the systems, and zooplankton disappeared. The microcosms recovered by the end of the experiment, but community composition and some chemical variables differed from pre-treatment conditions. (2 diagrams, 11 graphs, 22 references, 4 tables)

Giroux, J.-F. (1981)

Use of Artificial Islands by Nesting Waterfowl in Southeastern Alberta

Dept. Zool., Univ. Alberta, Edmonton, Alta T6G 2E9, Canada

J. Wildl. Manage., Vol. 45, No. 3, pp. 669-679.

ABSTRACT
From 1976 to 1978, the use of artificial islands by nesting waterfowl was investigated in southeastern Alberta. A total of 1,205 nests of 12 species of ducks and 144 nests of Canada geese (Branta canadens is) was found on 203 islands. Mallards (Anas platyrhynchos), gad walls (A. strepera), and lesser scaup (Aythya affinis) selected islands as nesting sites more than other species of ducks. The average density of ducks on the islands ranged from 1.8 to 29.1 nests/ha , with nesting success of 43-59%. Canada geese nested on 53% of the islands, with a mean of 1.35 nests/island their nesting success averaged 70%. Smaller islands, farther from shore and with greater vegetative cover, were most productive. Means of improving construction, positioning, and vegetation of islands are suggested.

Gladfelter, W.B.; Gladfelter, E.H. (1978)

Fish community structure as a function of habitat structure on West Indian patch reefs

Presented at the Simposio sobre Ciencias Marinas en las Americas San Jose (Costa Rica) 3 Jul 1977.

West Indies Lab., Fairleigh Dickinson Univ., St. Croix, US Virgin Islands 00820, USA, 26(Suppl.1), 65-84.

Rev. Biol. Trop.

ABSTRACT
The fish communities of 25 natural patch reefs in a back-reef lagoon off northeastern St. Croix, were censused visually during summer, 1976. These reefs fell into two morphologically distinct groups: those in the east were of consolidated carbonate pavement reaching to near the water surface those in the west consisted of scattered large coral heads (Porites porites and Montastrea annularis) separated by sand, and in slightly deeper water. Indices of similarity were calculated for the fish faunas of all pairs of reefs based on comparisons of abundances of all species present. The resulting matrix was used to construct a dendrogram of fish faunal similarity, which corresponded to major differences in the physical makeup of the reefs. Among structurally similar reefs, fish faunas were very similar, with forty-five species distributed uniformly among similar reefs. The majority of the remaining species were rare and local or uncommon. The distribution of some of the species could be correlated with single distinctive physical parameters of the reefs such as the presence of vertical walls, caves or the proximity to oceanic water or with biological factors such as food availability. Omnivores were most abundant, followed by herbivores, crustacean eaters, planktivores (nearly all nocturnally active species), piscivores, and species with other, specialized diets (e.g., sponges). Although the morphologically most dissimilar reefs collectively had the most dissimilar fish faunas, the overall trophic composition of the eastern and western groups of reefs was similar.

Glemarec, M.; Husenot, E. (1982)

Reponses des peuplements subtidaux a la perturbation creee par l'Amoco Cadiz dans les Abers Benoit et Wrac'h

(Response of subtidal populations to perturbations caused by the Amoco Cadiz in the Benoit and Wrac'h estuaries)

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill. Charleston, SC (USA), October 28, 1981; Brest (France), September 17, 1981.

Lab. Oceanogr. Biol., Inst. Etudes Mar., Fac Sci. et Tech., 29283 Brest Cedex, France

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission.

Gundlach, E.R.; Marchand, M., eds. Pages 191-204.

ABSTRACT
During three years after the Amoco Cadiz oil spill, the succession in time of different ecological groups with regard to excess of organic matter, allows the definition of chronological processes. First, total disappearance of sensible and tolerant species by toxicity. When pollution is stabilized, there is the appearance, development and regression of an opportunist fauna finally the excessive development of tolerant species before return to a new equilibrium. This temporal succession is studied along two different gradients of decreasing hydrodynamism, the abers, where the chemical decontamination and the biological process are not synchronized. Three years after the oil spill most communities are still perturbated and unbalanced. Patterns of temporal evolution and succession are discussed.

Glemarec, M.; Hussenot, E.; Moal, Y.Le (1982)

Utilization of biological indications in hypertrophic sedimentary areas to describe dynamic process after the Amoco Cadiz oil spill

International Symposium on Utilization of Coastal Ecosystems: Planning, Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982

Inst. Etudes Marines, Lab. Oceanogr. Biol., 29283 Brest, France

Fundacao Univ., Rio Grande (Brazil); Duke Univ. Mar. Lab., Beaufort NC (USA)

Atlantica, Vol. 5, No. 2, p. 48

Special issue. Summary only.

ABSTRACT
An ecological survey was conducted for 4 yr in the area which is the most affected by the Amoco Cadiz oil-spill, i.e., Abers Wrac'h and Benoit, to define chronological process which have been confirmed by another oil-spill two years later. The approach taken was to recognize taxonomic groups. These groups were used as biological indicators. The successive appearance of these various groups, their relative importance, and their disappearance, are the key features of this dynamic approach. This temporal succession is studied along two different gradients of decreasing hydrodynamism, the Abers, where the chemical decontamination and the biological process are not synchronized. Patterns of temporal evolution and succession are discussed. This type of analysis indicates that biological perturbations can persist within the ecosystem well beyond the time when most physical and chemical factors have apparently returned to normal.

Gomoiu, M.T. (1983)

Quelques aspects ecologiques concernant la construction de recifs artificiels dans les zones cotieres de la partie nord-ouest de la Mer Noire

(Some ecological aspects of artificial reef construction along the coasts of north-western Black Sea)

Journee d'Etudes sur les Aspects Scientifiques Concernant les Recifs Artificiels et la Mariculture Suspendue, Cannes, France, 7 Decembre 1982. Pages 113-119.

(Seminar on Scientific Aspects of Artificial Reefs and Floating Mariculture in the Mediterranean, Cannes, France, December 7, 1982)

Inst. Roumain de Rech. Mar., Constantza, Romania

ABSTRACT
The necessity of building artificial reefs in the north-western part of the Black Sea, where great ecological changes have taken place in the past fifteen years is discussed. The author considers that a fragment of the marine coastal ecosystem - lying in front of some sectors of economic or social importance - could be fitted up with man-made habitat and its quality could be improved by means of the artificial reefs. Some of the ecological benefits foreseen as a result of developing artificial reefs are summarized. (19 references)

Goodman, K.S.; Baker, J. (1982)

A preliminary ecological survey of the coastline of Abu Dhabi, United Arab Emirates

A report prepared for the Abu Dhabi Marine Operating Company (ADMA-OPCO) by BP International, Ltd., Environmental Control Centre, London. Volume 1. Text, tables and figures. Volume 2. Photographs.

Publisher(s): BP International, Ltd., London (UK), 178 pp.

ABSTRACT
In November 1980, the coastline of the United Arab Emirates was threatened by an oil spill originating from a blowout on the Hasbah 6 well offshore Saudi Arabia. At the request of the Abu Dhabi Marine Operating Company, BP International Ltd. carried out a preliminary ecological survey of the Abu Dhabi coastline. The sensitivity of the Abu Dhabi coastal biotopes to oil pollution is discussed. Sensitivities were ranked as follows: mangrove and seagrass beds - high, coral reefs and sheltered carbonate flats - medium, rocky shores and exposed sand beaches - low, blue-green algal mats - unknown. The need for coastal habitat mapping and sensitivity ranking in oil spill contingency planning is discussed and proposals for future studies including sensitivity mapping and rehabilitation of coastal habitats are presented.

Goodman, K.S.; Nunn, R.M. (1982)

The Littoral Ecology of the Area around Mongstad Refinery, Fensfjorden, Norway, 1981

An Interim Report to Rafinor A/S and Co. by BP International Limited.

Publisher(s): BP International Ltd., Brittanic House, Moor Lane, London EC2Y 9BU, UK, 63 pp.

ABSTRACT
A survey of 10 rocky shore sites was conducted in the vicinity of the Mongstad Refinery and Fensfjorden during May, 1981. The abundance and range of the major rocky shore species was noted and the size-frequency population structure of the limpet Patella vulgata was measured at 7 sites. Site 6R damaged by oil in 1975 shows good recovery although limpet recruitment is still be inhibited. Site 7R damaged by the same incident, is now almost completely recovered. Sites 8R and 9R established on rock during 1974-75 show advanced colonization but site 9R is now being affected by an oil seep. Kvernhussbekken Bay has improved since the severe damage observed in 1977 but will not completely recover until hydrocarbon pollution via the Kvernhussbekken stream ceases.

Gordon, W.G. (1986)

NMFS and Army Corps of Engineers restore fisheries habitats: A cooperative venture

U.S. Dept. Commerce, NMFS, 1825 Connecticut Ave., N.W., Washington, DC 20235, USA

Fisheries, Vol. 11, No. 5, pp. 2-7.

ABSTRACT
A pilot study was begun in the Southeast and Southwest, where scientists from NMFS regional offices and research centers and engineers and planners from the Corps' districts were to select appropriate sites with a high potential for success. New techniques for habitat restoration and generation were to be established methods for monitoring the productivity of newly generated marshes and for transplanting marsh, seagrasses, and mangroves were to be tested. A national program was to be established to provide advice and guidance on approaches and techniques for the protection, restoration and generation of habitats for marine resources to government agencies, states, conservation organizations, businesses, and private individuals.

Gordon, W.G. (1981)

Artificial Reefs and the FCMA

Proceedings of a Conference on Artificial Reefs, Daytona Beach, FL (USA), September 13, 1979.

Aska, D.Y., ed. Pages 75-77

Natl. Mar. Fish. Serv., Washington, D.C., USA

Rep. Fla. Sea Grant Program

Report Number: FSG-R-41

ABSTRACT
The Fishery Conservation and Management Act of 1976 (FCMA) mandates that U.S. fishery resources be managed to provide the greatest benefits to the Nation while maintaining the stocks. With both recreational and commercial fishing pressure increasing, innovative management thrusts are needed to meet this mandate. The construction and wise use of artificial reefs are examples of some thrusts that can help to both conserve and enhance fishery resources. Research and experience by scientists and reef builders in the United States and other countries have demonstrated the value of artificial reefs in enhancing habitat and reef fish stocks, providing additional opportunities for recreational and commercial fishermen, benefiting the economy of coastal communities and providing a means of resolving use conflicts. The use of artificial reefs is not without risk however. Many enthusiastic sport fishing clubs and other prospective reef building groups will confirm that reef construction is not an easy process. Reefs must be placed where they will not conflict with other uses of the marine environment such as commercial fishing, shipping or mineral development. Habitat improvement with artificial reefs should be well organized, coordinated and monitored by agencies or groups with technical expertise and adequate financial support.

Gore, J.A. (ed.) (1985)

The Restoration of Rivers and Streams: Theories and Experience

Butterworth Publishers, Stoneham, MA (USA)

Price: $39.95.

ABSTRACT
This book is intended to display theories, experiences, and techniques that have proven to be of good use in enhancing the recovery of damaged running water ecosystems. A wieldy volume of information cannot necessarily by comprehensive. Most of the case studies presented here emphasize large impacts from surface mining. Yet many of the same techniques can easily be applied to mitigation of impacts from highway and bridge construction and agricultural channelization. The stream manager using these works must be able to wisely employ needed measures on a site-specific basis.

Gore, J.A.; Johnson, L.S. (1979)

Biotic recovery of a reclaimed river channel after coal strip mining

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), July 16, 1979.

Wyoming Univ., Water Resour. Res. Inst., Laramie, WY 82071, USA

Gen. Tech. Rep. U.S. Dept. Agric.

US Dept. Agriculture, Fort Collins, CO (USA)

Report Number: p 239-244

ABSTRACT
A newly constructed channel of the Tongue River, reclaimed with layers of gravel and medium cobble, pine snags, bouldered rip-rap, and rubble piles, was rapidly recolonized with stream invertebrates (70 days). Fish were only found in 'snag' areas. Colonization curves predict attainment of a resident fish population in one to two years from channel opening.

Gossen, R.G.; Mann, G.J. (1979)

Environmental Considerations in the Cold Lake Project

Esso Resources Canada, Ltd., Alberta

Presented at UN Inst for Training & Research et al. Future of Heavy Crude Oils & Tar Sands 1st Intl Conf, Edmonton, Jun 4-12, 79, P729 (5). The original document is available from Bowker.

ABSTRACT
The ESSO Resources Canada, Ltd. cold lake project will recover an average of 160,000 BPD of bitumen from this oil sand deposit in Alberta. The overall objectives of the environmental management program associated with the project are outlined. Air quality, hydrology, wildlife and fisheries, archaeology, and development and reclamation issues are discussed. Use of water for the project will be minimized, and both air and water resources will be monitored.

Gourbault, N.; Helleouet, M.N.; Naim, O.; Renaud-Mornant, J. (1980)

Pollution par les hydrocarbures Amoco Cadiz

(Amoco Cadiz oil pollution)

Contract COB-MUSEUM 79 5975. Effets de la pollution sur la meiofaune de Roscoff (greve de Roscoff chenal de la riviere de Morlaix). Deuxieme annee. Premiers resultats.

[Research contract COB-MUSEUM 79/5975. Pollution effects on the meiofauna in Roscoff (Roscoff beach, Morlaix river channel). Preliminary results after two years study.]

Mus. Natl. Hist. Nat., Prog. Zool.-Vers, Paris, France

(Museum National d'Histoire Naturelle Paris, France)

Report Number: 6 pp.

ABSTRACT
Results of this pollution survey show that population numbers have been restored 2 yr after the Amoco Cadiz oil spill. All meiofauna species are present but on Roscoff beach, the mean level has lower population numbers, and in Morlaix river channel, modifications of species densities ar observed.

Gray, R.H. (1984)

Chemical and toxicological aspects of coal liquefaction and other complex mixtures

Health Environ. Res. Complex Organic Mixtures, Battelle, Pacific Northwest Lab., Richland, WA 99352

Regul Toxicol Pharmacol 4 (4). (RECD. 1985). 380-390. CODEN: RT OPD

ABSTRACT
Chemists, biologists and ecologists at Battelle's Pacific Northwest Laboratories [Washington, USA] developed a data base to aid engineers in the safe design of coal liquefaction process options. Objectives of this effort were identify and evaluate long-term health and environmental issues, evaluate options to permit environmentally acceptable design and assess risk to man and the environment from deployment of a large-scale coal liquefaction industry. Chemically complex materials produced by various coal liquefaction processes, and under various stages of process design and operating conditions, were screened for potential health and environmental effects. Biologically active materials were fractionated and rescreened. Chemical constituents of biologically active fractions were identified, and the environmental fate of problematic agents was determined. This approach, linking engineering and life sciences research was also relevant to the development of other energy technologies and industries that produced chemically complex materials. Full-boiling-range coal-derived liquids were generally more active than shale oil and petroleum crudes in biological and ecological test systems. Several biologically active agents were identified, including primary aromatic amines (PAA), polynuclear aromatic hydrocarbons (PAH) and phenols. Some components of coal-derived materials were taken up by biota and metabolized. Hydrotreating, a refining or upgrading process, reduced PAA, PAH and phenol content, and mutagenicity, carcinogenicity and toxicity of coal liquids. Selective distillation restricted PAA and PAH content and mutagenicity and carcinogenicity to high-boiling-range coal liquids. Other process conditions (i.e., extraction severity, catalyst age, etc.) and environmental factors influenced chemical characteristics and biological activity of coal-derived materials. Eliminating toxic input of coal liquids to ecological test systems resulted in partial system recovery. Biological responses to a particular chemical agent varied, depending on whether that material was presented to the organism or environment as a pure compound or in a complex mixture. Results of studies with pure compounds cannot be used alone to predict effects of complex mixtures. The research approach provided guidance to solve environmental problems before regulatory agencies required limitations or facility construction was completed, and costs of process changes were higher. This prospective strategy can be applied to the development of any technology or the environmentally safe utilization of any resource.

Greenberg, D.; Hellman, R.A. (1978)

Israel in the Mediterranean ecosystem

Presented at the Conference of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea, Monaco (Monaco), January 9, 1978.

Publisher(s): Environ. Protect. Serv., Jerusalem, Israel

Report Number: 70 pp.

ABSTRACT
Environmental problems from ships include oil and chemical pollution from discharges of contaminated ballast, bilge or cleaning water en route, or from spills during such routine operations as loading, or due to collision or grounding. Dumping at sea, dredging and offshore platforms, however, are not yet significant factors in Israeli waters. Threats from sources on land include municipal and industrial discharges through outfalls, drainage channels and intermittent streams of such pollutants as nutrients, salts, phenols, acids, waste oils, toxic chemicals and heavy metals. In addition, intensive agriculture contributes surface runoff of sediment, pesticides and fertilizers. Thermal and radioactive discharges, not yet a significant factor, may result from future powerplants on the Israeli coast. Pollution from sources on land are being prevented or abated and their effects mitigated through the following measures. All major streams flowing to the Mediterranean are monitored at least four times annually, and some, like the Yarkon monthly, for key pollutant parameters. Enforcement follows inspection reports of pollution. Beach water quality is tested and, if need be, beaches are closed to bathers to protect health. Sea outfalls are being eliminated progressively as the National Sewage Project, and particularly the Dan Region Project for the Tel Aviv metropolitan area, will provide sewerage, treatment to a high level and reuse, of virtually all urban wastewater. The Israeli contribution to Mediterranean environmental studies includes projects by seven research institutions as part of the Coordinated Mediterranean Pollution Monitoring and Research Program (MED POL).

Griffiths, W.B.; Dillinger, R.E. (1981)

Beaufort Sea Barrier Island-Lagoon Ecological Process Studies: Final Report, Simpson Lagoon, Part 5 - Invertebrates

LGL Limited, Sidney, British Columbia (Canada)

Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Volume 8: Biological Studies.

Publisher(s): NOAA/OMPA, Boulder, CO (USA), Vol. 8, pp. 1-198

Report Number: NOAA-OMPA-FR-80-8

ABSTRACT
Invertebrate investigations were conducted in the Simpson Lagoon area on the Alaskan Beaufort Sea coast during the open-water seasons of 1977 and 1978 and during the winter of 1978-1979. The research concentrated on those organisms identified as important food items for animals at high trophic levels. The main objective of the research was to study the seasonal and habitat distributions, abundances and biomasses, and life histories of these important invertebrates. Results of these studies showed that mysids and amphipods were among the most abundant invertebrates in Simpson Lagoon in summer, in terms of numbers and biomass, and also were the most common foods of key species of birds and fish that used the lagoon in summer. Construction of causeways or other structures that would block important movements of these invertebrates, particularly those movements between the lagoon and offshore areas, are likely to be detrimental. Likewise, invertebrates could be adversely affected by oil in the water-column or (probably more critical to epibenthos) by oil on and in bottom substrates. Previous investigations have shown that responses of epibenthic invertebrates to oil are highly variable, but that adverse effects occur under some circumstances. Adverse impacts of blockage of critical migration routes or of oil on invertebrates might indirectly affect the fish and birds that depend on those invertebrates for food. (213 references

Grove, R.S. (1982)

Artificial reefs as a resource management option for siting coastal power stations in southern California

Res. Dev. Div., Southern California Edison Co., Rosemead, CA 91770, USA

Mar. Fish. Rev., Vol. 44, No. 6-7, pp. 24-27

ABSTRACT
The Pendleton Artificial Reef project has demonstrated in its 1 year of existence that biological activity has followed an orderly succession to an apparently stable system that directly supports an enhanced fishery. The objectives of the Pendleton Artificial Reef and the continuing reef management study remain to establish a stable kelp bed on a manmade reef, to document the environmental stability and standing fisheries crop of the reef, and to determine the size and design criteria of structural habitat modifications that will selectively enhance desired marine resources in southern California. It is further hoped that this effort will lead to advances in artificial reef technology and marine resource management in coastal waters.

Grove, R.S.; Yuge, J.E.; Sonu, C. (1983)

Artificial reef technology: A strategy for active impact mitigation

Proceedings of Oceans '83: Effective Use of the Sea – An Update, San Francisco, CA, August 29 - September 1, 1983. Volume 2: Technical Papers. Mineral Resources and Energy, Non-Mineral Resources, Transportation. Pages 951-956.

Southern California Edison Co., P.O. Box 800, Rosemead, CA 91770, USA

Report Number: IEEE-83CH1972-9

ABSTRACT
Southern California Edison Company's artificial reef research program has stemmed from the updated vision of resource management in which the goal is a net gain in the quality of the environment. By adding a new habitat, the artificial reef will help enhance the marine environment through increased production of biomass, a compensating factor for using once-through cooling water for coastal power plants and also for siting power plants on the coast in general. By locating the reefs in naturally impoverished areas such as flat, sandy nearshore regions, fish and other marine biota may be attracted to it. Thus, in addition to producing biomass, this technique could be used to possibly better manage existing marine resources.

Grula, M.M.; Grula, E.A. (1983)

Biodegradation of materials used in enhanced oil recovery

Final report, July 1, 1978, to November 30, 1981

Oklahoma State Univ., Stillwater, OK 74074, USA

NTIS, Springfield, VA (USA)

ABSTRACT
Although the importing of oil by the United States has declined in the last two years, there is still a great deal of interest in enhanced oil recovery (EOR) from domestic oil fields. At least two of the technologies used in EOR, viz., polymer flooding and micellar-polymer flooding, involve the use of chemical agents. With the prospect of substantially increased application of such agents in enhanced recovery operations in the future, it is important to have information on the potential environmental impact of their heavy or widespread use. A major environmental impact could result from spills occurring during the transportation, preparation of solutions, storage, or handling of the chemicals. The degree of this impact would be largely a reflection of the ability of soil microflora to degrade the chemicals used for EOR. Failure of degradation within a reasonable time could result in toxicity for microbes, plants, or even animals, thus leading to environmental deterioration. The goals of this work are: (1) to obtain information on biodegradability of various chemicals used in EOR technologies under conditions similar to those found in the field; (2) to determine toxicities of EOR chemicals for a representative group of bacteria; (3) to determine the effects of environmental parameters on readiness of biodegradation; and (4) in the case of mixtures, to determine the relative rates of degradation of various components.

Gudin, C.; Syratt, W.J. (1975)

Biological Aspects of Land Rehabilitation Following Hydrocarbon Contamination

Env. Pollution, V8, N2, P107 (6)

ABSTRACT
The incorporation of hydrocarbon material into soil causes an increase in microbial oxygen uptake. Competition between microorganisms and higher plants for available soil nitrogen also occurs. Members of the Leguminosae at 15 oil-contaminated sites are abundant, possibly due to the nitrogen-fixing symbiotic relationship with Rhizobium spp. Rehabilitation of oil spill sites should include aeration of soil, addition of nitrogen, and seeding with leguminous species. (17 references, 4 tables)

Guiney, P.D.; Sykora, J.L.; Keleti, G. (1987)

Environmental impact of an aviation kerosene spill on stream water quality in Cambria County, Pennsylvania, USA

S.C. Johnson and Son, Inc., Safety Health Environ., 1525 Howe St., Racine, WI 53403-5011.

Environ Toxicol Chem 6 (12). 977-988. CODEN: ETOCD

ABSTRACT
A comprehensive survey of a small Cambria County, Pennsylvania, watershed contaminated by a British Petroleum aviation kerosene leak was conducted from 9 November 1982 until 20 December 1983. The biological data showed evidence of a rapid recolonization process by benthic macroinvertebrates that began at the last two downstream stations shortly after the spill. The recovery at stations located immediately below the spill was delayed because few organisms for repopulation were present in the clean, upstream section and because a drought eliminated most of the biota in the immediate headwaters during 1983. Measurements of species diversity of benthic invertebrates showed that most of the stations in the contaminated sections recovered between June and October 1983. Short-term in situ toxicity bioassays conducted with brook trout in April 1983 showed that the stream was again suitable for restocking with trout. In addition, a fish electroshocking program in May and October 1983 clearly demonstrated that the contaminated sections of the stream had recovered and again supported a diverse fish population, including trout and young-of-the-year minnows and sunfish. The results of chemical analyses and biochemical oxygen demand measurements indicated that the water quality in the contaminated section recovered between 30 November and 14 December 1982. The major factors that accelerated the recolonization process in the contaminated watershed were (a) immediate and effective cleanup activities; (b) a plentiful source of unpolluted dilution water; (c) the drift of benthic organisms available for recolonization; and (d) the immigration of fish from the unpolluted sections of the watershed.

Gumtz, G.D. (1972)

Restoration of Beaches Contaminated by Oil

Env Protect Techn Series 15080 EOTEPA USGPO Sep 72 (138). The original document is available from Bowker.

Gundlach, E.R.; Marchand, M. (eds.); Glemarec, M.; Husenot, E. (1982)

Reponses des peuplements subtidaux a la perturbation creee par l'Amoco Cadiz dans les Abers Benoit et Wrac'h

(Response of subtidal populations to perturbations caused by the Amoco Cadiz in the Benoit and Wrac'h estuaries)

Lab. Oceanogr. Biol., Inst. Etudes Mar., Fac Sci. et Tech., 29283 Brest Cedex, France

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill. Charleston, SC (USA), October 28, 1981; Brest (France) September 17, 1981.

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Pages 191-204.

Joint NOAA/CNEXO Scientific Commission, Washington, DC (USA)

ABSTRACT
During three years after the Amoco Cadiz oil spill, the succession in time of different ecological groups with regard to excess of organic matter, allows the definition of chronological processes. First, total disappearance of sensible and tolerant species by toxicity. When pollution is stabilized, there is the appearance, development and regression of an opportunist fauna; finally the excessive development of tolerant species before return to a new equilibrium. This temporal succession is studied along two different gradients of decreasing hydrodynamism, the abers, where the chemical decontamination and the biological process are not synchronized. Three years after the oil spill most communities are still perturbated and unbalanced. Patterns of temporal evolution and succession are discussed.

Gundlach, E.R.; Marchand, M. (eds.); Bodin, P.; Boucher, D. (1982)

Evolution a moyen-terme du meiobenthos et du microphytobenthos sur quelques plages touchees par la maree noire de l'Amoco-Cadiz

(Mid-term evolution of meiobenthos and microphytobenthos on beaches touched by the Amoco Cadiz oil spill)

Univ. Bretagne Occidentale, Lab., Oceanogr. Biol., 6 Ave Le Gorgeu, 29283 Brest Cedex, France

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill. Charleston, SC (USA), October 28, 1981; Brest (France) September 17, 1981.

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Pages 245-268.

Joint NOAA/CNEXO Scientific Commission, Washington, DC (USA)

ABSTRACT
The ecological follow-up undertaken after the Amoco Cadiz oil spill, on the beaches Brouennou and Corn ar Gazel (mouth of Aber Benoit) and Kersaint (near Portsall), was continued until November 1980. Chlorophyll pigments have suffered little quantitatively from the direct effect of pollution, but the study of temporal variations in the meiofaunal densities revealed disturbances in seasonal cycles. Other factors, e.g., hydrodynamic fluctuations and macrofaunal predators, could act as regulating mechanisms on the evolution of the populations. The effects of pollution are particularly obvious in some faunistic imbalances, as the study of harpacticoid copepods showed. However, particular evolutionary trends between and within ecological groups of species implied that recovery was nearly complete, at least on exposed beaches. The conclusions drawn to date are tentative because of the lack of reference data, and it is intended to continue the survey annually in spring.

Gundlach, E.R.; Marchand, M. (eds.); Levasseur, J.E.; Jory, M.L. (1982)

Retablissement naturel d'une vegetation de marais maritimes alteree par les hydrocarbures de l'Amoco Cadiz: Modalites et tendances

(Natural recovery of salt-marsh vegetation destroyed by the Amoco Cadiz oil spill: Circumstances and tendencies)

Lab. Bot. Gen., Campus Sci. Beaulieu, 35042-Rennes Cedex, France

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill. Charleston, SC (USA), October 28, 1981; Brest (France) September 17, 1981.

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Pages 329-362.

Joint NOAA/CNEXO Scientific Commission, Washington, DC (USA)

ABSTRACT
Recovery of Ile Grande salt-marsh vegetation (Spartina maritima, Salicorina perennis, Halimione portulacoides, Pucinella maritima , and Juncus maritimus) partially destroyed by hydrocarbons has been significantly started up since 1980. Ways and timing of recovery are due to the relative dominance, in each point, of two processes, viz. in situ regeneration of perennial individuals and germination of seeds produced near or on the site. Colonization is mainly due to annual species while germination of perennials is a rare event, except in shady places with loose and clean substrate. However, it is impeded either in tide exposed points or in formerly heavily trampled places.

Hameedi, M.J. (1980)

Kodiak marine environment and planned petroleum development

Outer Continental Shelf Environmental Assessment Program Off., Kodiak Lease Area, AK, USA

Environmental assessment of the Alaskan continental shelf. Kodiak interim synthesis report 1980.

Science Applications, Inc. Boulder, CO (USA)

Report Number: pp. 267-287

ABSTRACT
The continental shelf east of the Kodiak Archipelago has been selected for the exploration and development of petroleum resources (OCS Sale No.46). The Kodiak Archipelago and adjacent shelf waters are noted for high biological productivity, a number of unique habitats, and the seasonal occurrence of some endangered species of whales. The entire coastline is described as highly vulnerable to damage from spilled oil. OCSEAP studies have resulted in an extensive data base. Four major environmental issues have been identified and form the core of the studies program: impact on commercial fisheries, geological hazards, contaminant transport, and protection of the regional biota and important habitats. These issues, along with other pertinent environmental implications of planned petroleum development, must be addressed and the problems resolved or mitigated in order to guide petroleum development in this area in a manner that is environmentally safe and minimizes conflicts among users of the resources.

Hampson, G.R.; Moul, E.T. (1977)

Salt marsh grasses and N2 fuel oil

WHOI, Biology Dept., Main St., Woods Hole, MA 02543

Oceanus 20(4), 25-30, Coden: OCEAAK

ABSTRACT
The marsh grass community in a small cove in Massachusetts that was affected by spilled oil from a barge in Oct. 1974 has shown a progressive resistance to reestablish itself over the last 3 yr. The sediments in some areas around the marsh grass roots contain high concentrations of petroleum hydrocarbons, which have impregnated the peat substrate. Erosion rates over the 3 yr period have been 24 times greater than those at a nearby control site. A 4 yr analysis of a fuel oil spill in a freshwater mass off Mill River in Northampton, Massachusetts, showed similar results. Of 45 total plant species found before the spill, 18 were absent the following season. Perennial species were less affected than annuals. In the marine intertidal zone, a wider vertical area between low and high water was accessible to direct exposure to oil, whereas in the river, the oil was restricted to a smaller area due to the absence of tidal exchange. (FT) (illustrations, references, summary)

Hampson, G.R.; Moul, E.T. (1978)

No. 2 fuel oil spill in Bourne, Massachusetts: immediate assessment of the effects on marine invertebrates and a 3-year study of growth and recovery of a salt marsh

Presented at a Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977.

Woods Hole Oceanogr. Inst., Woods Hole, MA 02543, USA

J. Fish. Res. Board Can., 35(5), 731-744.

ABSTRACT
On October 9, 1974 the oil barge Bouchard 65 loaded with 73 000 barrels of oil spilled what was initially thought by the Coast Guard to be a few barrels and later raised to an undetermined amount of No. 2 fuel oil off the west entrance of the Cape Cod Canal in Buzzards Bay, Massachusetts. Within the following 2-wk period, oil from the barge was found contained along the west side of Bassett's Island and inner Red Brook Harbor, a distance of 5.0 km from the site of the spillage. Qualitative samples of dead and moribund marine invertebrates were collected in tide pools and slight depressions along the beaches. A collection consisting of 4360 invertebrates comprising 105 species, plus 2 species of fish were found in 8 samples. Noticeable effects of the oil on the salt-marsh plant community were also observed. A detailed quantitative examination was begun to determine the effects of the oil on various components of the affected salt-marsh community in Winsor Cove compared to a selected control site. From data collected in September 1977, the marsh grass in the lower intertidal zone in Winsor Cove has shown an inability to reestablish itself by either reseeding or rhizome growth. The associated sediments show a correspondingly high concentration of petroleum hydrocarbons impregnated in the peat substrate. Erosion rates measured in the affected area, as a result of the 3-yr period of marsh degeneration, were 24 times greater than the control site. Microscopic algae were collected during the sampling period and those present were considered least sensitive to environmental changes. Examination of the interstitial fauna found in the study area in the summer of 1977 showed an extremely reduced number of individuals and species.

Hann, R.W., Jr. (1977)

Fate of oil from the supertanker Metula

Presented at the Oil Spill Conference, New Orleans, LA (USA), March 8, 1977.

Texas A&M Univ., Cent. Mar. Resour., College Station, TX 77840, USA

Publisher(s): American Petroleum Inst., Washington, DC (USA). Pages 465-468.

Report Number: API-Publ --4284

ABSTRACT
The oil from the Metula spill is disappearing at varying rates at different locations on Tierra del Fuego. The exposed coastline is hiding or dissipating the oil into the sea by wave turbulence, blowing sand, and deeper penetration into the beach. Beach detritus such as oiled kelp and kelp holdfasts, lumber and trash will probably be the longest lived evidence of the spill. In the estuaries and protected areas, the rate of change is much slower and confined to the aging and hardening of the oil by air exposure and deeper penetration into the sediments. Removal is evident only where greatest energy is exerted, in high velocity flowing channels and exposed beach top areas. Some oiled birds still are in evidence. Salicornia is beginning to recover and grow through some oil deposits where previous stalks were present. The magnitude of the Metula spill coupled with the absence of any cleanup activity has made the spill serve a valuable role as a test system for observing recovery from a major oil spill in a cool climate.

Hannah, R. (1981)

Resource protection measures

NOAA, Off. Mar. Pollut. Assess., Bay St. Louis, MS, USA

NOAA Spec. Rep.

The IXTOC 1 Oil Spill: The Federal Scientific Response

Hooper, C.H., ed.

Publisher(s): NOAA/OMPA, Boulder, CO (USA), pp. 105-118

Report Number: NOAA-SR-HMRP-1981

ABSTRACT
The blowout of the IXTOC 1 well in the Bay of Campeche created a unique spill situation, since the time between the initial blowout and the subsequent impact of U.S. waters was approximately two months. This allowed a protracted period that is not usually available in spill situations to plan and prepare the response. The Scientific Support Team working with the U.S. Coast Guard began to formulate a spill mitigation plan for the south Texas area, while preparing for possible oil impact of the central and north Texas coasts. The primary objective of the oil spill response team was to keep the oil from entering the lagoons and bays, to collect oil at sea, and to remove oil from the beaches. The major areas for which mitigation strategies had to be developed included: (1) sensitive areas, both environmental and socioeconomic (2) commercial fishery (3) birds, marine mammals, and turtles (4) beach cleanup (5) dispersants (6) disposal of oil materials. Each of these subjects are discussed in this chapter as well as conclusions on the success of these operations.

Hann, R.W., Jr.; Rice, L.; Trujillo, M-C.; Young, H.N., Jr. (1978)

Oil spill cleanup activities

Texas A and M Univ., College Station, TX, USA

In: The Amoco Cadiz oil spill - A preliminary scientific report.

Hess, W.N., ed.

Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA); Environmental Protection Agency, Narragansett, RI (USA)

NOAA/EPA Special report.

Report Number: p 229-275

ABSTRACT
The oil spill from the supertanker Amoco Cadiz off the Brittany Coast of France overshadows by far any other spill into the marine environment. In terms of oil reaching the shore, it was on the order of four times the amount of the Torrey Canyon spill in the same general geographic area or the Metula spill in the Straits of Magellan. As a result, the spill and the subsequent activities to clean up the oil and mitigate damage provided a fascinating laboratory for those interested in institutional structure, planning, resource requirements, technology and training to deal with disasters of this magnitude. The physical properties, behavior, and movement of the oil and its ultimate deposition on the beaches is discussed in detail. The organizational structure established to deal with the spill and the strategy of control that appears to have been followed are presented and evaluated with regard to their utility in other spills. In addition the processes and unit operations used on the beaches are discussed. Estimates of the manpower and equipment used at different times throughout the spill are based on extensive reviews of newspaper reports and daily pollution reports issued by the Department of Equipment. The final section discusses what has been learned from this experience.

Hansen, K.; Vestergaard, P. (1986)

Initial establishment of vegetation in a man-made coastal area in Denmark

Dept. Bot., R. Vet. and Agric. Univ., Rolighedsvej 23, DK-1958 Copenhagen V, Denmark

Nord. J. Bot., Vol. 6, No. 4, pp. 479-495

ABSTRACT
A man-made coastal area (8 km long, 300 m wide), constructed from seed-free, marine sand was investigated from 1978 to 1983 as regards relief, soil properties, and establishment of vegetation. The following developments were apparent: The outer shore zone changed from a Cakile -dominated vegetation to a sparse and less diverse vegetation. The inner shore zone maintained spontaneous Ammophila as dominant and developed into a mobile dune with changing species. The outer dune slope with planted Ammophila developed into a mobile dune dominated by vigorous Ammophila. The dune zone with planted Ammophila : The outer part developed towards a somewhat fixed dune with increasing diversity. The inner part developed into a diverse and more fixed dune community with mainly Festuca rubra .

Hartstein, A.M.; Pawlowski, L.; Alaerts, G.; Lacy, W.J. (eds.) (1986)

State-of-the-art of the fossil fuel issue in the environment

Off. Oil, Gas and Shale Technol., U.S. Dept. Energy, USA

Proceedings of the 5th International Conference on Chemistry for Protection of the Environment, Leuven (Belgium), 9-13 Sep 1985, pp. 679-689

Elsevier Science Publishers, Amsterdam (Netherlands)

Studies in Environmental Science 29

ABSTRACT
Energy production from fossil fuels through both conventional and newer processes will have immediate and long-term effects on the environment in which we live. The exploitation, handling, and usage of our natural hydrocarbon resources, thus, requires that we understand and mitigate to the extent possible the small and large scale environmental problems associated with these applications. Fossil energy issues associated with the newer and more technologically advanced processes for recovering and utilizing these resources in an environmentally acceptable manner are the focus of these remarks. Problem areas and phenomena related to the use of these technologies is discussed in terms of state-of-the-art techniques and treatment processes for mitigating environmental concerns. Of primary interest are the environmental research activities supported through the Office of Oil, Gas, and Shale Technology, U.S. Department of Energy.

Hassler, R.A.; Klein, D.A.; Meglen, R.R. (1984)

Microbial contributions to soluble and volatile arsenic dynamics in retorted soil shale

Dept. Microbiol., Colorado State Univ., Fort Collins

J. Environ. Qual. 13 (3). 466-470. CODEN: JEVQA

ABSTRACT
As volatilization and solubilization from samples of Paraho and Lurgi retorted shale were evaluated with and without added soybean meal [Glycine max (L.) Merr.], dimethylarsinic acid (DMAA), methanearsonic acid (MAA), and sodium arsenate (SA) in 12-wk experiments. Using a Paraho process shale from an experimental reclamation site in western Colorado [USA], As was only volatilized when nutrients were present, using 23° C incubation. Organic As forms added at 267 x 10^6 mol As kg^{-1} shale tended to remain more in solution, and were volatilized to a greater extent (45.7 and 6.4 x 10^6 mol kg^{-1} shale as DMAA and MAA, respectively) than observed with less soluble SA or innate As. Soluble As dynamics were also influenced by nutrient availability. With added DMAA, soluble As levels decreased over the course of the experiment, and decreases followed by rerelease were observed with MAA and SA. The low initial levels of soluble innate As increased slightly over the course of the experiment. In contrast, without nutrients present, other than with added DMAA, the soluble As levels decreased. Incubation at 45° C resulted in a marked reduction of As mobilization, and after heat sterilization, no As mobilization could be observed. Addition of an unsterilized shale inoculum led to a reestablishment of these As mobilization processes in the sterilized samples. In addition, As mobilization was inhibited under anaerobic conditions. With a sample of Lurgi process shale, mobilization in the presence of nutrients was observed, but As volatilization could not be detected, suggesting that variations in oil shale sources and retorting may influence microbial As mobilization. Measurable amounts of As can be mobilized from some retorted shale samples, if nutrients are available and environmental conditions allow these processes to occur.

Hersham, M.J.; Ruotsala, A.A. (1978)

Implementing environmental mitigation policies

Presented at Coastal Zone '78: Symposium on Technical, Environmental, Socioeconomic and Regulatory Aspects of Coastal Zone Management, San Francisco, CA (USA), March 14-16, 1978.

Washington Univ., Inst. Mar. Stud., Seattle, WA 98105, USA

American Society of Civil Engineers, New York, Vol. 2, pp. 1333-1345

ABSTRACT
Mitigation is one dimension of environmental regulation that is receiving increasing attention. Mitigation refers to the requirement of regulatory agencies that the developer modify his project to reduce environmental harm or supply environmental resources to offset unavoidable losses. Mitigation policies developing at the federal and state level have been applied to dredge and fill projects in the nation's estuaries and thus are of interest to coastal zone planners and managers. This paper explores current mitigation policies found in federal statutes and the state coastal programs of California, Oregon and Washington. Examples are presented of mitigation practices stemming from these policies, which have arisen in west coast states. Ways to improve mitigation practices are suggested which would help overcome current implementation problems.

Hershner, C.; Moore, K. (1977?)

Effects of the Chesapeake Bay oil spill on salt marshes of the lower bay

Virginia Inst. of Marine Science, Gloucester Pt., VA 23062

1977 Oil Spill Conference New Orleans, LA, Mar. 8-10, 1977

American Petroleum Institute Publication 4284, pp. 529-533

ABSTRACT
A study to determine the effects of the Chesapeake Bay oil spill of Feb. 1976 and of the subsequent cleanup operations was conducted on the eastern shore of the bay. The primary objective was to assess the biological impact on the marshes at the population level. Populations of intertidal mussels, Modiolus demissus, and oysters, Crassostrea virginica, showed no significant short-term effects. The population of the snail, Littorina irrorata, was significantly reduced, but appears to be recovering well. The dominant marsh grass, Spartina alterniflora, showed increased productivity as measured by standing crop, increased density, decreased mean height, and increased flowering success. Hypotheses to explain these observations are discussed. The impact of the spill on the marshes is thought to have been minimized by virtue of the relatively low toxicity of the oil, the time of year the spill occurred, and the comparatively high energy environment of the shoreline. (AA) (illustrations, references, abstract)

Hersman, L.E.; Klein, D.A. (1979)

Restored oil shale effects on soil microbiological characteristics

Colorado State University

J Env Quality, Oct-Dec 79, V8, N4, P520 (5)

ABSTRACT
The effects of retorted oil shale additions on the microbial characteristics of surface soils were studied. Key microbial parameters considered were nitrogen fixation, dehydrogenase activity, oxygen utilization rates, glucose mineralization rates, ATP concentrations, and bacteria, actinomycetes, and fungi counts. Of all parameters measured, nitrogen fixation was most affected by soils containing 10% oil shale. Sufficient surface soil should be used to cover retorted oil shales to allow development and functioning of a diverse vegetation/microbial community in areas disturbed by oil shale processing. Experimental data should be of value in establishing guidelines for revegetation practices in areas disturbed by oil shale processing.
(6 graphs, 18 references, 2 tables)

Heubeck, M. (1979)

A report to SOTEAG on monitoring counts of seabirds and waterfowl in 2 areas of North Shetland, winter 1978-79

Shetland Oil Terminal Environmental Advisory Group (UK)

Report Number: 57 p

ABSTRACT
Results of monthly counts of seabirds and waterfowl in 2 areas of North Shetland, carried out during the winter 1978-79, are presented in this report. The areas studied were the Yell/Hascosay/Unst/Fetlar area and the Sullom Voe area. The birds recorded included the Great Northern Diver, Red-throated Diver, Gannet, Cormorant, Shag, Mallard, Eider, Velvet Scoter, Red-breasted Merganser, Long-tailed Duck, Guillemot, Razorbill, Puffin and Tystie. Surveys such as this are useful to assess the damage caused by oil spills which have or are likely to occur in the vicinity of the oil terminal at Sullom Voe, and to monitor the recovery of species.

Higo, N.; Nagashima, M. (1978)

On the fish gathering effect of the artificial reefs ascertained by the diving observation 2. At the sea of the Satsuma Peninsula in Kagoshima Prefecture

Lab. Fish. Gear, Fac. Fish., Kagoshima Univ., Kagoshima, Japan

Mem. Fac. Fish. Kagoshima Univ., 27(1), 117-130

ABSTRACT
Diving observations were carried out on 3 kinds of artificial reef (stone, concrete block and sunken boat construction) around the Satsuma Peninsula. Information was obtained concerning the influence of reef depth, contour of the reef surface, closeness of the building components, and the kinds of fish associated with the reefs. Different characteristics were encountered between the types of artificial reef, but in each case fish concentrated near surfaces abundant in fissures and convolutions. The urchin Diadema setosum was the attached organism most in evidence, while the cardinal fish Apogon semilineatus was a common small fish.

Holmes, W.N.; Cavanaugh, K.P.; Cronshaw, J. (1978)

The effects of ingested petroleum on oviposition and some aspects of reproduction in experimental colonies of mallard ducks (Anas platyrhynchos)

Dept. Biol. Sci., Univ. California, Santa Barbara, CA 93106, USA

J. Reprod. Fertil., 54(2), 335-347

ABSTRACT
Compared to unmated mallard ducks fed an uncontaminated diet, unmated birds given food contaminated with 3 ml South Louisiana crude oil per 100 g dry weight showed an 84% decline in the daily rate of oviposition, a 33% decrease in egg-shell thickness and at autopsy more than 82% of the ovarian mass consisted of atretic follicles. Similar studies on groups of mated females showed that although the addition of 1 ml South Louisiana crude oil/100 g dry food suppressed the daily rate of oviposition significantly. Less than 25% of these eggs had been fertilized and only 40% of the fertilized eggs yielded viable ducklings. In both of these groups of mated birds, normal patterns of oviposition, fertilization and hatchability were restored after removal of petroleum from the diet. The addition of 1 ml Kuwait crude oil/100 g dry food had no effect on the rate of oviposition, the incidence of fertility or the hatchability of the fertilized eggs. The addition of 3 ml oil/100 g dry food completely abolished oviposition, but a normal rate of oviposition was restored when the concentration of the crude oil was reduced from 3 to 1 ml/100 g dry food. However, the incidence of fertilization remained low and none of the fertilized eggs gave rise to viable ducklings. Kuwait crude oil had no effect on shell thickness.

Holmes, W.N.; Cronshaw, J.; Cavanaugh, K.P. (1978)

The effects of ingested petroleum on laying in mallard ducks (Anas platyrhynchos)

In: Proceedings of the Energy/Environment '78: A Symposium on Energy Development Impacts, Los Angeles (USA), 22 Aug 1978.

California Univ., Biol. Sci .Dept., Santa Barbara, CA 93106, USA

Lindstedt-Siva, J., ed. Pages 301-309

Society of Petroleum Industry Biologists Los Angeles (USA)

ABSTRACT
Mallard ducks given food containing 3% South Louisiana crude oil showed an 80% decline in the mean daily rate of laying, a 33% decrease in eggshell thickness and more than 80% of the developing eggs in the ovaries were degenerate. Among mated birds, the incidence of fertilization declined to 25% of normal and only 40% of these eggs yielded viable ducklings this compared to a normal hatchability of 88%. Although food containing 1% South Louisiana crude oil had no effect on the mean daily rate of laying, none of the eggs had been fertilized and their shell thicknesses were 19% below normal. When 1% Kuwait oil was added to the food the rate of laying, fertilization and hatchability and the shell thicknesses of the eggs remained unchanged but the presence of 3% Kuwait crude oil completely abolished laying reduction of the concentration to 1%, however, restored each of these parameters to normal.

Hooper, C.H. (1981)

The IXTOC 1 oil spill: The federal scientific response

Office of Marine Pollution Assessment, Boulder, CO (USA).

NOAA Spec. Rep.

Publisher(s): NOAA/OMPA, Boulder, CO (USA), 207 pp.

Report Number: NOAA-SR-HMRP-1981

ABSTRACT
On 3 June 1979, a Petroleos Mexicanos (PEMEX) exploratory well, IXTOC 1, blew out in the Bay of Campeche, about 80 km northwest of Ciudad del Carmen, Mexico. The spill, not brought under control until 27 March 1980, became the largest oil spill in history. During the IXTOC 1 spill more than 200 scientists from a number of Federal and State agencies, academic institutions, and private companies were marshalled to forecast the trajectory of the spilled oil and to give advice on beach processes, danger to living resources, and changing composition and toxic qualities of the petroleum over the several months that much of the oil remained at sea. The primary purpose of the physical, chemical, and biological activities described herein was to provide the Federal On-Scene Coordinator (OSC) with timely information concerning the location, toxicity, and potential ecological impact of the oil on the Texas coastline so that mitigation measures could be initiated. These studies did not constitute a comprehensive damage assessment program.

Horner, R.A. (1978)

Beaufort Sea plankton studies

Seattle, WA, USA

In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1978. Volume 5, receptors--fish, littoral, benthos.

Publisher(s): US Environmental Research Laboratories, Boulder, CO. Outer Continental Shelf Environmental Assessment Program

Report Number: p 85-142

ABSTRACT
The objectives of this project are to assess the density distribution and environmental requirements of zooplankton and ichthyoplankton in an array of samples of opportunity and to measure phytoplankton activity. Only a few studies have been done on the effects of oil on truly Arctic species and on species that contribute measurably to the Arctic marine ecosystem. Potential dangers to the plankton community include reduced primary productivity and possible changes in species composition of the phytoplankton community that might cause changes in zooplankton diversity and therefore affect higher trophic levels. Slow growth and low reproductive rates in the Arctic mean slow recovery following an oil spill. Some life cycle stages, especially larvae, are more susceptible to pollutants than other stages. Thus, if both adults and larvae are destroyed and recruitment from adjacent areas is slow, reestablishment of a community may take considerably longer than in a temperate region. Physical changes in the environment will also affect the organisms living in the Beaufort Sea. Construction of causeways and artificial islands and dredging of channels will change circulation patterns which could affect nutrient supplies and migration and recruitment patterns. Whether these changes will be harmful or beneficial is not known.

Howe, J.R. (1989)

Alaska Disaster

Defenders, V64, N3, P20(10). The original document is available from Bowker.

ABSTRACT
The 10 million gallons of crude oil spilled by the grounded Exxon Valdez tanker in Prince William Sound, AK, on March 24, 1989, have taken a heavy toll on birds, sea otters, and other wildlife in the region. The oil spill has impacted one of the least sullied marine expanses in the us, reaching into the Gulf of Alaska. A series of photographs depicts the enormity and tragedy of the event, and the scale of the cleanup effort awaiting those involved. (1 map, 14 photos)

Hueckel, G.J.; Buckley, R.M. (1986)

The mitigation potential of artificial reefs in Puget Sound, Washington

Oceans '86 Conference Record: Science-Engineering-Adventure, Vol. 2. Data Management, Instrumentation and Economics, Washington, DC (USA), 23-25 Sep 1986, pp. 542-546.

Washington State Dept. Fish., 115 Gen. Adm. Build., Olympia, WA 98504, USA

Oceans '86

Report Number: IEEE-86CH2363-0

ABSTRACT
In Puget Sound, Washington, artificial reefs are being studied to determine their potential to replicate productive rocky bottom habitat. The colonization of fish, invertebrates, and algae was documented on 11 artificial reefs during the first two reef years. All 11 reefs experienced similar colonization processes which resulted in common species assemblages. Physical and biological parameters of productive rocky bottom habitats are used to determine potential biological production at sites which are deficient of rocky substrates.

Hunt, L.J. (1979)

Use of dredged material disposal in mitigation

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979.

US Army Corps of Engineers, Waterways Exp. Stn., Vicksburg, MS, USA

Gen. Tech. Rep. U. S. Dept. Agric.

US Dept. Agriculture Fort Collins, CO (USA)

Report Number: p 502-507

ABSTRACT
Planned disposal of dredged material and subsequent development of upland and wetland habitat is a potential means of mitigating habitat losses due to water resources projects. The background, potential, constraints, and suggestions for use of this concept are presented.

Hutchinson, T.C.; Hellebust, J.A.; Soto, C. (1981)

Effect of Naphthalene and Aqueous Crude Oil Extracts on the Green Flagellate Chlamydomonas angulosa IV. Decreases in Cellular Manganese and Potassium

Dept. Bot., Univ. Toronto, Toronto, Ont., Canada M5S 1A1

Can. J. Bot., Vol. 59, No. 5, pp. 742-749.

ABSTRACT
The effect of exposure to naphthalene and to aqueous extracts of crude oil on contents of manganese and potassium in cells of Chlamydomonas angulosa has been measured simultaneously by neutron activation analysis. Decreases of both manganese and potassium from treated cells commenced within a very short time of treatment initiation, and may be due to hydrocarbon-induced membrane damage. In control experiments, manganese uptake into cells was found to be light dependent, and potassium uptake was even more so. In cells treated with a 100% saturated naphthalene solution in Bold's basal medium (BBM), little cellular manganese remained after 6h of exposure and less than 2% was left within 24h. Potassium loss was even more rapid and complete. Rates of loss for both elements in a 50% saturated naphthalene solution in BBM and in an aqueous crude oil extract were slower but showed a similar pattern. For potassium in both light or dark exposures, an initial increase in cellular content occurred. Sodium acetate was added to assess heterotrophic growth, and the effects of this addition on the loss of the two elements are discussed. Over a short time, it appeared to act as an alternative to light energy in restoring membrane function.

Hutchinson, T.C.; Freedman, W. (1978)

Effects of experimental crude oil spills on subarctic boreal forest vegetation near Norman-Wells Northwest-Territories Canada

Dept. Bot., Univ. Toronto, Toronto, Ontario M5S 1A1, Canada

Can J Bot 56 (19). 2424-2433. CODEN: CJBOA

ABSTRACT
Data are presented on the effects of experimental crude oil spills made on two subarctic boreal forest plant communities near Norman Wells [Northwest Territory, Canada]. Spray spills of fresh unweathered crude oil at an intensity of 9.1 l/m2 had a general herbicidal effect and caused the death of any green tissue coming in direct contact with the oil. Death of lichens and mosses was rapid and complete. For some higher plants, a considerable lag period occurred between the time of the spill and the time of death (up to 4 y for some individuals of Picea mariana). For others, death occurred during the first winter, with marked effects on cover values in the spring. These effects resulted in large decreases in total plant cover and frequency at spill sites. However, within a few weeks, and in subsequent years, some species developed regrowth shoots. Other species survived as underground rhizomes for a number of years prior to their reappearance above ground (i.e., Equisetum scirpoides). Limited seedling establishment by vascular plants was first observed in the 4th post-spill growing season, when some sporeling establishment was also noted for several bryophyte species. No Picea mariana regeneration has occurred in the spill plots in the 6 post-spill growing seasons monitored thus far. Crude oil spills made in winter were less damaging than equivalent summer spills in their short-term biological effects and on rates of recovery and species affected. Initial observations indicate that a summer diesel oil spill shows roughly equivalent toxicity to a summer crude oil spill of the same intensity. Comparisons between an intensive spill (8500 l) made at one point and dispersed spray spills indicate that the former are far less damaging per unit of oil applied to the plant community, with severe detrimental effects being largely limited to areas of direct surface contamination. In the point spill examined, most of the oil percolated downwards and then laterally. Surface vegetation growing above areas with subsurface horizons contaminated by oil was not greatly affected in the first 2 yr. An increased area of damage appeared in post-spill years 5 and 6, including death of P. mariana. Oil also appeared to move laterally in 1976 when severe rains occurred, and the oiled area increased somewhat. Limited short-term effects of the spill treatments on depth of active layer thaw were noted but these initial effects were not maintained after the 1st post-spill growing season. The low rates of oil application make the conclusions about the effects of large spills on active layer stability conjectural. Potential effects on vegetation are much more firmly based. Oil in the boreal forest soil appeared to retain toxic properties throughout the 5-yr study period.

Hyland, J.L.; Hoffman, E.J.; Phelps, D.K. (1985)

Differential responses of two nearshore infaunal assemblages to experimental petroleum additions

Battelle New England Mar. Res. Lab., 397 Washington St., Duxbury, MA 02332, USA

J. MAR. RES., Vol. 43, No. 2, pp. 365-394

ABSTRACT
Empirical support is provided for the hypothesis that benthic communities found in relatively constant and predictable environments are less stable (resistant and resilient) following unusual disturbances than lower-diversity communities found in more inconstant and unpredictable environments. A less diverse benthic community (i.e., the Streblospio-Tubificiodes assemblage) inhabiting an inconstant and unpredictable, shallow marsh cove was disturbed less and recovered faster from an experimental addition of No. 2 fuel oil, than the more diverse benthos (i.e., the Nucula-Mediomastus assemblage) inhabiting a relatively more constant and predictable, deeper coastal embayment. Disturbed sediment had a stimulatory effect on most populations in the marsh and an inhibitory effect on most populations in the bay. Differential responses of the 2 communities are attributable to intrinsic biological properties rather than differences in levels or composition of oil. This paper presents results of an in situ study of the responses of two macro-infaunal assemblages, observed in the vicinity of Narragansett Bay, Rhode Island, to experimental additions of No. 2 fuel oil.

Ibanez, F.; Dauvin, J.-C. (1988)

Long-term changes (1977 to 1987) in a muddy fine sand Abra alba -- Melinna palmata community from the western English Channel: Multivariate time-series analysis

CEROV, Stn. Zool., B.P. 28, F-06230 Villefranche-sur-Mer, France

MAR. ECOL. (PROG. SER. Vol. 49, No. 1-2, pp. 65-81

ABSTRACT
Long-term monitoring for 10 yr (1977 to 1987) of the muddy fine sand community of the Bay of Morlaix (N France) has allowed the authors to determine the principal stages of structural succession following pollution by the hydrocarbons of the Amoco Cadiz (1978). Abundance of 30 main species and biomasses of 30 categories were investigated. Regular series were obtained by averaging values from each season, resulting in 40 sequential observations. General trends and seasonal variations were extracted by the Eigen-Filtering method which takes into account the shortness of the annual sampling. Principal component analysis of the covariance matrix of the general trends exhibits 7 successive periods of temporal community changes. This succession is a function of changes in direction in gradients within the populations. The community developed through a successional phase following the oil spill, with establishment at first of a community of opportunists, followed by a colonization of the polychaete Lanice conchilega and finally by reestablishment of the original community pre-Amoco Cadiz.

Jacobs, R.P.W.M. (1980)

Effects of the Amoco Cadiz oil spill on the seagrass community at Roscoff with special reference to the benthic infauna

Lab. Aquat. Ecol., Catholic Univ., Toernooiveld, 6525 ED Nijmegen, Netherlands

Mar. Ecol. (Prog. Ser.), 2(3), 207-212.

ABSTRACT
The benthic fauna of an eelgrass (Zostera marina L.) community was investigated at Roscoff from Oct 1977 to April 1979. The impact of the Amoco Cadiz oil spill of March 1978 on the community was studied. Direct effects on the eelgrass itself were only local during the first weeks after the spill, when many plants had black, 'burnt' leaves. This was, however, a temporary phenomenon, for the production of new leaf tissue continued normally. Effects on the benthic fauna were observed directly after the arrival of the oil at Roscoff. A sharp decrease in numbers of both individuals and species occurred mainly caused by an almost total disappearance of the smaller Crustacea and Echinodermata, and a serious numerical decrease in other groups. Recovery took place relatively rapidly. In the beginning of 1979 all numbers were at the same level as the year before, the filter feeding Amphipoda being the only exception: on 1 May 1979 they were still absent.

Jeffries, H.P.; Johnson, W.C. (1976)

Petroleum, Temperature, and Toxicants: Examples of Suspected Responses by Plankton and Benthos on the Continental Shelf

Univ of Rhode Island

NOAA Sea Grant/Univ of Rhode Island Marine Reprint 69, 1976 (15). The original document is available from Bowker.

ABSTRACT
Gross sealife population changes in the New York Bight and nearby areas are examined. Topics include: responses to energy-related activities; collapse and recovery of a planktonic community; and significance of interactions possibly mediated through the plankton/fish catch in relation to subtle climatic change. In the open coastal areas of the Mid-Atlantic Bight, the direct effect of energy-related activities on copepod populations, which are the major component in the zooplankton, is presently not a concern. However, for benthos populations, experience suggests that small-scale environmental changes have cumulative effects that are enhanced, rather than dissipated (as in the plankton), by ecosystem processes. (1 diagram, 1 graph, 24 references, 5 tables)

Jennings, A.L. (1972)

Spill Damage Restoration

Natl Conf Hazardous Material Spill Houston Mar 21-23, 1972, P221 (3). The original document is available from Bowker.

Jenssen, B.M.; Ekker, M. (1989)

Rehabilitation of Oiled Birds a Physiological Evaluation of Four Cleaning Agents

Dept. Zool., Univ. Trondheim, N-7055 Dragvoll, Norway

Mar Pollut Bull 20 (10). 509-512. CODEN: MPNBA

ABSTRACT
The development of more efficient detergents for cleaning oiled birds is important in order to improve on existing methods. In the present study we tested the properties of four different cleaning agents to remove oil from the plumage and to restore the water repellent and insulative properties of the feathers of domestic ducks (Anas platyrhynchos) and of common eiders (Somateria mollissima). By using more efficient detergents, the cleaning time was reduced by approximately 50%. Our results also show that these detergents are efficient in restoring the insulative properties of the cleaned plumage. The study also showed that the water repellent properties of the plumage were not re-established before the plumage was dry, and that cleaning oiled birds using cold water resulted in hypothermia.

Jernelov, A. (1976)

The St. Peter Oil Spill: An Ecological and Socioeconomic Study of Effects

EPA Intl Env Document Report 04209A-Colombia, Oct 76 (38)

ABSTRACT
A team from the Swedish water and air pollution research laboratory was assigned to: assess the damage caused by an oil spill in the mangrove swamps in colombia; advise on possible reclamation; and recommend action in similar cases in the future. Biological studies of the oil-contaminated mangroves showed that organisms had returned in abundance and sizes that made contaminated areas indistinguishable from unaffected localities. This suggests that the mechanism for recovery is migration from unaffected parts of the mangrove rather than through multiplication of surviving individuals. Severe though short-term primary effects on marine fauna resulted in a sharp reduction of income for persons engaged in fishing or fish marketing.

Jessee, W.N.; Carter, J.W.; Carpenter, A.L.; DeMartini, E.E. (1986)

Density estimates of five warm-temperate reef fishes associated with an artificial reef, a natural reef, and a kelp forest

1027 Blair Ave., Sunnyvale, CA 94087, USA

ARTIFICIAL REEFS -- MARINE AND FRESHWATER APPLICATIONS.

D'Itri, F.M., ed. Pages 383-400

Incl. bibliogr.: 29 ref.

Report Number: ISBN 0-87371-010-X

ABSTRACT
The density of 5 warm-temperate fishes associated with Pendleton Artificial Reef, San Onofre Kelp Forest, and Las Pulgas Reef were quantitatively compared to evaluate the ability of artificial reefs to attract fish and to identify the potential benefits and detriments associated with high fish densities on artificial reefs. Findings suggest that the species/species assemblages likely to be affected, the value of the affected habitat, the degree of mitigation required and the time within mitigation is to occur must be clearly defined before artificial reefs are built. Once artificial reefs are built biological/physical manipulation may be required to direct community development towards the reef objective.

Johansson, S.; Larsson, U.; Boehm, P. (1980)

The Tsesis oil spill: Impact on the pelagic ecosystem

Asko Lab., Inst. Mar. Res., Univ. Stockholm, Box 58, S-150 13 Trosa, Sweden

Mar. Pollut. Bull., 11(10), 284-293

ABSTRACT
On 26 Oct 1977, the tanker Tsesis grounded in the Swedish archipelago, 65 km south of Stockholm (northern Baltic proper, 59° N, 18° E). The Tsesis carried 17575 t of No. 5 fuel oil. The total spill was estimated as being >1000 t, of which about 600-700 t were recovered, leaving 300 t. The effects on the pelagic ecosystem was studied for 1 month following the spill. Severe effects were recorded only in the immediate vicinity of the wreck where zooplankton biomass declined substantially during the first few days. Within 5 d the zooplankton biomass was re-established. Oil contamination of zooplankton was recovered over 3 wk. An increased phytoplankton biomass and primary production in the impacted area was due to decreased zooplankton grazing rates. Increased bacterial numbers and the oil degradation pattern indicated a rapid bacterial degradation of hydrocarbons in the water column. Sediment traps positioned in the area demonstrated the importance of sedimentation as a pathway for removal of oil from the water column. During the second week after the spill, 0.7% of sedimented material was petroleum hydrocarbon. Using sediment trap data, a total sedimentation of 30-60 t of oil was estimated in the impacted area (42 km^2). This corresponds to 10-15% of the unrecovered oil.

Johnson, L.A. (1981)

Revegetation and selected terrain disturbances along the Trans-Alaska Pipeline, 1975-1978

Cold Regions Research and Engineering Lab., Hanover, NH (USA), 122 pp.

NTIS Order No.: AD-A138 426/2.

ABSTRACT
Revegetation techniques along the trans-Alaska pipeline as employed by Alyeska Pipeline Service Company during the 1975-1978 summers were observed. Terrain disturbances due to the construction of the fuel gas line, snowpads, and oil spills were examined to identify and describe related environmental impacts on natural vegetation. Proper construction and use of snowpads minimized the extent and severity of disturbance. Crude oil spills did not cause total kill of vegetation, and certain types of spills may have only short-term effects. Results of restoration research by CRREL along the trans-Alaska pipeline are discussed.

Johnson, B.T.; Romanenko, V.I. (1989)

A multiple testing approach for hazard evaluation of complex mixtures in the aquatic environment the use of diesel oil as a model

Natl. Fisheries Contaminant Res. Cent , U.S. Fish and Wildlife Serv., Columbia, MI 65201.

Environ. Pollut. 58 (2-3). 221-236. CODEN: ENPOE

ABSTRACT
Traditional single species toxicity tests and multiple component laboratory-scaled microcosm assays were combined to assess the toxicological hazard of diesel oil, a model complex mixture, to a model aquatic environment. The immediate impact of diesel oil dosed on a freshwater community was studied in a model pond microcosm over 14 days; a 7-day dosage and a 7-day recovery period. A multicomponent laboratory microcosm was designed to monitor the biological effects of diesel oil (1 .cntdot. 0 mg litre-1) on four components: water, sediment (soil + microbiota), plants (aquatic macrophytes and algae), and animals (zooplanktonic and zoobenthic invertebrates). To determine the sensitivity of each part of the community to diesel oil contamination and how this model community recovered when the oil dissipated, limnological, toxicological, and microbiological variables were considered. Our model revealed these significant occurrences during the spill period: first, a community production and respiration perturbation, characterized in the water column by a decrease in dissolved oxygen and redox potential and a concomitant increase in alkalinity and conductivity; second, marked changes in microbiota of sediments that included bacterial heterotrophic dominance and a high heterotrophic index (0 .cntdot. 6), increased bacterial productivity, and the marked increases in numbers of saprophytic bacteria (10 .times.) and bacterial oil degraders (1000 .times.); and third, column water acutely toxic (100% mortality) to two model taxa; Selenastrum capricornutum and Daphnia magna. Following the simulated clean-up procedure to remove the oil slick, the recovery period of this freshwater microcosm was characterized by a return to control values. This experimental design emphasized monitoring toxicological responses in aquatic microcosm; hence, we proposed the term 'toxicosm' to describe this approach to aquatic toxicological hazard evaluation. The toxicosm as a valuable toxicological tool for screening aquatic contaminants was demonstrated using diesel oil as a model complex mixture.

Johnson, B.T.; Romanenko, V.I. (1983)

Fuel Oil 2 in a Fresh Water Microcosm Impact and Recovery

Columbia Nat. Fish. Res. Lab., U.S. Fish Wildl. Serv., Columbia, MO

83rd Annual Meeting of the American Society for Microbiology, New Orleans, LA, USA, Mar. 6-11, 1983. Abstr Annu Meet Am Soc Microbiol 83 (0). Q73. CODEN: ASMAC

Johnson, G.F.; deWit, L.A. (no date)

Ecological effects of an artificial island, Rincon Island, Punta Corda, California

Dames and Moore, Los Angeles, CA (USA)

Misc. Rep. US Army Coast. Eng. Res. Cent.

Contract No. DACW 72-76-C-0011

ABSTRACT
Marine ecological conditions at Rincon Island, located approximately 0.8 kilometer offshore between Ventura and Santa Barbara, California, at a depth of 14 meters are documented. The island, which was constructed between 1957 and 1958 to serve as a permanent platform for oil and gas production, is particularly suitable for ecological study. Habitat features associated with the armor rock and concrete tetrapods surrounding the island support a 'microecosystem' which differs in biotic composition from surrounding natural bottom areas. A major part of the study is devoted to analysis of seasonal dynamics in biotic composition. Data analysis indicates that many species exhibit significant variability in abundance from one season to the next. Other studies include a gill net survey of fish fauna, mapping of mussel 'talus' beds at the base of the island, and a survey of biota along a natural bottom transect between the island and shore. In general, the findings indicate a rich and varied fauna and flora associated with the high-relief solid substrate of Rincon Island which differs substantially from the more depauperate natural bottom habitats in the area.

Johnson, G.F.; deWit, L.A.; Wales, B.A.; Hurme, A.K. (1978)

Ecological effects of an artificial island

In: Proceedings of Energy/Environment '78: a symposium on energy development impacts, Los Angeles (USA), 22 Aug 1978.

Address not stated

Lindstedt-Siva, J., ed.

Society of Petroleum Industry Biologists Los Angeles (USA)

Report Number: p 145-162

ABSTRACT
The armor rock revetments of Rincon Island represent a significant addition of solid substratum to the local nearshore marine environment, which has contributed to an enhancement in the richness of local marine communities. Although observations on Rincon Island's marine life have been made since these studies, no comprehensive delineation of major habitats, nor detailed characterization of communities extant at any one time or on a seasonal basis, has been accomplished. This study was undertaken with the recognition that this information would be of value in furthering the understanding of ecological consequences associated with construction of artificial islands in the coastal environment. The objectives of the study were to: (a) delineate, map, and quantitatively characterize major species associations around Rincon Island, and compare these with the biota of the natural bottom between the island and shore (b) document the morphology and volume of the beds of shell debris lying along the flanks of each of the four cardinal sides of the island (c) establish permanent transects on each side of the island and survey major benthic organisms along these transects on a seasonal basis, documenting changes in biotic composition and habitat character and (d) expand the existing species list of the area.

Johnston, C.S.; Appelbee, J.F. (1981)

Strategy for Environmental Studies in North Sea Oil Development

Offshore Europe 81, Aberdeen (UK), 15-18 Sep 1981: Conference Papers, 9 pp.

Inst. Offshore Eng., Heriot-Watt Univ., Edinburgh, Scotland, UK

Report Number: OE81 SPE 10407

ABSTRACT
At frequent environmental meetings the importance of close communication between careful planning of environmental strategy associated with any new industrial development has been stressed (Appelbee & Johnston, 1978). Particularly crucial is the inclusion of all key environmental criteria at the initial planning/design phases, involving a close interaction between design engineers and environmental staff. It is equally important that this communication develops into a real understanding, a sympathy, which is maintained throughout the development. Not only will this minimize (and often totally remove) any barriers and conflicts associated with environmental matters, features so common in many US developments, it will lead to improved design and operation of plant. When one refers to environmental problems associated with oil developments, attention usually focuses on the pollution threat and likely damage to the environment. Although this forms a key part of this paper, some attention is given to potential impact of the bio-environment on the oil recovery process and the need for close interfacing of marine biological and engineering expertise. Brief attention will be given to biologically derived particulate in injection water, and to the biofouling of structures.

Jones, L.E.; Hunter, R.A. (1981)

Strategies for rehabilitation and enhancement of coastal sites for waterfowl

6th Biennial International Estuarine Research Conference, Gleneden Beach, OR (USA), 1-5 Nov 1981

Ducks Unlimited, Kamloops, B.C., Canada

Estuaries, Vol. 4, No. 3, p. 266.

Summary only.

ABSTRACT
The coast of British Columbia is of international significance as migratory and wintering habitat for waterfowl of the Pacific flyway. Despite this coasts 27,000 km length severe topography restricts available goose, swan, and dabbling species habitat to protected estuarine and salt marshes and associated fresh water wetlands. Strategies and techniques for enhancement and rehabilitation of impacted sites involve controlled breaching of dikes, increased channelization, regrading of channel slopes, recreation on intertidal marsh and associated habitat through transplanting, removal of debris and fill, water levels, pond establishment, creation of nesting and loafing islands (including floating islands), and controlled grazing and selective forage production.

Kakimoto, H. (1979)

Artificial fish reefs in Japan Sea coastal regions

In: Proceedings of the Seventh Japan-Soviet Joint Symposium on Aquaculture, September 1978, Tokyo and Tsuruga, Japan.

Niigata Prefect. Fish. Exp. Stn., Niigata City, Japan

Proc. Japan-Sov. Jt. Symp. Aquacult.

Yamamoto, G., ed.

Publisher(s): Tokai University, Tokyo (Japan); Ministry of Fisheries, Moscow (USSR); Tokai University Press, Tokyo (Japan)

Report Number: p 103-109

ABSTRACT
The Japanese government has promoted the construction of artificial reefs in Japanese waters since 1953, but the project was accelerated in 1976. The material used is mainly concrete blocks, but old boats, broken stone and timber are also used. Over 120 fish species are attracted to the reefs, but their construction is mainly aimed at the propagation of commercially important species such as Pagrosomus major, Paralichthys olivaceus, Seriola quinqueradiata and Sebastes inermis. The handline is the most favorable method for fishing in the reef area. The author describes the effects of the artificial reef with reference to type of fish attracted, distribution, developmental stages, the luring effect of the effect, predation and migration. The reef does seem to play a role as a site for spawning, sheltering, 'nursery' function and predation. The species caught are tabulated.

Kane, M.L.; Ladov, E.N.; Holdsworth, C.E.; Weaver, N.K. (1984)

Toxicological characteristics of refinery streams used to manufacture lubricating oils

Am. Petroleum Inst., 1220 L St., N.W., Washington, DC 20005, USA

Am. J. Ind. Med., Vol. 5, No. 3, pp. 183-200

ABSTRACT
In the past, reports on the tumorigenic potential of lubricating oils in experimental animals have poorly defined the material under study. In this paper the results of mouse skin painting studies with 46 clearly defined samples of refinery streams associated with lubricating oil processing show that modern conventional solvent refining of distillates removes tumorigenic potential while conventional acid refining may not. Furthermore, dewaxing, hydrofinishing, and clay treatments do not appear to mitigate the tumorigenicity of the lubricant distillates. Lubricant processing has changed over the years and assessment of the carcinogenicity of present-day lubricating materials must be based on knowledge of modern processing.

Kaplan, E.; Royce, B.; Garrell, M.H.; Riedel, E.F.; Sathaye, J.; Rotarius, G.J. (1984)

Environmental assessment of enhanced oil recovery

Div. Energy Econ. Anal., Natl. Cent. Anal. Energy Sys., Brookhaven Natl. Lab., Assoc. Univ., Upton, NY, USA

MINER. ENVIR Vol. 6, No. 2, pp. 54-65

ABSTRACT
The objective of this assessment is to quantify some of the environmental effects of a significant increase in United States oil production by tertiary or enhanced oil recovery (EOR) methods. The problems associated with each EOR technology are discussed and controls and regulations are briefly summarized. A tertiary oil production scenario for the United States was developed focussing only on mainland fields in the lower 48 states. It included all of the EOR methods expected to be in use during the next two decades. The environmental impacts, including water requirements, air emissions and generation of solid wastes, are then scaled to this scenario. The effects of control technologies and state regulations are considered. A comparison is also made between the impacts of EOR as an energy source and impacts associated with coal and synthetic fuels which concludes that EOR is preferable in many respects. There are environmental risks associated with EOR technologies, specific projects and specific fields in the production scenario; however, most problems are solvable by responsible regulation, enforcement of regulations and application of the best professional engineering by project operators.

Kelley, K. (1988)

Seagrass replanting efforts may improve fisheries

Natl. Fisherman, Vol. 68, No. 11, pp. 14-16.

ABSTRACT
The role that seagrass meadows play in the marine food chain is examined briefly, examining efforts made in Long Island Sound, Chesapeake Bay and Tampa to restore seagrass communities. Importance of the seagrass to fisheries and production yields is also discussed.

Kentula, M.E. (1986)

Wetland rehabilitation and creation in the Pacific Northwest

Northrop Services, Inc., Corvallis, OR (USA)

Ecol. Res. Ser., U.S. Environ. Prot. Agency, 29 pp.

NTIS Order No.: PB86-241023/GAR.

Report Number: EPA/600/D-86/183

ABSTRACT
The oldest, best documented project is the Army Corps of Engineers Miller Sands Marsh and Upland Habitat Development Project on the Columbia River, completed in 1977. In Oregon and Washington the majority are located west of the Cascade Mountains and near urban centers. Types of wetlands being rehabilitated/created are intertidal mudflats, seagrass beds, salt marshes, fresh water ponds and associated wetlands, and riparian and in-stream habitat. The permitting/mitigation process, e.g. Section 404 of the Clean Water Act, has an impact on the rehabilitation/creation of wetlands. To evaluate the success of a rehabilitation/creation project goals must be clearly stated, the construction plans given, the proper incorporation of design features verified, and a quantitative monitoring program established. (Sponsored by Corvallis Environmental Research Lab., OR.)

Kentula, M.E. (1986)

Wetland rehabilitation and creation in the Pacific Northwest

Northrop Services, Inc., Corvallis, OR (USA)

ECOL. RES. SER. U.S. ENVIRON. PROT. AGENCY, 29 pp.

NTIS Order No.: PB86-241023/GAR.

Report Number: EPA/600/D-86/183

ABSTRACT
The oldest, best documented project is the Army Corps of Engineers Miller Sands Marsh and Upland Habitat Development Project on the Columbia River, completed in 1977. In Oregon and Washington the majority are located west of the Cascade Mountains and near urban centers. Types of wetlands being rehabilitated/created are intertidal mudflats, seagrass beds, salt marshes, fresh water ponds and associated wetlands, and riparian and in-stream habitat. The permitting/mitigation process, e.g. Section 404 of the Clean Water Act, has an impact on the rehabilitation/creation of wetlands. To evaluate the success of a rehabilitation/creation project goals must be clearly stated, the construction plans given, the proper incorporation of design features verified, and a quantitative monitoring program established. (Sponsored by Corvallis Environmental Research Lab., OR.)

Kerley, G.I.H.; Crellin, C.G.; Erasmus, T. (1987)

Gravimetric determination of water-repellency in rehabilitated oiled seabirds

Dept. Zool., Univ. Port Elizabeth, P.O. Box 1600, Port Elizabeth 6000, South Africa

Mar. Pollut. Bull., Vol. 18, No. 11, pp. 609-611.

ABSTRACT
After removing oil, the aim of oiled seabird rescue operations is to restore the water-repellency of the birds plumage. Non-waterproof penguins absorb more water onto the plumage than waterproof penguins, measured gravimetrically. The authors suggest that oiled seabird rescue stations use this difference to test for readiness for release of cleaned birds.

Kerley, G.I.H.; Erasmus, T. (1987)

Cleaning and rehabilitation of oiled jackass penguins

Dept. Zool., Univ. Port Elizabeth, P.O. Box 1600, Port Elizabeth 6000, South Africa

S. Afr. J. Wildl. Res. S.-Afr. Tydskr. Natuurnavors., Vol. 17, No. 2, pp. 64-70.

ABSTRACT
The effectiveness of two washing techniques on the cleaning and rehabilitation of oiled jackass penguins Spheniscus demersus are compared. The technique described here, using high pressure, hot water, postwash rinsing was found to be highly effective, allowing oiled penguins to be released sooner than the traditional non-intensive rinsing cleaning method. Oiled penguins in poor condition on capture suffered significantly higher mortalities than those whose body weight was above 2.0 kg on capture. Oiled penguins should be allowed to recuperate for at least three days after capture before washing in order to reduce washing mortalities.

Kerley, G.I.H.; Erasmus, T. (1986)

Oil pollution of Cape gannets: To clean or not to clean?

Dept. Zool., Univ. Port Elizabeth, P.O. Box 1600, Port Elizabeth 6000, South Africa

Mar. Pollut. Bull., Vol. 17, No. 11, pp. 498-500.

ABSTRACT
In an attempt to evaluate the need of oiled gannets for cleaning and rehabilitation, the effects of oiling on the insulation of gannets was investigated. Oiled and washed gannets showed a decrease in body temperature in water, indicating impaired feather insulation. Oiled gannets, being aerial foragers, may however escape this hypothermia by limiting time spent in the water, provided that the extent of oiling does not prevent them from flying.

Kerley, G.I.H.; Erasmus, T.; Mason, R.P. (1985)

Effect of moult on crude oil load in a jackass penguin Spheniscus demersus

Dept. Zool., Univ. Port Elizabeth, P.O. Box 1600, Port Elizabeth 6000, South Africa

Mar. Pollut. Bull., Vol. 16, No. 12, pp. 474-476.

ABSTRACT
Induced moult has been suggested as a technique for rehabilitating oiled seabirds. An oiled jackass penguin (S. demersus) underwent natural moult in captivity. Analyses of oil extracted from premoult and postmoult feathers indicate little qualitative difference, with significant amounts of oil transferred from premoult to postmoult feathers. Inducing moult, therefore does not appear to be viable for cleaning oiled seabirds.

Kohlman, D.J.; Holowachuk, D.N. (1980)

Oil Recovery From Under the River Ice - Research and Development Project

Prairie Regional Oil Spill Containment Recovery Advisory Comm., Can.

Int. Oil Pollut. Prevent. Conf.(IOPPEC) Hamburg, W. Ger. 1980

IN *INT. OIL POLLUT. PREVENT. CONF.

HAMBURG MESSE & CONGRESS GMBH, W. GER.

ABSTRACT
Results indicate that effective and almost total spilled oil recovery is possible using ice slotting techniques and a specially constructed weir skimmer. The effectiveness of the continuous plywood barrier was unsatisfactory because wedges used in the installation interfered with the movement of oil in the recovery slot. Solid ice formations over the air diverter manifold prevented the formation of an effective stagnation line, causing virtually all the spilled oil to pass through the bubble barrier.

Kooyman, G.; Costa, D. (1978)

The effects of oil on temperature regulation in sea otters

Scripps Inst. Oceanogr., Physiol. Res. Lab., La Jolla, CA 92093, USA

In: Environmental assessment of the Alaskan continental shelf. Quarterly reports of principal investigators for April-June 1978.

Publisher(s): U.S. National Oceanic and Atmospheric Administration, Boulder, CO, Environmental Research Laboratories

Report Number: p 66-69

ABSTRACT
A significant amount of time has been spent preparing for the expedition to Prince William Sound, in July 1978. The objectives are to study: (1) energy requirements of normal sea otters at various water temperatures (2) energy requirements of sea otters after oiling (3) appropriate procedures for rehabilitating oiled sea otters and (4) at sea behavior and energetics of sea otters. These objectives will provide a data base from which the assessment of any kind of oil contamination, or other activity which may alter the nature of the otter's food sources can be derived. In addition, relative to oil contamination the difficulties and costs of rehabilitating the oiled otters can be estimated.

Kooyman, G.L.; Costa, D.P. (1978)

Effects of oiling on temperature regulation in sea otters

California Univ. at San Diego, Scripps Inst. Oceanogr., La Jolla, CA, USA

In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1978. Volume 7, effects.

Publisher(s): US Environmental Research Laboratories, Boulder, CO. Outer Continental Shelf Environmental Assessment Program.

Report Number: p 1-11

ABSTRACT
The objective of this study was to measure effects of crude oil contamination on sea otters through studies on the changes in the animal's metabolic rate and subcutaneous temperatures before and after contact with oil. A second objective was to attempt to rehabilitate the otters after crude oil contamination. Crude oil contamination over small areas of the sea otter's fur causes noticeable increases in their heat loss and metabolic rate. Oiled sea otters had metabolic rates 1.4 x normal. Removal of the crude oil by washing with a detergent resulted in metabolic rates that were 2.3 x normal. Crude oil contamination of wild sea otters would probably cause significant thermal stress and could lead to hypothermy and/or pneumonia resulting in death. Rehabilitation of large numbers of sea otters would require sophisticated pre-existing facilities and would be extremely expensive if at all possible.

Kooyman, G.L.; Costa, D.P. (1979)

Effects of oiling on temperature regulation in sea otters

Scripps Inst. Ocean., Physiological Res. Lab., La Jolla, CA 92093, USA

In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1979, Volume 6, effects.

Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA), Outer Continental Shelf Environmental Assessment Program

Report Number: p 1-26

ABSTRACT
The objective of this study was to measure effects of crude oil contamination on sea otters through studies on the changes in the animals' metabolic rate and subcutaneous temperatures before and after contact with oil. A second objective was to attempt to rehabilitate the otters after crude oil contamination. This study has shown that small amounts of crude oil contamination have large effects on the metabolic rate of sea otters. Light oiling of approximately 25% of the animal's pelt surface area resulted in a 1.4X increase in metabolic rate while immersed in water at 15 C. Furthermore, when the oil was removed by detergent, the animal's metabolic rate increased 2.1X while immersed in water at 15 C. Of the three animals studied two contracted pneumonia and one died. Any contact with oil at any time of year would have a profound influence on the health of individual sea otters through increases in the animal's thermal conductance and the subsequent increase in metabolic rate. It is probable that death may follow from pneumonia or hypothermia depending upon the amount of the animal's fur fouled. Rehabilitation of oil-fouled sea otters would be very costly requiring holding facilities to keep the animals for at least two weeks, and the success rate is likely to be rather low.

LaRoe, E.T. (1979)

The biological basis for estuarine ecosystem mitigation

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979.

The Coastal Soc., Tallahassee, FL, USA

Gen. Tech. Rep. U.S. Dept. Agric.

US Dept. Agriculture Fort Collins, CO (USA)

Report Number: p 90-92

ABSTRACT
The objective of mitigation should be to protect and maintain the variety of benefits produced by the estuarine ecosystem. Migration efforts cannot be based on a single factor, such as productivity, but must incorporate comprehensive consideration of the critical processes and features of the ecosystem, including surface area, flushing, and biological diversity. The selection of appropriate mitigation actions must balance the resources and functions lost with those to be provided.

Laubier, L. (1980)

The Amoco Cadiz Oil Spill: An Ecological Impact Study

Cent. Natl. Exploitation of the Oceans, 66, Ave. d'Iena, 75116 - Paris, France

AMBIO., Vol. 9, No. 6, pp. 268-276

ABSTRACT
On the night of March 16-17, 1978, the supertanker Amoco Cadiz ran aground, spilling into the sea almost 223,000 tons of oil with a volatile fraction of 30 to 40 percent. A program to assess the ecological impact of the spill was begun immediately, to run for three years. It includes: chemical monitoring of the water, the sediments and the marine organisms study of ecological effects on flora and fauna, including acute mortality and re-establishment of heavily damaged communities studies of microbial degradation of the oil. Major results of these studies have been presented at a special symposium and are reviewed here. The recovery of areas exposed to waves, currents and wind energy is almost complete, but there is still oil in areas more protected from the physical energy of the sea. The ecological impact was extremely complex in addition to the direct loss in biomass (acute mortality) and the corresponding loss in production, there are sublethal long-term effects especially on reproduction.

Le Moal, Y. (1983)

Veille ecologique des plages de la cote nord de Bretagne

(Ecological survey of beaches (after the Amoco Cadiz oil spill) on the northern coast of Brittany)

Lab. Oceanogr. Biol., Brest Univ., 29283 Brest Cedex, France

Etude de la Macrofaune du Microphytobenthos de la Meiofaune des Estrans et Etude des Chenaux des Abers. (Ecological Survey of Macrofauna, Microphytobenthos and Meiofauna of the Foreshore, and Survey of the Channels of the Abers Estuaries.), pp. 1-19

Report Number: Contract CNEXO82/2604

ABSTRACT
Some 50 stations on the northern coast of Brittany were surveyed in 1983, 4 years after the Amoco Cadiz , and 2 years after the Tanio . The populations were mainly composed of Polychaeta (37%), Amphipoda (25%) and Bivalvia (10%) they were divided in ecological groups as a function of their tolerance to oil pollution. Some beaches are now restored, but for those which were twice heavily polluted, populations were far from being restored.

Le Moal, Y. (1980)

Etude d'impact ecologique de la pollution petroliere de l'Amoco Cadiz sur les communautes littorales des fonds rocheux et des fonds meubles. (2eme annee). Theme 1: etude extensive: Claude Chasse. Theme 2: etude intensive: Yveline le Moal

[*Ecological effect of the Amoco Cadiz oil pollution on littoral communities living on hard and soft substrata. (2nd year). Part 1: extensive study: Claude Chasse. Part 2: intensive study: Yveline Le Moal*]

Univ. Bretagne Occidentale, Lab. Oceanogr. Biol., 29283 Brest Cedex, France

Chasse, C.; Le Moal, Y.

Universite de Bretagne Occidentale Brest (France)

Report Number: vp

ABSTRACT
The macrofaunal settlements (of a size >1 mm) have been studied on four beaches, in the Abers Benoit and Wrac'h which had been heavily polluted by the Amoco Cadiz oil spill. 'Pollution settlements' have been observed and as the sediment pollution is persistent in these sheltered zones, the restoration has only begun. These 'pollution settlements' (Capitella capitata and Scolelepis fuliginosa) constitute the flatfish food,and this is the cause of the whole-chain contamination.

Lee, W.Y.; Macko, S.A.; Nicol, J.A.C. (1981)

Changes in nesting behavior and lipid content of a marine amphipod amphithoe-valida to the toxicity of a no. 2 fuel oil

Univ. Tex. Mar. Sci. Inst., Port Arkansas Mar. Lab., Port Arkansas, TX 78373, USA.

Water Air Soil Pollut. 15 (2). 185-196. CODEN: WAPLA

ABSTRACT
Laboratory cultured amphipods, A. valida, were exposed to the water soluble fractions (WSF) of a No. 2 fuel oil for 6 days and then transferred to clean sea water for 1 wk. Survival and nesting behavior were observed daily and the lipid contents were checked at the end of exposure and at the end of depuration. Survival of amphipods during exposure was high at all concentrations of WSF tested (0-25%). A delayed toxicity was observed; mortality was high in concentrations .gtoreq. 15% WSF during depuration. The number of nests decreased with increasing concentration of WSF and length of exposure. Recovery of nest building activity in clean sea water was lacking or small, indicating some damage to nesting capability. Lipid contents of amphipods were close to the expected range (except at 25% WSF) following exposure but dropped to about 1% following recovery compared with an expected value of 3.3%. Impairments of the chemosensory and locomotory systems may occur during exposure, which prevented amphipods from constructing nests for protection and food reserves and eventually led animals to use their stored energy of lipid for survival. Of the 3 biological parameters studied, nesting behavior and lipid content as a percentage of dry weight were better indicators of the sublethal stress of WSF than survival response. Significant alterations of the former 2 parameters were found at concentrations .gtoreq. 5% WSF.

Lees, A.; Noel, B.; Bouw, P. (1977)

The Waulsortian 'reefs' of Belgium: A progress report

Lab. Geol. Gen., Univ. Cathol. Louvain, Batiment Mercator, Place L. Pasteur, 3, B-1348 Louvain-la-Neuve, Belgium

Mem. Inst. Geol. Univ. Louvain, 29, 289-315

ABSTRACT
The main structural, lithological and palaeontological characters of the Waulsortian carbonates are reviewed and related to those of the 'off-reef' time equivalents using biostratigraphic markers (conodonts, forams). New information from detailed studies of two Waulsortian 'reef' masses (Moniat, Furfooz) near Dinant is used to develop a general model of a Waulsortian buildup. This is shown to be a complex entity whose facies and microfacies show distinct changes with time an evolution matched in the 'off-reef' rocks. The bryozoan/crinoid mud-mound facies widely recognized as characterizing 'Waulsortian-type bioherms' is only a part of the Waulsortian story. The existence of a relatively featureless, biomicrite facies, important in the upper half of the Waulsortian, has generally been ignored by sedimentologists. This facies is significant because it passes laterally into an 'off-reef' facies habitually interpreted as resulting from contemporaneous erosion of the 'reefs'. Growth mechanisms and sedimentary environments are discussed in the light of the new information. The evidence suggests that the Waulsortian carbonates began to form in the aphotic zone below wave-base, and developed in water deep enough to mitigate the effects of regional shallowing sufficient to produce karst surfaces a few tens of kilometers away.

Leigh, J.T. (1981)

Spill Containment and Cleanup - Research and Development

Texaco, Inc., Beacon, NY

Mar. Technol., Vol. 18, No. 4, pp. 342-343.

ABSTRACT
Current and past Coast Guard research and development interest in oil spill containment and cleanup can generally be categorized as concerned with severe environmental conditions and rather large spill volumes. Problem areas receiving attention at this time include recovery of oil in fast currents, pollution response in ice-infested regions, open-ocean pollution response, disposal, and pollution prevention. Each of these problems is at a different stage of development. The scope of the problem and the nature of USCG efforts vary substantially, and this note briefly outlines its interest and activities.

Lenssen, Nicholas, Worldwatch Inst, Washington, DC (1989)

The Ocean Blues

World Watch, Jul-Aug 89, V2, N4, P26(11). The original document is available from Bowker.

ABSTRACT
Daily chemical and biological inputs are damaging the world's oceans at an alarming pace, while coastal development and overfishing hamper their ability to recover. Human sewage is a chief marine pollutant, causing algal blooms, some of which are toxic to marine biota. Hydrocarbons enter the ocean via oil spills, urban runoff, and wastewater outfalls; plastic, a petroleum derivative, also takes a heavy toll on marine life. Declining populations of marine mammals and contaminated food chains provide evidence of chemical contamination. Problems of overfishing, disrupted or altered food chains, decreased stratospheric ozone, and the impending greenhouse effect pose additional threats and pressures on ocean resources. International agreements, such as the UN Law of the Sea Convention, must be adhered to to encourage global stewardship of this shared resource. (2 drawings, 2 graphs)

Leonard, J. (1983)

Chelating agent solves scale problem to halt production slide in Prudhoe Bay

c/o Oil and Gas Journal, P.O. Box 1260, Tulsa, OK 74101, USA

Oil Gas J., Vol. 81, No. 50, pp. 78-80.

ABSTRACT
The Sadlerochit sand has yielded 3.2 billion bbl of crude from the Prudhoe Bay field on Alaska's North Slope. Prior to and shortly after the start-up of production in 1977, a few of the newly completed wells exhibited a production decline which was significantly greater than anticipated from geologic and engineering reservoir studies. Reperforating the original completion interval restored a well to initial productivity, the response was temporary sharp decline followed almost immediately thereafter. In the process of reperforating, samples of downhole scale were noted and removed from the wire line. Analysis showed that the scale was nearly pure calcium carbonate (CaCO sub(3)). The combination of brine and scale analyses proved that CaCO sub(3) was the primary mineral precipitated from Prudhoe Bay formation water.

Leppaekoski, E. (1980)

Man's impact on the Baltic ecosystem

Aabo Akademi, Inst. of Biology, SF-20 500 Aabo 50, Finland

Ambio 9(3-4) 174-181, Coden: AMBOCX

illus. refs.

Abs.

ABSTRACT
Most real and potential risks to human health from the Baltic Sea are manmade and include oil spills, the discharge of industrial wastes into the Sea, and the bioaccumulation of heavy metals and pesticides in fish. Changes seen in the Baltic include the physical dimensions of the Sea as they are affected by land reclamation projects, changes in species composition, eutrophication, and the addition of a number of toxic substances to its waters. Scientific research on the Baltic has been conducted for the past 100 yr, but protection of the Sea has only been discussed since the mid-1960s. Some of the adverse changes seen in the Sea are reversible and examples of recovery are given. (FT)

Leppaekoski, E.J.; Lindstroem, L.S. (1978)

Recovery of benthic macrofauna from chronic pollution in the sea area off a refinery plant, Southwest Finland

Aabo Akademi, Inst. of Biology, SF-20500 Aabo, Fin.

Symposium on recovery potential of oiled marine northern environments Halifax, N.S., Can. Oct. 10-14, 1977

Recovery potential of oiled marine northern environments: Symposium papers. Edited by J. C. Stevenson. In CANADA. FISHERIES RESEARCH BOARD. JOURNAL 35(5), 766-775, Coden: JFRBAK

illus. refs. (Some in Finn.; Ger.)

ABSTRACT
The environmental impact of a 90%-95% reduction of Naantali refinery oil and liquid effluent by a wastewater treatment plant was quantitatively measured over time. Density, wet weight biomass, Shannon diversity, species richness, and evenness of distribution of benthic organisms showed that the pollution reduction increased population size and species diversity. The amphipods Pontoporeia affinis, Corophium volutator, and C. lacustre, midge larvae of the Chironomus plumosus-group, the oligochaete Tubifex costatus, the polychaetes Harmothoe sarsi and Polydora redeki, and the bivalve Cardium sp. were the most successful recolonizers of the 23 taxa sampled. The strong lethal effect of oil-contaminated sediments on C. lacustre decreased markedly in laboratory experiments (LT50 increased from 7 d in 1973 to 28 d in 1974 to K28 d in 1975. (AM)

Levasseur, J.; Durand, M.-A.; Jory, M.-L. (1981)

Biomorphologic and Floristic Aspects of the Reconstitution of a Phanerogamic Vegetal Cover, Altered by the Amoco Cadiz Oil Spill and the Following Clean-Up Operations: Special Study of the Ile-Grande Salt Marshes (Cotes du Nord)

Amoco Cadiz: Fates and Effects of the Oil Spill, Brest (France), 19 Nov 1979

Lab. Bot. Gen., Fac. Sci. Biol., Campus de Beaulieu, 35042 Rennes Cedex, France

Amoco Cadiz : Consequences d'une Pollution Accidentelle par les Hydrocarbures. Actes du Colloque International

Amoco Cadiz : Fates and Effects of the Oil Spill. Proceedings of the International Symposium. Centre Oceanologique de Bretagne, Brest (France). November 19-22, 1979, pp. 455-473

Report Number: ISBN 2-90272-09-9

ABSTRACT
Oiling and subsequent cleaning of coastal marshes of the Ile Grande have drastically reduced vegetational cover. They have also caused profound modifications of habitat types and distribution. Current reestablishment of vegetation involves the two classical processes of (1) primary succession, where dikes have been raised or lower and middle areas of marshes have been bulldozed, (2) secondary succession elsewhere. It seems necessary to consider changes at the level of the site rather than the community and specifically as regards the population. The age and prior extension of certain clones have a decisive influence on the redistribution of species dominance actually under way since the first stage of succession implies reoccupation of the surface. In this respect, rhizomatous geophytes are currently favored. In the middle and upper marsh areas, contrary to what is seen in "haute-slikke" or "bas-schorre", chances of vegetational reestablishment are correlated with degree of species and growth form diversities.

Levasseur, J.E.; Jory, M.L. (1982)

Retablissement naturel d'une vegetation de marais maritimes alteree par les hydrocarbures de l'Amoco Cadiz: Modalites et tendances

(Natural recovery of salt-marsh vegetation destroyed by the Amoco Cadiz oil spill: Circumstances and tendencies)

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill Biological Studies after the Amoco Cadiz Oil Spill Charleston, SC (USA). Brest (France) 17 Sep 1981. 28 Oct 1981

Lab. Bot. Gen., Campus Sci. Beaulieu, 35042-Rennes Cedex, France

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission.

Gundlach, E.R.; Marchand, M., eds. Pages 329-362

ABSTRACT
Recovery of Ile Grande salt-marsh vegetation (Spartina maritima, Salicornia perennis, Halimione portulacoides, Puccinellia maritima , and Juncus maritimus) partially destroyed by hydrocarbons has been significantly started up since 1980. Ways and timing of recovery are due to the relative dominance, in each point, of two processes, viz. in situ regeneration of perennial individuals and germination of seeds produced near or on the site. Colonization is mainly due to annual species while germination of perennials is a rare event, except in shady places with loose and clean substrate. However, it is impeded either in tide exposed points or in formerly heavily trampled places.

Leymann, G. (1983)

Gedanken zur Schadensbekaem fung von Oelunfaellen in der mittleren Ostsee

{Reflections on the rehabilitation of damages caused by oil pollution in the central Baltic Sea}

D-2308 Postfeld, FRG

Wasser Boden., Vol. 35, No. 11, pp. 512-514.

ABSTRACT
The recent oil mishap in the Kieler Foerde was a disaster in the view of environment control. The technique of handling oil pollution at sea has not been solved. The concept of the federal and countries governments to encounter oil threats is very costly, the procured equipment only partly applicable and the results more than doubtful. The introduced concept may not be perfect, but to my opinion it should be tested at the next oil mishap, which is bound to come.

Lindall, W.N., Jr.; Mager, A., Jr.; Thayer, G.W.; Ekberg, D.R. (1979)

Estuarine habitat mitigation planning in the southeast

Presented at the Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979.

US NMFS, Southeast Fisheries Cent., St. Petersburg, FL 33702, USA

Gen. Tech. Rep. U. S. Dept. Agric.

US Dept. Agriculture Fort Collins, CO (USA)

Report Number: p 129-135

ABSTRACT
Although habitat loss to non-water-dependent projects has declined in recent years due to national recognition of the importance of wetlands, there is still a decided loss of wetlands in the southeastern part of the United States for water-dependent projects such as marinas, petroleum exploration, navigation and mooring facilities. How long we can continue to lose habitat until fish production and the other attributes of wetlands are irreversibly affected is unknown. The only method for stopping this loss is to adopt a program of zero-habitat loss. This can be achieved through mitigation options consisting of preservation, restoration of habitat to its original state, or de novo generation of new habitat.

Linden, O.; Elmgren, R.; Boehm, P. (1979)

The Tsesis oil spill: Its impact on the coastal ecosystem of the Baltic Sea

Swedish Water and Air Pollut. Res. Inst. (IVL), Studsvik, S-611 82 Nykoeping, Sweden

Ambio 8(6), 244-253.

ABSTRACT
The grounding of the Soviet tanker Tsesis in the archipelago south of Stockholm in October 1977 resulted in a spill of over 1000 tons of medium grade fuel oil. The environmental impact of the spill was studied by an international research team. Severe but not catastrophic initial effects were found in pelagic, littoral and benthic ecosystems. The effects proved to be of short duration in the pelagic system and after about one year the littoral zone had also recovered considerably, whereas in the soft bottom communities not even the beginning of a recovery was found. The results from the first year of study presented here illustrate the recovery rates of a coastal ecosystem in a cold brackish sea, following an oil spill.

Linden, O.; Elmgren, R.; Westin, L.; Kineman, J. (1978?)

Scientific summary and general discussion

Swedish Water and Air Pollut. Res. Inst. (IVL), Studsvik, Sweden

In: The Tsesis oil spill. Report of the first year scientific study (October 26, 1977, to December, 1978) - a cooperative international investigation.

Kineman, J.J.; Elmgren, R.; Hansson, S., eds.

NOAA/Outer Continental Shelf Environmental Assessment Program Boulder, CO (USA)., Mar 1980.

Report Number: p 43-58

ABSTRACT
In the supra-littoral zone, faunal and floral surveys were carried out about 8 months after the Tsesis accident. In general these studies showed no obvious remaining effects either on the invertebrate fauna of the beaches or on the various land plant species along the shores. The studies of the impact of oil on the littoral zone indicate substantial acute damage to all macrofauna species of the Fucus belt. The molluscs of the littoral zone do not appear to have suffered drastic mortality. Instead, bivalves and gastropods seem to have reentered the algal zones after some time of immobilization on the bottom. Even if the recovery of the littoral fauna is incomplete, the results obtained so far would indicate that a complete recovery of all fauna representatives can be predicted within 2 to 3 years. The pattern of depuration of the Tsesis oil from Mytilus indicated a somewhat more rapid release of the aliphatic fraction compared to the aromatic hydrocarbons. Weathered Tsesis oil sedimented to the bottom in quantity within days after the spill, as shown by sediment trap data. These together with the oil analysis of Macoma balthica from a number of stations, show that the exposed area was much larger than originally suspected, including areas which were considered clean by visual inspection or biological sampling. Of the meiofauna, all taxonomic groups except the nematodes showed abnormally low abundance at the most affected station and there was evidence of greatly increased mortality of ostracods following the spill. One month after the spill all parameters measured in the pelagic system were essentially normal.

Linkins, A.E.; Johnson, L.A.; Everett, K.R.; Atlas, R.M. (1984)

Oil spills: Damage and recovery in tundra and taiga

Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981

Cairns, J., Jr.; Buikema, A.L. eds. Pages 135-156

Dept. Biol., Virginia Polytech. Inst. and State Univ., Blacksburg, VA 24061, USA

Report Number: ISBN 0-250-40551-2

ABSTRACT
In this chapter, the Arctic-subarctic environment proximal to oil field development and transportation activity will be described in relation to current oil spill cleanup, revegetation, and restoration practices. Recommendations for management practices and future research activities are presented. The recommendations presented in this review are directed specifically to the terrestrial ecosystem of the North Slope of Alaska and the Trans-Alaskan Pipeline System (TAPS) corridor as it extends through subarctic taiga.

Little, A.E. (1983)

A resurvey of rocky shore transects in Milford Haven, January - April 1979: Comparisons with data collected from 1961-1978

Oil Pollut. Res. Unit, Orielton Field Cent., Pembroke, Dyfed, UK

241 pp., published in 2 volumes

Report Number: FSC(OPRU)/6/83

ABSTRACT
Twenty-one of the transects studied by Crapp (1970) were resurveyed and the results are presented. The decline in numbers of Monodonta lineata had continued. In general, the barnacle species compositions recorded in 1979 were closer to those recorded in 1960-1963 than to those of the 1968-70 survey. The recovery of localized areas affected by individual pollution incidents had continued, and in most cases it was not possible in 1979 to identify the damaged areas affected from their biota, except possibly for the species composition of the acorn barnacle populations. There had been large changes in the cover of fucoid species in the decade up to 1979 with net reductions at many sites for some species, and increases in other species. These results are possibly due to a subtle shift in climatic conditions. No widespread pollution effects can be discerned from the studies reported here.

Lum, A.L. (1978)

Shorebird fauna changes of a small tropical estuary following habitat alteration: Biological and political impacts of environmental restoration

WHOI, Marine Policy and Ocean Management, Woods Hole, MA 02543

Environmental Management 2(5), 423-430, Coden: ENVMA6

illus. refs.

Abs.

ABSTRACT
Paiko Lagoon is a small, shallow estuary located on the southeastern shore of Oahu, Hawaii. The lagoon bottom is composed of mixed mud and sand overlying a coral reef base. Prior to modification, the lagoon was characterized by intertidal mud and sand bars dispersed throughout. A sand-covered reef flat extends about 500 m seaward to the south from the mouth of the lagoon. Several species of shorebirds, e.g., American Golden Plover (Pluvailis dominica fulva), Ruddy Turnstone (Arenaria interpres), Sanderling (Calidris alba), Wandering Tattler (Heteroscelus incanum), and Black-necked Stilt (Himantopus himantopus knudsenii), feed and rest in the lagoon and along the adjacent reef during the day. Following completion of the habitat improvement project, the lagoon was designated a wildlife sanctuary in 1974. Improvement consisted of the following: the lagoon was dredged only to a depth necessary to eliminate the intertidal bars; channels were dredged in existing subtidal areas; mangroves were removed; and small islands were created from the dredged spoil to provide areas where stilt might nest undisturbed. Monthly averages for the 5 bird species studied were compared between years using a Wilcoxon Sign-Rank test. A lower abundance was noted in 1973 for plovers, turnstones, and tattlers. Stilt, the important species in terms of habitat improvement goals was not sighted between Jan. and May 1976. Although the project did not yield significant biological benefits to shorebirds, the public, especially local residents, felt that the lagoon was more ecologically valuable after its restoration. When that state planned to acquire the sanctuary and construct a single family dwelling in 1975, the Court did not support public opposition, stating they did not provide sufficient evidence that the construction would adversely impact wildlife. (FT)

Lutz, R.E.; Meck, J.P. (1977)

Recovering for marine life damage: Legal aspects of allocating social costs and protecting public interests

Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977.

McGeorge Sch. Law, Sacramento, CA, USA

Publisher(s): American Petroleum Inst., Washington, DC (USA), pp. 11-14

Report Number: API-Publ --4284

ABSTRACT
Determining and evaluating wildlife damage is becoming a necessary procedure in the settlement or adjudication of harm resulting from major oil spills. This is especially so in light of the several present and the many proposed compensation funds which provide for wildlife damage. Once a dollar figure is ascertained, various methods are available in compensating for these damages. In determining damages, 2 basic problems exist. First is the question of who owns the wildlife or who can assert a claim to ownership of the wildlife. Second, how can the fact and extent of damage to wildlife be assessed. The various theories supporting the right to wildlife damage recovery include: ownership in fee, trusteeship, parens patriae, public interest/private Attorney General, and citizen-guardian ad litem. Ascertaining the fact and extent of damages must be reasonably certain and not speculative. Such certainty can be determined from statistical estimations based on adequate sampling or inventories. Wildlife damage resulting from a major oil spill can amount to many millions of dollars. Arriving at the final figure in most instances necessitates addressing 2 issues: one, placing a dollar figure on wildlife species having no current market value two, calculating the damage of the destroyed wildlife in the context of the relevant ecosystem. Methods of evaluating currently non-marketable natural resources and damage to relevant ecosystems include replacement value, psychic value, and consumptive and non-consumptive use values. Means of compensating and settling damage claims can be accomplished by a number of means including the traditional method of direct cash payment. Alternative approaches could include trust funds, specific replacement and restoration programs, maintenance of sanctuaries and reserves, and financing of wildlife refuges and habitats. Compensating for wildlife damage is moving from the strictly unquantifiable approach of civil penalties to an approach which allows for a quantification of damages. This article discusses many of the issues, as briefly described above, relating to this expanded approach.

Lyke, W.L.; Hoban, T.J. (eds.); Phillips, J.D.; Phillips, L.R. (1988)

Delineation of shoreline buffer zones for stormwater pollution control

Dept. Geogr., Arizona State Univ., Tempe, AZ 85287, USA

Symposium on Coastal Water Resources Wilmington, NC (USA) (1988)

Proceedings of the Symposium on Coastal Water Resources. Pages 351-358

Tech. Publ. Ser. Am. Water Resour. Assoc.

ABSTRACT
Buffer zones are effective for mitigating impacts of nonpoint source pollution from estuarine shoreline developments, but no physically valid method for delineating buffer zones has been available. A physical model for buffer zone delineation can be derived from Bagnold's stream power theory and the Manning equation for overland flow. The model relates the transport capacity of runoff for a particular buffer zone to reference conditions, and is based on the assumption that pollutant transport is proportional to the energy of overland flow. Once reference conditions -- i.e., an acceptable buffer zone design -- are established, any proposed buffer zone can be evaluated to determine its pollution control effectiveness relative to the reference condition. Example applications are given.

Mackie, P.R.; Hardy, R.; Whittle, K.J. (1978)

Preliminary assessment of the presence of oil in the ecosystem at Ekofisk after the blowout, April 22-30, 1977

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1077.

Torry Res. Sta., Abbey Rd., Aberdeen, UK, 35(5), 544-551.

J. Fish. Res. Board Can.

ABSTRACT
The marine environment in the Ekofisk area was assayed for the presence of oil components after the blowout on Platform Bravo was brought under control. Several methods of assay were used but the results were not always strictly comparable. Relatively high fluorescence values were observed in water samples in the vicinity of the platform. However, gas-liquid chromatography of these samples indicated that although some of the hydrocarbon fractions now resembled crude oil, none had increased markedly in concentration. The presence of oil could be detected in the biota and taste panels were able to identify an oily taint at low level in some fish caught near the platform. A second survey some 2 months after the spill indicated that little, if any, oil from the blowout remained in the water column.

Maiero, D.J.; Castle, R.W.; Crain, O.L. (1978)

Protection, cleanup and restoration of salt marshes endangered by oil spills: A procedural manual

United Research Services, San Mateo, CA (USA)

Contract No. EPA-68-03-2160.

Report Number: 167 p

ABSTRACT
Decision making criteria are provided for both the protection and cleanup. Special attention is given to the cleanup phase which involves foot and vehicular traffic in the marsh and which may lead to serious adverse impacts. The user is presented with criteria for termination of activities for both protection and cleanup activities. Recovery includes evaluation of the need for restoration versus natural recovery, and restoration techniques.

Mair, J.M.; Matheson, I.; Appelbee, J.F. (1987)

Offshore macrobenthic recovery in the Murchison Field following the termination of drill-cuttings discharges

Inst. Offshore Eng., Heriot-Watt Univ., Research Park, Riccarton, Edinburgh EH14 4AS, UK

Mar. Pollut. Bull. 18 (12). 628-634. CODEN: MPNBA

ABSTRACT
The effects of discharged drilling cuttings contaminated with oil-based drilling fluids on the macrobenthos surrounding several North Sea oil-production platforms have been well documented. Areas of biological effect ranging from highly modified benthic communities, through transitional zones to undisturbed zones have been identified and characterized. Results are presented from a series of studies at the Murchison oil field which indicate partial recovery of macrofaunal communities around the production platform after cuttings discharges had ceased. Eventual rates of recovery of affected macrobenthic communities around production platforms are discussed in terms of persistence of oil in the drilling cuttings and the rates of degradation of the oil and its toxic components.

Majumdar, S.K.; Miller, E.W. (ed.) (1984)

USA Solid and Liquid Wastes Management Methods and Socioeconomic Considerations

Publication of the Pennsylvania Academy of Science, Easton, PA, USA. XXIII+412 pp.

Dept. Biology, Lafayette College, Easton, PA 18042

ILLUS. MAPS.

Report Number: ISBN 0-9606670-3-2. 0 (0), CODEN: 19408

ABSTRACT
This text is comprised of papers written by leading authorities in the field of solid and liquid waste management. The text is divided into 5 main sections. Section 1 discusses the sources and management of waste types, including classification and properties of solid and liquid wastes, solid waste handling in hospitals, and the management of wastes in India. The 2nd section discusses treatment technology and includes wastewater treatment, microbial destruction and solid waste land treatment systems. The 3rd section is on the environmental and health impacts, including organic compounds in the terrestrial environment, cadmium and other trace elements, and oil pollution in the ocean. The next section includes disposal, recycling and energy recovery, and the concluding section discusses laws, regulations and socioeconomic considerations. An appendix on acid rain research is reprinted from the EPRI Journal. Maps, tables, graphs and an index supplement this text.

Mann, K.H. (1978)

A biologist looks at oil in the sea

Dalhousie Univ., Dept. of Biology, Halifax, N.S. B3H 4J1, Can.

SHORE AND BEACH 46(4), 27-29, Coden: SHBEAS

no refs.

No abs.

ABSTRACT
Oil contamination of highly productive inshore waters results in varying degrees of damage, depending on the type of oil and the type of community living there. In temperate water the recovery time for coastal communities is about 10 yr, during which time much of the oil is consumed by microorganisms and converted to carbon dioxide or is buried in sediments, but because biological decomposition of oil and recolonization are slower in colder waters, recovery for oiled arctic waters may be much longer than 10 yr. Short growth seasons for plants, low temperatures, and long periods of ice cover also contribute to community stress by affecting species diversity, already lowered by the oil contamination. (FT)

Mann, K.H.; Clark, R.B. (1977)

Session 3. Summary and overview: Long-term effects of oil spills on marine intertidal communities

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1977.

Dept. Biol., Dalhousie Univ., Halifax, NS B3H 4J1, Canada, 35(5), 791-795.

J. Fish. Res. Board Can.

ABSTRACT
Consequences of oil pollution are similar in principle to other natural and man-made perturbations of the marine environment, and should be viewed in the context of the broader aspects of ecology. Community structures usually take about 10 years to return to something approaching this normal state, but rate of recovery depends on many factors. Organisms with little mobility and slow rates of reproduction take a long time to recolonize and, therefore, recovery of arctic environments may be slower than that of temperate and subboreal environments. Recovery cannot begin until polluting substances have been removed. Data on natural variability of organisms must be obtained to establish that those exposed to oil are significantly different.

Marchand, P. (1978)

Le petrole marin

[*The marine oil*]

CNEXO, 66, av. d'Iena, 75116 Paris, France

Oceanis (Doc. Oceanogr.), 4(suppl.), 252-293.

ABSTRACT
Twenty percent of world oil production (480 million tons) is coming from the sea. This proportion will increase in the future, even if a general decline of production is expected in 10 years. Ultimate world resources are estimated to be $260x10^9$ tons the marine part is $120x10^9$ tons. Seismic is the most used marine prospection method. Adaptation of rotary drilling method to the sea has given 4 kinds of support: jack up (half of the 360 drilling units in 1977), semi-submersibles (25%), drillship (20%) and submersible (6%). The two principal innovations were dynamic positioning and riser (flexible connection between well-head and surface unit). Concerning oil recovery, more than 10 directional drillings are generally needed from a fixed platform where wellheads, separation and treatment units are found. Oil is transported by tankers (storage methods) or pipe lines. Oil from the sea is much more expansive than terrestrial one, in particular under rough climates or in deep water. The North Sea oil production is booming. Experts are expecting an oil crisis before the end of the century: production capacity will be unable to satisfy the oil demand.

Marcus, M.D.; Bergman, H.L.; Stoller, D.A.; Brown, S.K.; Molhot, P.A. (1980)

Bibliography of aquatic ecosystem effects: Analytical methods and treatment technologies for organic compounds in advanced fossil-fuel processing effluents

Dept. Zoology and Physiology, Wyoming Univ., Laramie, WY 82071, USA

Environmental Protection Agency, Duluth, MN (USA). Office of Research and Development.

Ecol. Res. Series, U.S. Environ. Protect. Agency

EPA, Duluth, MN (USA)

1314 refs.

Report Number: 362 p

ABSTRACT
Advance fossil-field processing operations, including oil-shale retorting, coal gasification, coal liquefaction and tar-sands recovery, can result in chemically complex aqueous waste effluents. This bibliography compiles much of the recent literature (1970-1977) concerning effects of organic compounds in advanced fossil-fuel processing effluents when discharged into aquatic ecosystems, plus information available on analytical methods and treatment technologies for these organics. To compile the bibliography, nearly 500 organic compounds known to be constituents of fossil fuels and fossil-fuel processing effluents were crossed with a list of key words during a computerized search of six bibliographic data bases. The bibliography contains 1314 citations which are indexed by chemicals, key words, taxonomic categories and authors. This bibliography is intended especially for researchers working with advanced fossil-field processing effluents in aquatic environments, but may also be useful to those concerned with fossil-fuel processing effluents in terrestrial environments and to those working in pulp mill and pesticide research.

Matthews, D. (1988)

Reclaiming Riley Ridge

Lamp, Winter 88, V70, N4, P24(6)

ABSTRACT
The probable impact of natural gas development plans formulated for an Exxon lease in southwestern Wyoming were assessed to aid in environmental and aesthetic restoration. Representatives from various federal environmental agencies inspected the 40,000 acre development twice yearly to insure that the oil company was complying with federal regulations. Exxon took innovative steps to inform local communities of project plans, to protect wildlife and water, and to guard against unacceptable risk to the public of exposure to lethal concentrations of hydrogen sulfide. Pipeline rights of way and other areas showing signs of disruption have been successfully revegetated and recontoured. (8 photos)

Mavis, J.D.; Rosain, R.M. (1982)

Pollution Control Practices: Water Management in the Oil Shale Industry

CH2M Hill, WA

Chemical Engineering Progress, Jun 82, V78, N6, P61 (9). The original document is available from Bowker.

ABSTRACT
Disposal options for the effluents produced by oil shale mining and recovery in the Western U.S. are surveyed. Wastewater reuse is the only realistic disposal alternative in this water-short region. Reuse opportunities, water chemistry, and treatment alternatives are examined. The application of biological and physicochemical processes to the treatment of retort and condensate wastewaters is described.
(5 diagrams, 22 references, 3 tables)

McGill, W.B. (1977)

Soil restoration following oil spills - A review

Dep. Soil Sci., Alberta Inst. Pedol., Univ. Alberta, Edmonton, Alta., Canada

J. Can. Pet. Technol., 16(2), 60-67.

ABSTRACT
An average of 1-2 oil spills occur in Alberta per day. Most of these are on land. Although many studies have been conducted into the effects of oil on plants and water, only a limited number have dealt with soil. This paper summarizes our information on soil restoration following oil spills. The development of our understanding of oil spill effects on soil is reviewed together with the early literature examining site restoration. Recent restoration research is dealt with in detail and the advantages of various techniques are discussed. Non-biological mechanisms of oil removal from soil, such as volatilization, burning and photodecomposition, are examined first, followed by biological restoration procedures. The effectiveness of various techniques depends on the type of oil, amount of oil and soil environment. Up to 40% of the residual oil left at a site after initial clean-up can be removed through non-biological mechanisms, primarily volatilization. Biological restoration is required to deal with much of the remainder. Biological restoration generally requires nutrient additions, aeration, maintenance of a neutral pH, tillage or mixing to break surface crusts and some form of drainage in very wet spors. Proper implementation of these techniques can increase the rate of restoration by several fold and sometimes an order of magnitude.

McIntyre, D. (1983?)

Underground Oil Spill Investigation and Cleanup

EPA, MA

API/EPA/USCG Oil Spill 8th Conf, San Antonio, Feb 28-Mar 3, 1983, P393 (4). The original document is available from Bowker.

ABSTRACT
The EPA Region I office received in April 1978 an oil spill report which involved a sheen leaching from an industrial park into a river in Connecticut. Investigations revealed that a buried storage tank had released an estimated 37,500-151,000 gal of no. 2 fuel oil. The source identification phase of the study is detailed, as are river cleanup and oil recovery/disposal efforts. Groundwater restoration programs were also initiated as a result of this major inland spill. (6 diagrams, 1 graph, 3 references)

McKell, C.M.; van Epps, G. (1980)

Vegetative Rehabilitation of Arid Land Disturbed in the Development of Oil Shale and Coal

Utah State Univ

NTIS Report PB80-189541, APR 80 (50). The original document is available from Bowker.

ABSTRACT
Field experiments were established on sites disturbed by exploratory drilling and production of coal and oil shale in Utah. Greenhouse studies were also performed using soil samples from these sites. Establishment of container-grown transplants was far more successful than plantings of bare-root seedlings or direct seeding. Propagation of native shrubs from stem cuttings provided a means of multiplying desired biotypes for land rehabilitation.

McVay, M.E.; Heilman, P.E.; Greer, D.M.; Brauen, S.E.; Baker, A.S. (1980)

Tidal freshwater marsh establishment on dredge spoils in the Columbia River Estuary

Western Washington Res. and Ext. Cent., Puyallup, WA 98371, USA

J. Environ. Qual., 9(3), 488-493.

ABSTRACT
A study of marsh establishment through seeding and transplanting of tufted hairgrass Deschampsia cespitosa and slough sedge Carex obnupta on sandy dredge material in an intertidal location is reported. The experiment included treatments with single and split applications of a mixed N, P, and K fertilizer. Survival and growth of plants and N, P, and K concentrations in plant tissues are presented. Survival and biomass production differed significantly with respect to elevation with few plants of either species surviving after the first winter below 0.7 m above Mean Lower Low Water (MLLW). The best growth of tufted hairgrass transplants was in upper elevations (Average about 1.9 m above MLLW), but satisfactory stands were obtained down to about 0.9 m above MLLW. The best growth of slough sedge was at middle elevations (about 1.1 m above MLLW) with satisfactory growth down to about 0.8 m above MLLW. Direct seeding was not a satisfactory means for establishing these species, although natural seeding of tufted hairgrass began to occur in the second year of the plantings in areas protected and stabilized by the transplants. Fertilizer significantly increased growth of tufted hairgrass during both growing seasons, particularly at the upper tier. With slough sedge, except for a slight increase in the number of culms, fertilizer had no significant effect on growth in either year.

Meade, N.F. (1981)

The Amoco Cadiz Oil Spill: An Analysis of Emergency Response Clean-Up and Environmental Rehabilitation Costs

NOAA

Presented at OECD Cost of Oil Spills Conf, France, Jun 16-18, 81, P130 (18). The original document is available from Bowker.

ABSTRACT
Preliminary total and incremental cost estimates for the emergency response, clean-up, and environmental restoration activities following the grounding of the tanker Amoco Cadiz near Portsall, France, on March 16, 1978, are presented. A methodological framework is created that will make it easier for researcher to conduct similar analyses in the future of oil spills. The cost of the clean up is made explicit as it is an important component of the total damage cause by the Amoco Cadiz incident. (3 references, 9 tables)

Meier, V. (1978)

Oil well operation and salt-water intrusion: Policy implications

Cities Service Oil Co., Charleston, WV

Industrial Wastes 24(2), 42-45, Coden: INWABK

no refs.

No abs.

ABSTRACT
Oil and salt water are the primary water pollutants in oil well operation and maintenance. Whenever control measures are a necessary part of a well site development, a control plan is included in an environmental impact assessment plan required in some states. Erosion and spills are prevented by installing dikes or pits around drilling equipment. Pits may be lines with impervious materials to prevent leakage. Earthen pits are regularly inspected by state personnel during drilling operations. Drilling operations must have a spill prevention control and countermeasures plan required by EPA. Waste oil from equipment must be collected by ditches and dikes. Emulsifiers must be available to clean up spills. If a freshwater well is within 200 ft of an oil well, additional approval must be obtained from both the state and the landowner. Caution is exercised during all drilling operations to prevent rupture of casing. Any known mineral deposit is cased off and cemented across the zone to prevent migration of fluids to or from mineral zones into freshwater horizons. Brine is disposed of by evaporation or injection wells. The oil content of all waters dumped into surface waters is ordinarily J50 ppm. Oil wells must have adequate cement plugs between producing and saltwater zones and above and below freshwater horizons. State and federal regulations pertaining to groundwater protection should be coordinated. Additional regulations could substantially decrease ultimate recovery of hydrocarbons. (FT)

Michaelis, F.B. (1983)

Effect of Turoa oil spill on aquatic insects in the Mangawhero River system

16 Lanoma St., Launceston, Tas., Australia 7250

N.Z. Entomol., Vol. 7, No. 4, pp. 447-455.

ABSTRACT
Oil (17,000 l) was spilled from Turoa Skifield on Mt Ruapehu and entered the headwaters of the Mangawhero and Makotuku Rivers where it persisted for up to 5 months. Brown trout, rainbow trout, long-finned eels, and blue duck were not killed. However, in the upper reaches, aquatic insects were disturbed and killed by the oil spill within 2 weeks. The total numbers of aquatic insects were not significantly affected at the lower stations within Tongariro National Park over the following year. The mayflies Deleatidium nr myzobranchia B and D nr lilii A (Ephemeroptera: Leptophlebiidae) were significantly reduced in numbers in the Mokotuku River following the oil spill and may be indicator species for oil pollution. Comparisons with overseas studies confirmed a recovery time of at least 6 months for the "sensitive" orders of aquatic insects following an oil spill of this magnitude.

Mickelson, P.G.; Schamel, D.; Tracy, D.; Ionson, A. (1977)

Avian community ecology at two sites on Espenberg Peninsula in Kotzebue Sound, Alaska

Alaska Univ., Inst. Arctic Biol., Fairbanks, AK, USA

In: Environmental assessment of the Alaskan continental shelf. Volume 5. receptors--birds.

U.S. National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Laboratories, Mar 1977, p. 1-74

Contract No. 03-5-022-56

Report Number: NOAA/ERL-AR-77-5

ABSTRACT
Cape Espenberg is an 1.5 km wide peninsula, jutting 13 km into the western edge of Kotzebue Sound in western Alaska. It is comprised of a series of sand dune ridges, interspersed with numerous ponds and marshes. Prevailing winds are westerly during summer and currents, which sweep nearshore at Espenberg, come from the west. Thus, large oil spills on Chukchi Sea waters north of the Bering Strait to Kotzebue Sound are likely to be deposited on the beaches of Cape Espenberg. The main objectives of this study were to: determine the seasonality of habitat use by birds, determine the productivity of nesting birds and factors affecting productivity, determine use of the area by sea mammals, and establish guidelines for future biological monitoring. Oil contamination of nearshore waters poses a threat to bird populations throughout the summer. Numerous birds rely upon marine organisms throughout the summer and would be subjected to oil contamination while foraging at sea. The beach of Cape Espenberg is a likely site of sand extraction for petroleum development-related activities. Such an activity during summer may produce sufficient turbidity to lower the feeding efficiency of birds around the site, as well as downcurrent. More importantly, sand extraction may endanger the integrity of the cape, through subsequent erosion of the dunes, and jeopardize marsh habitat.

Millemann, R.E.; Haynes, R.J.; Boggs, T.A.; Hildebrand, S.G. (1982)

Enhanced oil recovery: Environmental issues and state regulatory programs

Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830, USA

Environ. Int., Vol. 7, No. 3, pp. 165-177.

ABSTRACT
During 1977-78, Oak Ridge National Laboratory prepared environmental impact assessments for nine U.S. Department of Energy-sponsored enhanced oil recovery (EOR) field demonstration projects located in six states and reviewed the oil regulations for all oil-producing states. These evaluations revealed some potentially important environmental impacts associated with EOR including pollution of land and surface waters from spills or leaks of oil and brine or other chemicals, loss of biota and, contamination of groundwater. Potential groundwater impacts include production of toxic and carcinogenic substances from synergistic interactions among chemicals used primarily in the micellar-polymer flooding technique. For use of EOR techniques to expand in an environmentally acceptable manner, environmental planning (including monitoring, protection measures, and reclamation strategies) must be an integral part of the initial project development. Acceptable monitoring, prevention, mitigation, and reclamation procedures are available for most of the identified environmental problems, but the best techniques may not be known by operators or required by law.

Mitchell, J.K. (1976)

Onshore impacts of Scottish offshore oil: Planning implications for the Middle Atlantic states

Rutgers Univ., New Brunswick, NJ 08903, USA

J. Am. Inst. Plann., 42(4), 386-398.

ABSTRACT
Existing environmental impact statements have failed to consider many possible onshore impacts associated with offshore oil and gas recovery from the Baltimore Canyon. They have also ignored the cumulative effects of other coastal zone energy proposals. By providing an overview of problems which have arisen elsewhere, the Scottish North Sea experience can supply valuable alternative inputs to the planning process in Middle Atlantic states. Since strategic planning goals may be superseded by the need to meet rapidly changing short-term demands, a comprehensive management program that includes facilities inventories, site acquisition, hazard guidelines, and identification of priority investment zones is necessary.

Moldan, A.; Chapman, P.; Fourie, H.O. (1979)

Some Ecological Effects of the Venpet-Venoil Collision

South Africa Dept of Industries, Sea Point

Marine Pollution B, V10, N2, P60 (4)

ABSTRACT
The effects of oil released by the Venpet-Venoil collision in December 1977 on the intertidal fauna along the rocky shores, beaches, and estuaries along the south coast of South Africa have been monitored at monthly intervals since the incident. Estuaries and sheltered coves suffered the greatest damage as a result of the smothering effects of the oil. Damage to the remaining areas has been slight because of the patchy distribution of oil. Additional studies on the rate of recolonization will be conducted during the coming months. The recolonizing fauna and flora are expected to undergo succession before stable communities are reestablished. (2 maps, 16 references)

Moore, S.F. (1976)

Oil Spills and the Marine Environment

MIT

Technology Review, Feb 76, V78, N4, P61 (8). The original document is available from Bowker.

ABSTRACT
How profound the initial impact of an oil spill will be depends both on the nature of the community of animals and plants in the area and on the nature of the oil. Recovery from spills consists generally of degradation and natural removal of oil from exposed areas followed by return of populations and communities. Biological recovery from a spill, estimating recovery, impact of a hypothetical spill, and the implications of ecological uncertainties are discussed. (11 drawings, 2 graphs, 3 references, 1 table)

Moore, S.F.; Chirlin, G.R.; Puccia, C.J.; Schrader, B.P. (1974)

Potential Biological Effects of Hypothetical Oil Discharges in the Atlantic coast and Gulf of Alaska

MIT

NTIS Report COM-74-11089, Apr 1, 1974 (206). The original document is available from Bowker.

ABSTRACT
The primary biological effects of potential oil discharges resulting from hypothetical oil production activity on the Atlantic/Alaskan outer continental shelf are analyzed. Although emphasis is placed on analysis of impacts and recovery from large volume infrequent accidental oil spills, small volume continuous discharges of hydrocarbons are also considered. Effects of oil releases from offshore platforms and spills occurring at coastal terminals are assessed. Qualitative predictions that are a rough order of magnitude estimates of physical, chemical, and biological changes likely to occur due to oil releases into the marine environment are attempted. The study consists of several principal parts: an environmental inventory; a summary of response and sensitivity of individual organisms to petroleum substances; an analysis of population/community level responses to oil, especially population recovery from accidental spills; and an assessment of potential effects of specific oil discharges associated with hypothetical outer continental shelf petroleum developments.

Mott, C.A. (1983)

Geological risk mitigation in U.S. offshore shelf oil exploration and production

Comap Geosurveys Inc., San Francisco, CA, USA

Oil Gas J., Vol. 81, No. 38, pp. 156-162.

ABSTRACT
Examples of geological hazards that may be encountered during drilling operations: Movement of sea floor sediments, either downslope as a result of normal sedimentary processes, e.g. slumping or creep, or due to seismic shaking as a result of earthquake activity shallow gas may be present in near seabed sediments where it may reduce the bearing capacity of these sediments, thereby endangering life and equipment and strong ocean currents may erode away the sediments into which a structure is set. Regulations have been implemented by the Minerals Management Service of the Department of the Interior. These regulations stipulate what techniques must be employed and with what coverage they must be used to identify these risks so that the appropriate measures are taken to migrate them.

Mozley, S.C.; Butler, M.G. (1978)

Arctic Effects of crude oil on aquatic insects of tundra ponds

Presented at the Workshop on Ecological Effects of Hydrocarbon Spills in Alaska, Woods Hole, MA (USA), 8 Apr 1978.

Dept. Zool., North Carolina State Univ., Raleigh, NC, USA, 31(3), 299-241.

ABSTRACT
Aquatic insects comprise most of the biomass and production of tundra thaw ponds. Field experiments on two ponds with application rates of about 10 l/m^2 (Pond E 1970) and 0.24 l/m^2 (Pond 1975) resulted in the selective elimination of Asynarchus (Trich., Limnephilidae) and Nemoura (Plec., Nemouridae). Chironomidae in Pond displayed much lower rates of adult emergence in 1976 and 1977 than in 1975, immediately before and after oil treatment, with several species in the tribe Tanytarsini most reduced. Pond E did not show low emergence rates, but the proportion of Orthocladiinae was much higher than in reference ponds. Trichotanypus was severely reduced in Pond but unusually abundant in Pond E in 1976 and 1977. Effects of oil seem to be different for different species, and occur at some point during the late larval stages of insects or at metamorphosis, but toxicity experiments did not confirm this. Oil may also interfere with reproduction in insect species which remain mainly on or near the pond surface as adults. There is no indication of recovery of Nemoura, Asynarchus or Tanytarsini in Pond E seven years after the spill, but biomass and abundance of the other aquatic insects remain high. It is recommended that clean-up measures avoid introducing solvents or dispersants, which might be toxic to insects in the ponds.

Mumphrey, A.J., Jr.; Carlucci, G.D., Jr. (1978)

Environmental planning for offshore oil and gas. Volume 5. Regional status reports, part 3: Gulf Coast region

New Orleans Univ., Urban Studies Inst., New Orleans, LA, USA

Conservation Foundation, Washington, DC (USA)

Biol. Serv. Program Fish. Wildl. Serv. (U.S.)

Publisher(s): US Fish and Wildlife Service, Office of Biological Services Washington, DC (USA)

Contract No. 14-16-0008-962

Report Number: 172 p

ABSTRACT
Oil and gas have been recovered for several decades from the Outer Continental Shelf of Texas and Louisiana. The major environmental impacts of OCS development have been in the form of oil spills, dredging and channelization of the wetlands, and onshore development. The specific effects of these actions are discussed. An outline of the major types of oil and condensate spills that have occurred, as well as a discussion of the other types of environmental problems are provided. Probably the most significant environmental impact of OCS operations has been the effect on the wetlands from dredging and channelization in order to bury and maintain pipelines. The second significant effect is the urbanization that has resulted from the economic expansion stimulated by offshore operations. The socioeconomic impacts are discussed.

Murrell, T.L.; Levine, J.R.; Regg, J.B.; Tennyson, E.J. (1987)

Oil-Spill-Response Measures for Offshore Oil and Gas Operations

US Minerals Management Service Report 87-0062, Apr 87 (179). The original document is available from Bowker.

ABSTRACT
Oil spill response capabilities are examined for arctic and subarctic outer continental shelf (OCS) areas. The responsibility to protect the marine environment from oil pollution is established by the OCS Lands Act of 1978. U.S. Minerals Management Service judges the adequacy of leasees' spill response preparedness and requires operators to provide training and oil spill response exercises. Various spill response measures identified for use offshore Alaska are emphasized. These involve efforts in eight major categories: detection, containment, recovery, in situ burning, chemical application, shoreline cleanup, wildlife protection and rehabilitation, and disposal. Equipment and procedures highlighted are oil booms, skimmer systems, chemical dispersants, shoreline cleanup via direct suction or in situ burning, and disposal via incinerators, dispersion, or in situ burning. (3 graphs, 99 references, 8 tables)

Nesterova, M.P.; Mochalova, O.S.; Antonova, N.M. (1985)

Fiziko-khimicheskie predposylki ispol'zovaniya dispergiruyushchikh sredstv v bor'be s neftyanymi razlivami

[*Some physico-chemical aspects of using dispersants for oil pollution control*]

Inst. Okeanol. AN S.S.S.R., Moscow, USSR

Okeanologiya., Vol. 25, No. 1, pp. 93-99.

ABSTRACT
Evidence is provided to support the view that colloidal chemical properties of dispersants are responsible for transformation of surface oil slicks into stable emulsion restoring air-water exchanges. The experiments have shown that a co-effect of surfactants and aqueous phase results in the intensification of natural processes of oxidation of hydrocarbons.

Newell, B.S. (1981)

Restoration of Lake Wellington -- a multi-objective experiment

Victorian Brown Coal Counc., Vic., Australia

AUST. FISH., Vol. 40, No. 5, pp. 19-21, (1981).

ABSTRACT
The author describes briefly a plan to keep Lake Wellington permanently fresh and thereby help it to restore its original vegetation. The plan calls for the creation of a partial barrier in the eastern end of Reeve Channel, which would diminish channel cross-section and thereby reduce the tidal, prism which is responsible for Lake Wellington's variations in salinity.

Nichols, A.B. (1989)

Alaskan Oil Spill Shocks the Nation

WPCF J, Jul 89, V61, N7, P1174(12). The original document is available from Bowker.

ABSTRACT
Nearly 11 million gal of oil escaped from the tanker, Exxon Valdez, into Alaska's Prince William Sound on March 24, 1989, despite massive efforts to contain the spill. Spill teams employed by Exxon have used various means, including fire hosing the oil stained beaches using heated seawater to remove the effects of the spill along the shoreline. Total cost of the cleanup could exceed $1 billion, and authorities predict that it could take as long as ten years before the effects of the spill disappear from the shores of the sound.

Niedzialkowski, D.M.; Kerr, R.L. (1988)

Wetlands mitigation banking: Planning for protection of environmental values

Proceedings of the Symposium on Coastal Water Resources Wilmington, NC (USA) (1988)

Lyke, W.L.; Hoban, T.J., eds. Pages 789-790

U.S. EPA (PM-223), 401 M St., S.W., Washington, DC 20460, USA

Tech. Publ. Ser. Am. Water Resour. Assoc.

Report Number: TPS-88-1

ABSTRACT
Wetlands mitigation banking is an innovative alternative for compensating for the unavoidable impact of development in wetlands where mitigative measures cannot be achieved on or near the site of impact. To establish a bank, a sponsor (developer, industry, state agency or other entity) proposes a plan for creating new wetlands or restoring existing degraded wetlands. The plan is either incorporated directly into a contractual agreement called a "Memorandum of Agreement" (MOA) or referenced in the MOA, and implemented prior to the project requiring mitigation. An interagency team including the bank sponsor, and some (but not usually all) of the authorities having regulatory jurisdiction over the wetland or wetland resources in the area of the proposed bank is usually involved in the development and administration of the MOA.

Niesen, T.M.; Lyke, E.B. (1981)

Pioneer infaunal communities in the Hayward Salt Marsh restoration (San Francisco Bay)

6th Biennial International Estuarine Research Conference, Gleneden Beach, OR (USA), 1-5 Nov 1981

San Francisco State Univ., San Francisco, CA 94132, USA

Estuaries, Vol. 4, No. 3, p. 243.

Summary only.

ABSTRACT
The most extensive salt marsh restoration project on the West Coast involves a 200 acre former salt evaporation pond in Hayward, California on San Francisco Bay. Historically a wetland area, this diked pond was returned to Bay tidal action in May 1980. The site has been graded for restoration to Spartina-Salicornia salt marsh habitat basins, meandering channels and islands for potential development of submerged, intertidal and upland habitat have been created. Colonization of the restoration site was initially slow. The earliest colonizers were adult amphipods, which presumably rafted in from the Bay mud flat. Subsequent planktonic recruitment to the site has been dominated by spionid polychaete worms and several species of bivalve molluscs.

Niewolak, S. (1978)

Microbiological aspects of restoration of cultivated soils contaminated with crude oil

Inst. Hydrobiol. Ochr. Wod, Akad. Roln.-Tech., 10-957 Olsztyn, Poland

Wiad Ekol 24 (2). 109-118. CODEN: WEKLA

ABSTRACT
Due to contamination of cultivated soils with crude oil the germination of corn plants and legumes was delayed and potatoes did not germinate. The plants died showing symptoms of chlorosis. Simultaneous changes of physical and chemical properties of soils contaminated with crude oil caused the death of microfauna and the majority of aerobic bacteria, Actinomycetes and fungi. The excess of organic C at a simultaneous deficit of O2, N and P produced worse conditions for the development of microorganisms in soils which can use crude oil as a source of C and energy. Under natural soil conditions many microorganisms decomposed the crude oil hydrocarbons. Development of these microorganisms may be stimulated by proper cultivation (aeration) and mineral fertilization (N + P) or by adding selected hydrocarbon-oxidizing bacteria.

Norderhaug, M. (1979)

Problems in arctic conservation

Oslo Dep., Minist. Environ., Myntgaten 2, Oslo 1, Norway

Dan Ornithol Foren Tidsskr 73 (1-2). 59-68. CODEN: DOFTA

ABSTRACT
The environmental problems resulting from Man's present activities in the North are numerous. Some of the main (or potential) problems are summarized. Significant improvements have been achieved in Arctic conservation in the last 10-15 yr. Much remains to be done. Larger and more representative parts of terrestrial Arctic ecosystems need protection. Increasing human activity, including expanding tourism, needs better control from the responsible governments. Various types of technical/economic activities, including possible overexploitation from modern fisheries and oil exploration, may threaten the food base and the environment of various species of birds and mammals. Several populations of marine mammals have still not recovered from former overexploitation. Various populations of birds are probably facing increasing problems during their regular winter migration. Pollutants through ocean and atmosphere may on a long term basis cause new environmental problems in the Arctic. The need for increased conservation oriented research in the Arctic and a more future oriented conservation policy in the Arctic nations are of vital importance. There is also a need for more close international cooperation to deal with the conservation problems.

Restoration of beaches contaminated by oil (1972)

NTIS Report PB-214 419/4 SEP 72 (129)

Oil Spillage Study-Literature Search and Critical Evaluation for Selection of Promising Techniques to Control and Prevent Damage: BNPC-319 (1967)

NTIS Report AD-786 403, Jun 20, 67 (60)

The original document is available from Bowker.

ABSTRACT
The current state of oil spillage control and prevention technology is surveyed and analyzed to determine areas where R&D can better protect the environment against oil pollution. The pertinent areas of research are: preventing accidents that will affect the environment; limiting effects to the immediate environment in the event of an accident; and restoring the environment. Literature survey and evaluation, recommendations for R&D, and liability and legal considerations are included.

Nulty, P. (1989)

The Future of Big Oil

Fortune, May 8, 89, V119, N10, P46(4). The original document is available from Bowker.

ABSTRACT
The Valdez, Alaska, Exxon oil tanker spill of 1989 is notable not just for its extensive damage to Alaska's pristine coastline, but also for the political and economic impact it could have. Congress postponed action on a bill to open up the Arctic Natl Wildlife Refuge to oil exploration as a result of the Valdez spill. If American oil resources are withheld, reliance on foreign sources could soar. However, actual effect of the Valdez spill could be minimal and toxic effects flushed out in two years. Alaskans interviewed still support the presence of oil companies, which provide 85% of the state's revenues. The accident at Valdez may ensure better preparation for future spill cleanups. (3 graphs, 1 map, 4 photos)

O'Brien, P.Y.; Dixon, P.S. (1976)

The effects of oils and oil components on algae a review

Br. Phycol. J. 11 (2). 115-142. CODEN: BPHJA

ABSTRACT
It appears that algae are able to withstand the effects of oil more effectively than susceptible animals, which has led to numerous reports of algal proliferations in the face of grazer mortality. The ability of primary consumers to regulate the distribution and abundance of intertidal and sublittoral algae has been considered by several authors and it would appear that the differential tolerances to pollution characteristic of various grazers will exert considerable influence on colonization success and eventual patterns of algal diversity and distribution following contamination of an exposed shoreline. After 14 yr the cove disturbed by the "Tampico Maru" grounding had not entirely reattained its pre-spill biological composition (North, in Neushul, 1970) even though 90% of the biota was restored after 3-4 yr (Mitchell et al., 1970). In the planktonic realm similar relationships between zooplankton susceptibility to oil and ultimate effects on phytoplankton populations have received comparatively little attention. Toxicity considerations notwithstanding, the possibility that disruptions of spatial and temporal relationships among primary space occupiers may lead to potential long term changes in patterns of intertidal community structure should be clearly documented in field impact assessments.

O'Farrell, T.P.; Mitchell, D.L. (1985)

Habitat Restoration Plan for Naval Petroleum Reserve No. 1, Kern County, California

EG and G Energy Measurements, Inc., Goleta, CA. Santa Barbara Operations.

Corp. Source Codes: 085084001; 9520079

Sponsor: Department of Energy, Washington, DC.

Report No.: EGG-10282-2081

68 pp.

NTIS Prices: PC A04/MF A01

Country of Publication: United States

Contract No.: AC08-83NV10282

ABSTRACT
In 1976 Congress directed that production on the US Department of Energy's (DOE) Naval Petroleum Reserve No. 1 (NPR-1) in Kern County, California, be increased to the maximum efficient rate to fulfill some United States needs for domestic oil and gas. The US Fish and Wildlife Service (FWS) issued a Biological Opinion, r4s spill cleanup to restore the environment was $280,000. The National Transportation Safety Board determines that the probable cause of this accident was the failure of the master and the docking pilot of the CONCHO to determine that the depth of the water was sufficient in the Constable Hook Reach of Kill Van Kull in Upper New York Harbor before attempting to navigate the loaded CONCHO through the channel.

Oviatt, C.; Frithsen, J.; Gearing, J.; Gearing, P. (1982)

Low Chronic Additions of No. 2 Fuel Oil: Chemical Behavior, Biological Impact and Recovery in a Simulated Estuarine Environment

Univ. Rhode Island, Mar. Ecosyst. Res. Lab., Kingston, RI 02881, USA

Mar. Ecol. (prog. Ser.)., Vol. 9, No. 2, pp. 121-136,.

ABSTRACT
Three long term experiments were conducted in estuarine microcosms with a water accommodated fraction of No. 2 fuel oil. The water column and benthic compartments (structure and processes) were assessed for impact of chronic oil concentrations (190 and 90 ppb in the water column), and recovery from exposure to 90 ppb oil concentration. Oil impacts were a function of concentration, oil residence time and temperature. The 190 ppb concentration reduced zooplankton both 190 ppb and 90 ppb reduced benthic fauna. In 1 yr after additions ceased the benthic fauna did not recover from 90 ppb. Effects on and oil residence time in the water column were transitory effects on and oil residence time in the benthos were long lasting. Effects on benthic fauna were most severe during the warm summer months.

Owens, E.H. (1978)

Mechanical dispersal of oil stranded in the littoral zone

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1977.

Coastal Stud. Inst., Louisiana State Univ., Baton Rouge, LA 70803, USA, 35(5), 563-572.

J. Fish. Res. Board Can.

ABSTRACT
The neutral weathering and dispersion of oil stranded in the littoral zone depend on the type and volume of the oil and on the amount of available energy. Energy inputs can be biological, chemical, mechanical, or thermal however, the single most important input appears to be from mechanical energy (winds, waves, tides, water levels, and ice). The residence time or persistence of stranded oils increases as mechanical energy levels at the shoreline decrease. The primary inputs of mechanical energy at the shoreline are due to wave action, and energy levels vary depending on the wind regime, fetch areas, and local exposure of a section of coast. In cold or polar climates, energy levels at the shoreline are reduced by the presence of ice on the sea or an ice foot on the beach. This review of the concepts associated with littoral processes, in terms of the mechanical dispersal of stranded oil, provides the basis for estimation of the persistence of oil on shorelines.

Owens, E.H.; Rashid, M.A. (1976)

Coastal environments and oil spill residues in Chedabucto Bay Nova Scotia Canada

Can. J. Earth. Sci. 13 (7). 908-928. CODEN: CJESA

ABSTRACT
Investigations following the oil spill from the tanker Arrow in Chedabucto Bay, Nova Scotia [Canada], in 1970 have focussed on the physical and chemical degradation of the Bunker C oil in different littoral environments and on the effects of sediment removal to restore polluted beaches. Natural processes have restored the beaches effectively on coasts exposed to wave activity. In sheltered, low-energy areas, the oil has undergone relatively little change over the 3 yr period and is still present in the littoral zone. The removal of contaminated sediments from exposed beaches has not caused major changes but has resulted in permanent retreat of the beach crest in areas of limited sediment supply.

Owens, E.H.; Robillard, G.A. (1981)

Spill Impacts and Shoreline Cleanup Operations on Arctic and Sub-Arctic Coasts

Woodward-Clyde Consultants, British Columbia

Presented at EPA/API/USCG 1981 Oil Spill Conf, Atlanta, Mar 2-5, 81, P305 (5). The original document is available from Bowker.

ABSTRACT
Spill response operations in ice-infested or arctic environments must take into account environmental factors or constraints that are not applicable in more temperate climates. The potential impact of oil on biological habitats or communities must be evaluated carefully in terms of species distributions and population abundance at the time of the spill. The potential natural recovery from spilled oil is reduced because of the modifying effects of ice on wave processes at the shoreline. The development of spill response decisions in arctic regions must focus on: the necessity for cleanup versus natural recovery; assigning priorities for the protection and cleanup of coastlines; and considerations of constraints resulting from climatic conditions. (1 diagram, 6 references, 1 table)

Pain, S. (1989)

Alaska Has its Fill of Oil

New Scientist, Aug 12, 89, V123, N1677, P34(7). The original document is available from Bowker.

ABSTRACT
The Exxon Valdez oil spill has changed Alaska's once blissful attitude towards the oil industry. Exploration for oil in Bristol Bay, the richest fishing ground in Alaska, has been postponed indefinitely. The controversial plan to drill for oil in the arctic national wildlife refuge on the north coast has increasingly lost favor. If the oil industry is to salvage its reputation, oil companies must prove willing to learn from their mistakes. Improved measures for spill prevention and control must be devised and their effectiveness demonstrated. (1 map, 6 photos)

Palmer, H.V.R., Jr. (1972)

Falmouth's oiled shellfish beds being restored

Unknown

National Fisherman. Camden, ME, 53(4): C10, Aug. 1972

Pasquet, R. (1981)

Effectiveness and Cost of Onshore Techniques to Control the Accidental Pollution of the Sea by Oil

Cedre, France

Presented at OECD Cost of Oil Spills Conf, France, Jun 16-18, 81, P112 (18). The original document is available from Bowker.

ABSTRACT
The effectiveness of an oil spill control technique must be considered in terms of restoring the coastline's appearance and its impact on the ecosystems of that coastline. Different phases of onshore clean-up involve rocky or sandy areas exposed to the waves or sheltered areas; clean-up also involves collection, restoration, storage and transportation, and disposal. One surprising fact is that manual pick-up of waste materials is not significantly more expensive in terms of the amount of oil collected than mechanical pickup. (7 tables)

Perna, A.J.; Wayne, T.J. (1970)

Effects, Recovery, Reuse of Oil from Aqueous Environments

Conf at Univ of Rhode Island, Jul 21-23, 70 P232 (12)

Perry, M.C.; Ferrigno, F.; Settle, F.H. (1978)

Rehabilitation of birds oiled on two Mid-Atlantic estuaries

Proceedings of the 32nd Annual Conference Southeastern Association of Fish and Wildlife Agencies, Hot Springs, VA (USA), 5 Nov 1978.

U.S. Fish Wildl. Serv., Migratory Bird Habitat Res. Lab., Laurel, MD 20811, USA, 32, 318-325

ABSTRACT
An estimated 52,500 birds died as a result of 7 major oil spills on 2 mid-Atlantic estuaries between 1973-78. Ruddy ducks (Oxyura jamaicensis) constituted 98% of 12,500 birds known to have died from 5 spills on the Delaware River. Seventy-six percent of 40,000 dead birds from 2 Chesapeake Bay spills were horned grebs (Podiceps auritus) and oldsquaw (Clangula hyemalis). Oiled waterfowl that were captured alive (6% of the estimated mortality) were cleaned with a variety of cleaning agents and techniques. High mortality occurred during and shortly after cleaning, and was apparently due to hypothermia and to toxicity of solvent cleaning agents. Eight-two percent of the 3113 birds that were cleaned died prior to or at time of release. The fate of the remaining 18% is unknown. Petroleum solvents used as cleaning agents were toxic to the birds. Most detergents left a surfactant (wetting agent) on the feathers which resulted in subsequent wetting of released birds. Although rehabilitation techniques have improved in recent years, high bird mortality can be expected following future oil spills.

Petersen, J.A. (1984)

Establishment of mussel beds: Attachment behavior and distribution of recently settled mussels (Mytilus californianus)

Nat. Hist. Mus., Los Angeles Co., 900 Exp. Blvd., Los Angeles, CA 90007, USA

Veliger, Vol. 27, No. 1, pp. 7-13.

ABSTRACT
The distribution and behavior of small M. californianus (plantigrades) were studied, and results were interpreted with respect to intertidal community structure and establishment of mussel beds. M. californianus plantigrades were found on mussel beds, algae, and bare rock. Highest densities of plantigrades were observed on the red alga Endocladia muricata . Field experiments and sample data suggest that algae that grow upon adult mussel shells have no effect on the density of settlers or plantigrades in a patch of mussels. Plantigrades were abundant in established mussel beds throughout the year because settlement is continuous. M. californianus beds are established only after a surface has been previously colonized. By settling and surviving upon many different surfaces, M. californianus is capable of establishing populations throughout a broad geographic range.

Phillips, R.C. (1980)

Transplanting methods

Sch. Nat. and Math. Sci., Seattle Pacific Univ., Seattle, WA 98119, USA

In: Handbook of seagrass biology: An ecosystem perspective

Phillips, R.C.; McRoy, C.P., eds.

Publisher(s): Garland STPM New York, NY (USA)

Report Number: p 41-56

ABSTRACT
Using transplanting techniques, there appears to be a great potential for investigating basic biological problems in seagrasses, i.e. intraspecific variation, phenotypic plasticity and population adaptations, phenology, and effects of oil and sewage pollution on seagrasses. Transplantation is reviewed as a technique for recolonizing areas which lose seagrass cover by human or natural perturbations, or to create new seagrass meadows in suitable areas. In doing this it will be possible to restore and create associated animal communities which lead to food animals. The author reviews methods used for seagrass transplantation. He summarizes the application to different species of seagrass. The methods fall principally into those involving anchoring, and non-anchoring methods. The author summarizes with a discussion of seagrass transplantation, noting areas for future research.

Political, Economic Fallout Spreads from Exxon Valdez Crude Oil Spill (1989)

Oil & Gas J, Apr 10, 89, V87, N15, P13(4)

ABSTRACT
When it ran aground in Prince William Sound, AK, on March 24, 1989, the Exxon Valdez tanker spilled more than 240,000 BBL of north slope crude oil. Spill cleanup is underway, while political and economic fallout continues to spread from history's largest crude oil spill in us waters. At least one refinery shut down, and another cut throughput because the accident halved the supply of north slope crude to 1 million BPD. Spot shortages of gasoline have been reported on the West Coast while various class action and criminal lawsuits are being filed against Exxon. The company's cleanup response to the spill, which has been criticized, is surveyed, as are apparent environmental damages associated with the incident.
(1 map, 1 photo)

Prince, E.D.; Maughan, O.E. (1978)

Freshwater artificial reefs: biology and economics

U.S. Fish and Wildlife Service, Southeast Reservoir Investigations, 206 Hury 123 By Pass, Clemson, SC 29631, USA

Fisheries, 3(1), 5-9.

ABSTRACT
Habitat improvement is recognized as an effective measure in managing and conserving inland fisheries resources disrupted by increased fishing pressure and pollution. Artificial reef construction is a proven medium for improving the abundance of fishes where lack of underwater structures is a limiting factor. It is shown that artificial reefs may increase fish colonization, harvest rates and production, by: (1) modifying the water temperature (2) shortening the lacustrine food web and (3) providing spawning sites. Economic considerations are outlined, and construction costs are given for various artificial reef sites. A number of practical techniques are suggested, with estimates for each method.

Prince, E.D.; Maughan, O.E.; Prouha, P. (1977)

How to build a freshwater artificial reef

Virginia Polytechnic Institute and State University, Blacksburg (USA). Sea Grant Extension Division

Sea Grant Rep. Va. Polytechnic Inst.

Publisher(s): VIP, Blacksburg, VA (USA), 2nd ed. 17p.

Report Number: VPI-SG-77-02

ABSTRACT
Updated guidelines for planning and constructing artificial reefs in freshwater are given. Reef-building methods vary depending on habitat type (i.e. lakes, ponds, and reservoirs). Artificial reefs involve different problems in rivers than in non-flowing waters. The present guidelines are for non-flowing waters. Since each body of water has unique characteristics and poses different problems, the reef builder must be flexible in adapting these instructions to each particular situation. Materials that have been used in freshwater reefs include tires, brush, trees, concrete and clay pipes, cement blocks, stake beds, automobile bodies, and old boats. Selection of construction design and material depends on the costs and availability of labor, material, funds, and equipment (barges, cranes, etc.). The estimated cost of several reef structures is given. After the reef units have been constructed, they must be positioned. In areas with sufficient winter ice, the units may be built over the ice or hauled out to the desired location and allowed to sink during the spring thaw. Reefs may also be planned directly in conjunction with reservoir construction.

Proskurenko, I.V. (1977)

Planirovanie tekhnicheskogo obespecheniya v marikul'tere

The planning of technical facilities in mariculture

In: Proceedings of the Fifth Japan-Soviet Joint Symposium on Aquaculture, September 1976, Tokyo and Sapporo, Japan.

Motoda, S., ed.

Presented at the 5th Japan-Soviet Joint Symposium on Aquaculture, Tokyo (Japan), 14 Sep 1976; Sapporo (Japan), 15 Sep 1976.

Pac. Res. Inst. Fish. Oceanogr. (TINRO), 20, Lenin St. Vladivostok, USSR

Publisher(s): Tokai University, Tokyo (Japan), Mar 1977, p. 297-304

ABSTRACT
The modern tendency of mariculture development includes the formation of high and effective commercial farmings, built in accordance with the latest achievements of science and technique. The formation of such farmings demands the development of scientific research, experimental works directed to the technical facility of technological processes in mariculture. Technological scheme of marine culture formation is the most effective one, from the point of view of energy expenditure and completeness of sea resources. It also combines the processes, which take place in coastal constructions (i.e. spawner stimulation, fry rearing, etc.) and the processes, which take place in the sea (pen-rearing, sea-ranching, etc.). Separate units and constructions for rearing of concrete aquatic organisms (aquariums, fish-ponds, collectors, etc.), and equipment of control and operation, providing optimum regimes of functioning (regulators of temperature, oxygen consumption, transmission of hydrological conditions in a sea, drawing up of operation commands). Algorhythmics of technological process, which is made together with specialists of biological and technical trends, is the initial process during the planning of technical facilities in rearing technology of some mariculture organisms. The improved algorhythms serve as a base for the formation of operation systems, which should be established from the following elements: an object, united by outward and admission parameters control system of hydrological and weather situations the service of object control the coastal technological equipments operation machine.

Putwain, P.D. ; Gillham D.A.; Holliday R.J. (1982)

Restoration of Heather Moorland and Lowland Heathland, with Special Reference to Pipelines

Univ of Liverpool, UK,

Env Conservation, Autumn 82, v9, n3, p225 (11)

ABSTRACT
Heather moorland and lowland heathland in Britain have been experiencing severe loss or degradation as a result of reforestation, reclamation to agriculture, urbanization, mineral extraction, and the laying of gas and oil pipelines. Three examples of severe disturbances caused by the laying of pipelines where original heathland vegetation has not survived are presented. Techniques for the reinstatement of heather moorland and lowland heathland after such disturbances are discussed. (1 diagram, 3 graphs, 2 photos, 16 references, 2 tables)

Race, M.S. (1985)

Critique of present wetlands mitigation policies in the United States based on an analysis of past restoration projects in San Francisco Bay

Dep. Agric. and Nat. Resour., Univ. California, 2120 University Ave., 7th Floor, Berkeley, CA 94720, USA

Environ. Manage., Vol. 9, No. 1, pp. 71-82.

ABSTRACT
A detailed evaluation of past wetland restoration projects in San Francisco Bay was undertaken to determine their present status and degree of success. Many of the projects never reached the level of success purported and others have been plagued by serious problems. On the basis of these findings, it is debatable whether any sites in San Francisco Bay can be described as completed, active, or successful restoration projects at present. Policies encouraging or allowing quid pro quo exchanges of natural wetlands with man-made replacements should proceed with caution. The technology and management policies used at present are many steps ahead of the needed supporting documentation.

Race, M.S. (1986)

Wetlands restoration and mitigation policies: Reply

Univ. California, Div. Agric. and Nat. Resour., 2120 University Ave., Berkeley, CA 94720, USA

Environ. Manage., Vol. 10, No. 5, pp. 571-572.

Radecki, E.A.; Matson, C.; Brenoel, M.R. (1987)

Enhanced Natural Degradation of a Shallow Hydrocarbon Contaminated Aquifer

Groundwater Technology, Inc., MI

Haztech Intl (Pudvan) Conf, St. Louis, Aug 26-28, 87, P331(11). The original document is available from Bowker.

ABSTRACT

The success of a groundwater bioreclamation project in Michigan is summarized. The site is characterized by a shallow unconfined aquifer with a considerable dissolved hydrocarbon plume covering over 1.5 Acres. In early 1985, monitoring wells were installed and a recovery system was implemented to rehabilitate the gasoline-tainted water resource. Hydrogeological and other studies indicated the utility of in situ bioreclamation. A well-established population of aerobic, hydrocarbon-utilizing bacteria was stimulated by pre-aerating infiltration water and by direct well sparging. The degradation of the hydrocarbons by the resultant biomass has resulted in a reduction in excess of 100 gal of gasoline in 12 weeks of operation. (3 graphs, 9 references)

Radvanyi, A. (1980)

Control of Small Mammal Damage in the Alberta Canada Oil Sands Reclamation and AF Forestation Program

Canadian Wildlife Service, Environment Canada, 9942-108 ST., Edmonton, Alberta, Canada T5K 2J5.

For Sci 26 (4). (Recd. 1981). 687-702. CODEN: FOSCA

ABSTRACT
Open pit mining procedures being conducted in the [Athabasca] oil sands of northeast Alberta greatly disrupt many acres of the environment. The reclamation and afforestation program intended to restore the forest habitat encountered problem when a large percentage of young nursery raised trees planted on a tailings pond dike and on overburden dump sites were girdled by meadow voles [Microtus pennsylvanicus] in the dense grass habitat created to stabilize steep sandy slopes of the spoil piles. The study monitored small mammal populations through a high, low and a 2nd high level commensurate with the 3-4 yr population cycle of small mammals. A [rodent] control technique utilizing grain treated with an anticoagulant rodenticide made available to the mice in poisoned bait feeder stations effectively reduced small mammal numbers to very low levels and reduced girdling damage from an average of 50% to 1-2%.

Randall, R.M.; Randall, B.M.; Bevan, J. (1980)

Oil pollution and penguins is cleaning justified?

Dep. Zool., Univ. Port Elizabeth, POB 1600, Port Elizabeth 6000, South Africa

Mar. Pollut. Bull., 11(8), 234-237, (1980)

ABSTRACT
Oil pollution has been the main mortality factor of adult jackass penguins Spheniscus demersus found dead on St. Croix I., South Africa, over a 32 yr period. In July 1979, 150 oiled penguins found on the island were sent to the South African Foundation for the Conservation of Coastal Birds (SANCCOB) to assess the effectiveness of cleaning and rehabilitation attempts. Oil was removed with a detergent and in severe cases with liquid partiality rate before and during treatment was 32%. Once waterproof, the penguins were released at sea near Cape Town. By Feb 1980, 87% of those released had returned to St. Croix I. They appeared healthy, molted normally, returned to former nests and mates and 6 had produced clutches. SANCCOB has treated 6551 oiled penguins since 1968, and, based on these release and rehabilitation rates, attempts to clean and rehabilitate oiled penguins are justified.

Range, J.D.; Feller, M.A. (1979?)

Congressional Perspectives on the Need for Estimating Environmental Damage from Oil and Hazardous Waste Spills

Presented at US Fish & Wildlife Service Pollution Response Conf, St. Petersburg, May 8-10, 79, P157 (5). The original document is available from Bowker.

ABSTRACT
Congressional consideration of oil and hazardous waste spill damage assessment techniques is surveyed. A proposed Oil Spill Liability and Compensation Act drafted by the Senate Environment and Public Works Committee includes provisions for such damage assessment. Compensation for public losses of natural resources must be based on restoration and replacement for those resources. Damage assessment is the key to determining the amount and type of restoration required. Codified damage assessment procedures must be implemented to provide a standard mechanism for such compensation.

Rauta, C.; Zarioiu, V.; Creanga, I.; Petre, N.; Kaszoni, E.; Carstea, S.; Mihalache, G. (1987)

Preliminary Research Concerning the Technology for Bringing under Agricultural Use Some Soils Polluted with Petroleum Residues

Inst Cercetari Pentru Pedol. Agrochim., Bucuresti.

An Inst Cercet Pedol Agrochim 47 (0). 211-220. CODEN: AICAD

ABSTRACT
The paper is dealing with the preliminary results of a research concerning the reclamation of soils polluted with petroleum residues (salted water included), knowing that in Romania several thousands of hectares of agricultural land are polluted with petroleum, especially around the oil wells and oil processing factories, as well as along the oil pipes. The research was carried out on a vertic planosol polluted with petroleum residues and salted water, and the best results were obtained under the following treatment: land leveling, deep (60 cm) chiselling along the two perpendicular directions 1.5-1.7 m apart and application of 150 t/ha manure (planned every three years). This treatment had as effect a better leaching of soluble salts in the upper 60 cm of soil; a more intensive decomposition of the oil, especially of the saturated and aromatic hydrocarbons; and a more increasing tendency of restoration of soil global biological activity. All these improvements are also reflected by the relatively higher yields of winter wheat, barley, sunflower and silage corn as compared with the other treatments, without obtaining, however, at the same time, any yield with millet, sorghum for seeds and Sudan grass.

Ray, G.C. (1978)

Critical marine habitats

Address not stated

Oceans, 11(1), 2-3.

ABSTRACT
The author, who has been given the task of delineating 'critical marine habitats' by the World Wildlife Congress, presents a broad outline of the issues involved. Environmental protection has hitherto resulted mainly in establishing marine parks and sanctuaries, or protecting individual species. Consideration of actual environments reveals that the ecosystem is a more meaningful functional unit for conservation purposes, leading to the concept of 'critical habitats', defined as areas within which an essential species function, support function or ecological process takes place. Ultimately, a linked system of reserves, representative of the principal global ecosystems, should be established to facilitate research as well as conservation objectives. General problems of implementation are discussed.

Ray, G.C.; Dobbin, J.A.; Salm, R.V. (1978)

Strategies for protecting marine mammal habitats

Dep. Pathobiol., Johns Hopkins Univ., Baltimore, MD 21218, USA

Oceanus, 21(2), 55-67.

ABSTRACT
The protection of marine mammal species requires identification of areas of special biological significance, or 'critical habitats'. Recent legislation and research work have emphasized the value of a habitat approach to management, which the authors have attempted to illustrate by means of a management model, based on walrus (Odobenus rosmarus divergens) populations in the Bering Sea. The model integrates data on: (1) the hydrography of the study area (2) the distribution, life history, food habits and community structure of the walrus (3) existing and proposed socioeconomic activities (4) legal and jurisdictional matters. Areas of high vulnerability are identified by mapping the mating grounds, pupping grounds, migration routes and food supply, and then overlaying additional data in a color-coded system. This gives a visual presentation of potential conflicts and responsibility for action, which may be used as a strategic planning tool for protection measures such as the establishment for sanctuaries. The article concludes with a discussion of the usefulness of this and other approaches to management problems.

Redente, E. F. ; Cook, C. W. (1982)

Revegetation Studies on Oil Shale Related Disturbances in Colorado

Colorado State Univ., Fort Collins. Dept. of Range Science.

Corp. Source Codes: 006665073; 1828300

Sponsor: Department of Energy, Washington, DC.

Report No.: DOE/EV/04018-6

90 pp.

Portions of document are illegible.

NTIS Prices: PC A05/MF A01

Country of Publication: United States

Contract No.: AC02-76EV04018

ABSTRACT
An interdisciplinary research project was initiated in 1976 to provide both basic and applied information that would aid in the reestablishment of natural functioning ecosystems on land disturbances associated with energy development. The approach included field, laboratory, and greenhouse experiments designed to provide both structural and functional information about disturbed ecological systems in the semiarid west. This report presents results from the sixth year of the study. Separate abstracts have been prepared for each of the 4 studies reported for inclusion in the Energy Data Base. (ERA citation 07:056212)

Relini, G.; Moretti, S. (1986)

Artificial reef and Posidonia bed protection off Loano (western Ligurian Riviera)

Tech. Consult. of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association with Artificial Reefs Ancona (Italy)

Lab. Biol. Mar. Ecol. Anim., Univ. Genova, Via Balbi, 5, 16126 Genoa, Italy

FAO Fish. Rep. FAO Rapp. Peches, no. 357

Report of the Technical Consultation of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association with Artificial Reefs, Ancona, Italy, 17-19 March, 1986, pp. 104-108

Report Number: ISBN 92-5-0024550-X

ABSTRACT
A description is given of an EEC financed project regarding the construction of an artificial reef in the Port of Loano in order to protect the Posidonia beds against damage caused by trawling and to restock fishery resources.

Renaud-Mornant, J.; Gourbault, N. (1980)

Survire de la Meiofaune Apres l'Echonement del Amoco Cadiz (Chenal de Morlaix Greve de Roscoff)

[*Survival of Meiofauna After the Amoco Cadiz Oil Spill (Morlaix Channel and Roscoff Beach, Brittany, France)*]

Lab. Zool., (Vers) Mus. Natl. d'Hist. Nat., 43 rue Cuvier, 75237, Paris Cedex 05, France

Bull. Mus. Natl. Hist. Nat. (France) (4E Ser.) (A Zool. Biol. Ecol. Anim.), Vol. 2, No. 3, p. 759-772.

ABSTRACT
The effects of hydrocarbon contamination on subtidal and inter-tidal meiofauna were studied a few days after the spill (March 1978) and surveyed one month and seven months later. Apparently no drastic reduction in species had occurred, but reduced densities were observed after one month. Turbellaria and particularly Harpacticoidea seemed to have been more affected than other taxonomical groups, Nematodes of which 103 species were listed from the Morlaix channel in October 1978. Recovery within seven months seemed related to both hydrodynamism and sediment porosity allowing a proper restoration of living conditions. Resistance to hydrocarbon toxicity may be due to the ability of faunal taxa to withstand large trophic temporary fluctuations. High reproduction rates, protection of brood and adaptability to unstable habitats, might have been important recovery factors.

Rice, S.D.; Korn, S.; Karinen, J.F. (1979)

Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components

US Nat. Mar. Fish. Serv., Northwest and Alaska Fish. Cent. Auke Bay Lab., Auke Bay, AK., USA

In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1979, Volume 6, effects.

Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA), Outer Continental Shelf Environmental Assessment Program,

Report Number: p 27-59

ABSTRACT
The FY 1979 programme involves physiological and bioassay tests of applied research on species indigenous to the Gulf of Alaska, Bering Sea, and Beaufort Sea. The major emphasis of research has shifted from strictly descriptive acute toxicity determinations to mechanistic studies, sublethal tests, and long-term exposures that will eventually allow prediction of oil impact on the biota. Because low temperature appears to be such an important factor in governing the sensitivity of some subarctic species to oil it is necessary to determine whether this relationship holds for similar Arctic species or Arctic species in general. A base of information has now been accumulated on acute toxicity, sublethal effects, relative toxicity of oil aromatics, effects of various environmental factors on these parameters, and effect on larvae but this is only a small part of the information needed to predict and evaluate the major impacts of hydrocarbons in the marine environment. This study has given more knowledge about the effects of temperature and salinity on the ability of subarctic organisms to metabolize, eliminate or recover from petroleum exposure.

Robers, R. (1987)

Beaufort Sea Sale 97, Alaska outer continental shelf, final environmental impact statement. Volume 1.

Minerals Management Serv., Anchorage, AK (USA), 485 pp.

OCS/EIS/EA/MMS-87-0069-VOL-1

NTIS Order No.: PB88-118625/GAR

Report Number: MMS/AK/EIS-87/001

ABSTRACT
The Environmental Impact Statement (EIS) analyzes a proposed oil and gas lease sale in the Beaufort Sea, alternatives to the proposal, major issues determined through the scoping process, and potential mitigating measures. The proposal consists of 3,516 blocks, located in the Beaufort Sea Planning Area in waters that are from about 5 to 260 kilometers offshore. The mean economically recoverable resources unleased in the area are estimated to be 650 million barrels of oil with a marginal probability of 0.69 for hydrocarbons. See also Volume 2, PB88-118633, and PB87-165114.

Roland, J.V.; Moore, G.E.; Bellanca, M.A. (1977)

The Chesapeake Bay oil spill - February 2, 1976: A case history

Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977.

Virginia State Water Control Board, Richmond, VA 23230, USA

Publisher(s): American Petroleum Inst., Washington, DC (USA) (p.523-527, API-Publ.--4284

ABSTRACT

On Feb 2, 1976, one of the worst oil spills in recent history occurred in the lower Chesapeake Bay. Approximately 250,000 gallons of No.6 oil were discharged into the bay after a barge, the STC-101, sank in a storm near the mouth of the Potomac River. The oil contaminated extensive beach and marsh and the cost approached $400,000. The US Coast Guard estimated the 167,000 gallons of oil were recovered by cleanup crews. The remaining oil is believed to be widely dispersed over large areas of the bay - possibly tied up in fringe marsh grass, buried under sand on the beaches or carried out into the Atlantic Ocean. The heavily-contaminated fringe marsh grasses were cut, leaving the root systems intact, in order to protect the fragile marsh areas. An overall assessment of the environmental damages caused by the spill is almost complete. Estimates of the number of waterfowl killed range from 20,000 to 50,000 birds. Damage to shellfish and other aquatic resources is still under study. Preliminary reports indicate that damages to the environment may not be as severe as initially expected.

Sabourin, T.D.; Tullis, R.E. (1981)

Effect of Three Aromatic Hydrocarbons on Respiration and Heart Rates of the Mussel, Mytilus californianus

Dept. Zool. & Physiol., LA State Univ., Baton Rouge, LA 76803, USA

Bull. Environ. Contam. Toxicol., Vol. 26, No. 6, pp. 729-736

ABSTRACT
Recent studies of marine invertebrates have focused mainly upon respiration, locomotion, and growth. Special attempts have been made by various researchers to utilize specific invertebrates in measuring changes in certain variables as an index of oil pollution. The filter feeding marine bivalves have received primary attention due to their proximity to coastal oil spills, importance in human food consumption and possible role in petroleum hydrocarbon bioconcentration. Studies on respiratory responses adequately fit criteria for answering such questions. In addition, cardiac activity may serve to indicate changes as the relatively constant lamellibranch heart rate may be the least variable of all metabolic processes. Thus, respiration and heart activity reveal a great deal of information concerning the physiological state of the bivalve. We report measurements of these two variables in the mussel, Mytilus californianus (Conrad), under conditions of exposure to, and recovery from, three aromatic hydrocarbons.

Samuels, W.B.; Lanfear, K.J. (1982)

Simulations of Sea Bird Damage and Recovery from Oil Spills in the Northern Gulf of Alaska

U.S. Geological Survey, Reston, VA 22092, USA

J Environ Manage 15 (2). 169-182. CODEN: JEVMA

ABSTRACT
An oilspill trajectory analysis was performed for Proposed Outer Continental Shelf Lease Sale 55 (Northern Gulf of Alaska) to analyze the probability of spill occurrence, likely movement of the spills and the locations of biological resources vulnerable to oilspills. Ecological damage assessment and recovery of glaucous-winged gulls and common murres in the Northern Gulf of Alaska were approached in 2 ways. Oilspill contacts were simulated in Monte Carlo fashion for a large number of simulated lease lifetimes (a lease lifetime was defined as the number of yr oil production occurred). Oilspill contacts to seabird colonies, during the lease lives, were randomly sampled according to their probability distribution. Population effects were modeled according to a specified growth curve. Damage and recovery for a specific number of oilspill contacts were calculated to examine the sensitivity of the population model to growth and mortality parameters. If an oilspill contacted a colony of gulls, reducing the population by 50%, the population was expected to recover to its prespill level in .approx. 20 yr. For common murres, this same situation yielded a recovery time of .approx. 70 yr. Assuming that oil was found, and based on the expected number of oilspills and contact with these colonies during the lease lifetime, and assuming that each oilspill contact caused a fractional population loss of 0.95, the probability of reducing the population to some fraction of its initial level was calculated. For gulls, only a 10% chance of population reduction to < 1/2 the prespill level was calculated for the lease lifetime. For murres, only a 4% chance of similar reduction was calculated.

Samuels, W.B.; Ladino, A. (1984)

Calculations of Seabird Population Recovery From Potential Oilspills in the Mid-atlantic Region of the United States

USGS, VA, and USBLM, NY

Ecological Modelling, Jan 84, V21, N1-2, P63 (22)

ABSTRACT
The estimated recovery of herring gull and common tern populations from potential oil spill damage in the U.S. Mid-Atlantic outer continental shelf oil leasing area was calculated. A density-dependent age-specific life history table for each species was employed to compute recoveries. Under a worst-case scenario assuming that all age classes suffer 95% mortality from a spill, gull and tern populations would recover to prespill levels in 45 and 100 years, respectively, as estimated with a deterministic approach. Oil spill trajectory analysis using a stochastic approach shows risks from offshore developments to be minimal. (10 graphs, 2 maps, 38 references, 2 tables)

Sanders, H.L. (1977)

The West Falmouth spill Florida 1969

Woods Hole Oceanogr. Inst. Dep. Biol., Woods Hole, MA 02543, USA

Oceanus, 20(4), 15-24.

ABSTRACT
In September 1969 the barge Florida lost about 650,000 to 700,000 liters of oil in a spill off West Falmouth, Massachusetts. The author outlines the exhaustive investigation carried out in assessing the biological effects of this spill. The investigation is the most detailed study undertaken so far on the impact of oil on bottom-dwelling marine life. It is also one of the very few studies of long enough duration to measure long-term effects. Samples collected in the study showed an overwhelming numerical dominance by two capitellid polychaete species Capitella capitata and Mediomastus ambiseta. By spring 1970, the gonads of the surviving remnants of the blue mussel Mytilus edulis were thin, emasculated, and hardly more than empty sacs. Marsh grasses that came in contact with the waterborne oil at high tide during the first 3 weeks after the spill were killed. Sediments, both inter- and sub-tidal, particularly those with a predominantly sandy composition became more unstable. This was apparently due to the breakdown and disappearance of animal secretions, tubes, and benthic algae that bound the sediment. Subtidally the zone of oil pollution spread. This phenomenon continued to occur for years after the spill. Recovery at the stations sampled has been slow with recovery initiated at highly oiled places first, and at least one station has still not yet gained its full complement of animal species.

Schiegg, H-O. (1980)

Field Infiltration as a Method for the Disposal of Oil in Water Emulsions from the Restoration of Oil Polluted Aquifers

Electrowatt Eng. Serv., Ltd., CH-8022 Zurich, Switzerland

Water Res 14 (8). 1011-1016. CODEN: WATRA

ABSTRACT
An oil accident involves the unintended infiltration of oil into the ground. If the propagation of the oil along the water table is stopped by pumping water, oil-in-water emulsions with low oil content may occur. Their disposal by infiltration in the proximity of the oil accident is called field infiltration. The idea of field infiltration is based on the retention of oil by the soil and on the microbial degradation of oil. Advantages of field infiltration are its simplicity, low cost and the minimum consumption of fresh water during pumping. Disadvantages are the unknown degree of microbial degradation and in some cases the uncertainty as to whether the Jamin effect, which governs retention, is operative at all, which can be proved by experiment only. Hydromechanical fundamentals of field infiltration are examined and the maximum retention of oil by the Jamin effect is determined experimentally.

Schneider, K. (no date)

Sex and age segregation in Alaskan sea otter populations

Presented at the 2nd Conf. on the Biology of Marine Mammals, San Diego, CA (USA), 12 Dec 1977.

Alaska Dep. Fish Game, Anchorage, AK 99502, USA, p. 14

ABSTRACT
Knowledge of patterns of geographical segregation of sea otters by sex and age is essential to any active conservation and management program on that species. The sexes and ages of sea otters harvested or captured from several Alaskan populations were examined by specific location and season. All populations contained large female areas where most adult females and dependent pups in the population were found. The number of sexually mature males over 6 years old in female areas fluctuated seasonally and was positively correlated with the number of estrous females. Sexually immature males between the ages of 1 and 6 years appeared to be actively excluded from female areas. Where high densities of sea otters were continuous and range expansion had ceased, many adult males and most immature males concentrated in geographically discrete male areas. Permanently established male areas did not exist in some populations where areas of high sea otter density were separated by areas of low density or where the population was expanding into vacant habitat. Areas of low sea otter density and the fringes of expanding concentrations appeared to function as male areas in these populations. Topography, habitat quality, population density and male breeding behavior appeared to influence patterns of sex and age segregation. Segregation may influence survival, productivity, population composition and vulnerability to natural events and human activities.

Schulze, R.H. (1981?)

A Cost Effectiveness Approach to Oil Spill Response

Arctec, Inc., MD

Presented at EPA/API/USCG 1981 Oil Spill Conf, Atlanta, Mar 2-5, 81, P495 (6). The original document is available from Bowker.

ABSTRACT
Although large sums of money are spent on responding to oil spills, it is often difficult to assess the effectiveness of the spill response effort. A portion of an analysis performed by epa that evaluates the response effort in terms of the change of spill impact and the cost of producing this change is summarized. Using this method of analysis, it is demonstrated that in a typical inland spill situation the minimum acceptable level of response may be the most cost effective, and an intensive effort to recover the last traces of oil may have an adverse environmental impact. (2 graphs, 1 reference, 1 table)

Scoones, I., Imperial College, UK (1988)

Ecological Impact Assessment: The Case of Onshore Oil in Britain

J Env Management, Jul 88, V27, N1, P11(13). The original document is available from Bowker.

ABSTRACT
Heightened interest in ecological impact assessment has been provoked by the expansion of onshore oil development in southern England. The UK planning system and new EEC legislation provide a legal and institutional context for environmental impact assessment, but the articulation of this with its scientific context has not been explored. It is necessary to tailor scientific frameworks to the requirements of planners. A methodological framework is introduced that improves on recent experience of ecological assessment for onshore oil activities. Eight applied ecological questions are identified for the wytch farm oil field. By asking a sequence of questions, theoretical insight can be gained in the assessment. Successional theory can provide an input to questions concerning restoration from pipeline construction, and island biogeography to land take questions. (5 diagrams, 1 graph, 23 references, 3 tables)

Seale, M.R.M. (1978)

Control of major oil spills in the marine environment

HONG KONG ENGINEER 6(7), 15-21, Coden: HKOEDU

illus. no refs.

No abs.

ABSTRACT
Spilled oil is influenced by spread (the natural tendency of oil to become a thinner layer on the surface of the water) and by drift (movement caused by currents, wind, and turbulence) and is dispersed through evaporation, solution, dispersion, emulsification, oxidation, and biological degradation. Common methods of containing spilled oil include mechanical booms, pneumatic barriers, and chemical oil-collection agents. After the oil has been contained, it is recovered through mechanical skimmers or sorbents. Spilled oil can be dispersed by the use of chemicals, but the rate of dispersal can be influenced by currents, temperature, and other environmental conditions. Oil spilled at sea will contaminate shoreline areas at a rate of approximately 25 bbl/mi of shoreline, depending on the properties of the oil and the type of shoreline. Construction of a sand berm at the water line and use of commercial sorbents and straw will help reduce the penetration of the oil. Restoration can be achieved through use of detergents and removal of contaminated materials. (SS)

Seaman, W., Jr.; Aska, D.Y. (1986)

The Florida reef network: Strategies to enhance user benefits

Sch. Forest Resour. Conserv., Univ. Florida, Gainesville, FL 32611, USA

Artificial Reefs -- Marine and Freshwater Applications

D'Itri, F.M., ed. Pages 545-561

Incl. 20 ref.

Report Number: ISBN 0-87371-010-X

ABSTRACT
The marine waters of Florida, U.S., probably contain more structures built specifically for fishing enhancement than any other state. Traditional methods based on local initiative of private and public interests have been augmented by recent statewide events that have streamlined permitting, provided uniform construction guidelines and some funding, and increased the level and quality of technical information exchange and education. Drawing on a base of global experience, Florida reef interests are at the beginning stages of experimentation with new reef materials and designs, and analysis of habitat productivity from both a biological and an economic perspective.

Segal, W.; Mancinelli, R.L. (1987)

Extent of Regeneration of the Microbial Community in Reclaimed Spent Oil Shale Land

Dep. Environ. Population and Organ. Biol., Box 334, University of Colorado, Boulder, CO 80309

J Environ Qual 16 (1). 44-48. CODEN: JEVQA

ABSTRACT
Since the microbial community is an integral component of the soil ecosystem, an understanding of the microbiological parameters of reclaimed spent oil shale land is essential for environmental assessment of the potential for reclamation of such land. It was found that determination of the numbers of microorganisms, bacterial diversity and richness (number of genera), and biogeochemical activity indicated by relative rates of cellulose decomposition, yielded significant information regarding the regenerative potential of the microbial communities sampled from three shale mining areas in Colorado and Wyoming [USA] that had undergone varying degrees of weathering, leaching, fertilization, and revegetation. Compared to regional soils used as controls, the spent oil shale soils were characterized by low numbers of microorganisms, depressed values of bacterial diversity and richness, and low rates of cellulose decomposition. However, samples taken from 6-yr revegetated sites were characterized by the least reduction in microbial numbers, higher indices of diversity and richness, and highest rates of cellulose decomposition, in comparison to intermediate values for the 3-yr revegetated site, and the most extreme values for the nonrevegetated site. The latter site was characterized by very reduced numbers of bacteria, actinomycetes, and fungi, the lowest indices of richness and diversity indicative of a high level of environmental stress, and no decomposition of cellulose. It may be concluded that oil shale processing had a drastic negative impact on indigenous microbial communities in reclaimed, shale land. However, conditioning by weathering, fertilization, and revegetation does have a partially restorative effect on the microbial community; the degree of restoration progressively increasing with increasing length of time of these environmental conditions.

Seip, Knut Lehre (1984)

The Amoco Cadiz oil spill -- At a glance

Marine Pollution Bulletin, Vol. 15, No. 6 (June), p. 218

Seltzer, R.J. (1989)

Oil Industry Unveils Program to Combat Major Spills

Chemical & Engineering News, Jul 3, 89, V67, N27, P28(2). The original document is available from Bowker.

ABSTRACT
In the wake of the disastrous Exxon Valdez oil spill in Alaska on March 24, 1989, a task force composed of high-ranking officials from eight major oil concerns has unveiled a comprehensive industry oil spill prevention program. At a cost of more than $250 million for the first five years, the plan addresses prevention, containment, and cleanup of major spills, as well as research on spill control and mitigation. However, due to charges of the inadequate and slow cleanup effort administered by Exxon in Alaska, the plan has been viewed with skepticism by environmentalists and some members of congress, who seek legal mandates rather than voluntary actions. Citing its 99% safety record in transporting oil, the petroleum industry contends that the new program which is aimed at the infrequent, low-risk, high-cost catastrophic spills, will be effective. (2 photos)

Seneca, E.D.; Broome, S.W. (1982)

Restoration of marsh vegetation impacted by the Amoco Cadiz oil spill and subsequent cleanup operations at Ile Grande, France

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill Biological Studies after the Amoco Cadiz Oil Spill Charleston, SC (USA). Brest (France) 17 Sep 1981. 28 Oct 1981

Dep. Bot., North Carolina State Univ., Raleigh, NC 27650, USA

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission.

Gundlanch, E.R.; Marchand, M., eds. Pages 363-420

ABSTRACT
The authors developed a proposal for restoring marsh at the Ile Grande site adapting techniques and procedures developed for Spartina alterniflora , in North Carolina to restoration of a part of the Ile Grande marsh using vegetation indigenous to that region. Although there was considerable variation in response to fertilizer materials and rates, both nitrogen and phosphorus were required for good transplant growth on the disturbed sites tested. Slow release fertilizer materials produced better growth than did the conventional, more soluble fertilizer materials. Higher survival and better growth were obtained with Halimione portulacoides and Puccinellia maritima transplants than with those of the other three species tested, Juncus maritima, Spartina maritima , and Triglochin maritimus . Aboveground growth of the best experimental plantings of Puccinellia spread radially at the rate of about 10 cm annually. At this rate of spread, these experimental plantings would achieve complete substrate cover in about 3 years after planting.

Senner, S.E. (1989)

The Exxon Valdez oil spill: First impressions and commentary

Route 2, Kempton, PA 19529

Am Birds 43 (2). 218-220. CODEN: ABRDA

Sheehy, D.J. (1979)

Fisheries Development: Japan

Aquabio Inc., Belleair Bluffs, FL 33540, USA

Water Spectrum., Vol. 12, No. 1, pp. 1-9.

ABSTRACT
In Japan artificial reefs receive major emphasis and funding because of their importance to current methods of habitat improvement, which a seven-year national coastal resource development program presently in effect stresses as a promising means of meeting the country's seafood requirements. The structurally sophisticated, highly specialized reefs which the Japanese have designed and manufactured as habitat improvement bear little physical resemblance to their American counterparts. Habitat improvement for fisheries development in Japan goes beyond the construction of standard artificial reefs and includes a variety of structures and alterations which contribute to increasing coastal fisheries and aquacultural production. Included in the structures are moored surface and midwater fish attractors, as well as shelters designed to increase specific species of seaweed and invertebrates such as abalone and lobster, and to serve as nursery areas for hatchery-reared juveniles. Also included are measures to alter the substrate conditions, water flow or to dampen the adverse effects of waves. Artificial reefs for both fish and invertebrates are often used in conjunction with other techniques such as stocking, predator management, and supplemental feeding programs.

Sheehy, D.J. (1986)

New approaches in artificial reef design and applications

Aquabio, Inc., Annapolis, MD 21403-6130, USA

Artificial Reefs -- Marine and Freshwater Applications

D'Itri, F.M., ed. Pages 253-263

Report Number: ISBN 0-87371-010-X

ABSTRACT
The results to date of Aquabio Inc.'s research strongly suggest that when long-term fisheries or environmental benefits rather than solid waste disposal are the primary objectives of a reef project, designed and prefabricated units should be considered as potentially more effective and versatile. The final decision will depend on a variety of local site and logistic factors. Designed and prefabricated reefs should especially be considered for future applications in mitigation or compensation efforts, extensive aquaculture (stocking programs), and recreational fishery projects where space is limited, high energy conditions exist, or intensive fishing pressure is anticipated.

Shell Oil Company Environmental Impact Report (1976)

Draft Environmental Impact Report for Proposed Gas Pipeline from Sacramento Airport to Martinez, California, for Shell Oil Company, Aug 15, 1975; Feb 20, 1976, Vol. 2 (421). The original document is available from Bowker.

ABSTRACT
The existing environmental setting, likely positive and adverse environmental impacts, and alternatives to a 53.7 Mi proposed natural gas transmission line from the Sacramento area to the Shell Sacramento River Gas System are detailed. Socioeconomic impacts are also considered. No completely irreversible long-term effects would result. Construction would disturb about 337 acres of land, 40% agricultural and 7.4% Marshland. The vegetation and habitat should reestablish quickly, with no long-term impact on flora and fauna. There would be increased downstream turbidity. About 6 mi of agricultural land would have new use limitations imposed as a result of the pipeline. Extensive appendices include: geologic, climatic and air quality, surface water quality, biological, and soils investigation data. (20 diagrams, 9 graphs, 14 maps, 8 photos, 93 references, 31 tables)

Sherry, J.P. (1984)

The Impact of Oil and Oil-Dispersant Mixtures on Fungi in Freshwater Ponds

Env Canada Natl Water Research Inst

Science of the Total Env, Apr 19, 84, V35, N2, P149 (19)

ABSTRACT
The impact of crude oil and oil-dispersant mixtures on the mycoflora of a freshwater ecosystem was assessed using artificial ponds. Norman wells crude oil was added to study ponds alone or in combination with corexit 9527. After pond treatment, an immediate increase occurred in the number of aquatic fungi in oil-treated systems; an increase, followed by a sharp decrease and a recovery period, occurred in oil-dispersant-treated ponds. Fungal enhancement effects were short-term in duration, lasting in the range of 7-83 days. No medium- or long-term enhancement effects were documented. No obvious treatment effect was observed on the percentage of fungi capable of growth on non-degraded or biodegraded oil as a sole carbon source. (5 graphs, 38 references, 8 tables)

Shilova, I.I. (1977)

Primary plant successions on technogenic sand outcrops in oil and gas producing regions in the Central Ob' Valley

Acad. of Sciences USSR, Ural Scientific Centre, Inst. of Plant and Animal Ecology, Ulitsa Pervomaiskaya 91, Sverdlovsk, Nauka, USSR

Soviet Journal of Ecology 8(6), 475-482, Coden: SJECAH

illus. refs. (Some in Czech; Russ.)

Abs.

ABSTRACT
Dependence of the colonization process of sands on the salient features of the technogenic ecotope and surrounding natural phytocenoses was determined. Soil samples were taken for determination of mineral composition, agrochemical properties, and algal populations. Absence of toxicity, favorable properties of the sands, adequate moisture, and the proximity of forests facilitated a relatively high capacity for natural colonization. The 4 phases of natural colonization, which follow a pattern of syngenetic succession, are detailed. Biological recultivation requires a flexible approach which takes into account characteristic features of natural colonization and use of local flora which participate in syngenesis. (AM & FT)

Shin, P.K.S. (1989)

Effects of a Spill of Bunker Oil on the Marine Biological Communities in Hong Kong

No. 110, 10127-121 St., Edmonton, Alberta, Can. T5N 3X1

Environ Int 14 (6). 545-552. CODEN: ENVID

ABSTRACT
The effects of a recent bunker oil spill on the marine environment were assessed through investigation of the rocky shore fauna, phytoplankton population and macrobenthic communities over a study period of 150 days. In addition, toxicity experiments were carried out in the laboratory to ascertain the toxic effects of the oil-plus-dispersant on selected test organisms. The impacts of the spill on the marine fauna were minimal with no visible reduction in species and individual numbers. Possible reasons were the small amount of the oil spilled, the rapid containment and dispersion in the clean-up operations, and the less toxic effects of the heavy bunker oil. On Hong Kong shores, the limpets can be identified as indicator species to oil pollution. A quick survey of the limpet fauna on the rocky shores immediately after a spill provides an initial assessment of the impacts on the shoreline. However, faunal recovery over a long-term period may be difficult to assess in view of the lack of baseline data on most of the marine biological communities in Hong Kong waters.

Shtina, E.A.; Shilova, I.I.; Neganova, L.B.; El'Shina, T.A. (1986)

Effect of Methods for the Biological Recultivation of Oil-Polluted Lands on Soil Algoflora in Taiga

Kirov Agric. Inst., Kirov, USSR

Ekologiya 0 (2). 23-30. CODEN: EKIAA

ABSTRACT
The recovery of the groups of soil algae during the biological recultivation of oil-polluted soils was studied in a field experiment in Tyumen Oblast [Russian SFSR, USSR]. The following algae were considered: Phormidium, Nostoc, Anabaena, Calothrix, Plectonema, and Ellipsoidion. Oil biodegradation rate was determined on the basis of the intensity of alga development. The rate depends on the degree of pollution and the method of phytoamelioration. Intensive blue-green alga development was observed when grasses were sown on oil-polluted technogenic lands. Apparently, the indirect participation of algae in oil biodegradation makes it possible to use these algae as bioindicators of the degree of degradation.

Simmons, C.L.; Everett, K.R.; Linkins, A.E.; Webber, P.J.; Walker, D.A. (1983)

Sensitivity of plant communities and soil flora to seawater spills, Prudhoe Bay, Alaska

Inst. Arctic Alpine Res., Univ. Colorado, Boulder, CO, USA

NTIS, Springfield, VA (USA)

ABSTRACT
Secondary recovery of oil at Prudhoe Bay, Alaska, will involve transporting large quantities of seawater in elevated pipelines across tundra for injection into oil-bearing rock strata. The possibility of a pipeline rupture raises questions concerning the effects of seawater on tundra vegetation and soils. To evaluate the relative sensitivities of different plant communities to seawater, eight sites representing the range of vegetation types along the pipeline route were treated with single, saturating applications of seawater during the summer of 1980. Within a month of the treatment 30 of 37 taxa of shrubs and forbs in the experimental plots developed clear symptoms of stress while none of the 14 graminoid taxa showed apparent adverse affects.

Sims, P.L. (1977)

Rehabilitation Potential and Practices of Colorado Oil Shale Lands: Progress Report, June 1, 1976--May 31, 1977

Colorado State Univ., Fort Collins.

Corp. Source Codes: 1822000

Sponsor: Energy Research and Development Administration.

96p

NTIS Prices: PC A05/MF A01

Contract No.: EY-76-S-02-4018

ABSTRACT
Substantial progress has been made towards implementing all of the prescribed studies and satisfying the stated objectives since the Oil Shale Rehabilitation Project was actively initiated in June 1976. Concurrent with implementation, research objectives were substantively defined and supplemented without distracting or departing from the original purpose. Current studies are designed to fill voids in the present status of knowledge regarding lands disturbed by an impending oil shale industry in Colorado. The efforts of all contributing investigators have therefore been integrated and directed toward the goal of developing methodologies requisite for restoring diverse and complex ecosystems which will require only a minimal amount of maintenance or input of scarce resources. An intensive study site southeast of the Oil Shale Tract C-a has been obtained through a Cooperative Agreement with the Bureau of Land Management. Following this agreement, most subprojects were initiated at the intensive site. Additional programs will be implemented as spent shale becomes available this summer. Studies conducted principally in the laboratory and greenhouse, such as the microbiological and plant genetic studies, have achieved significant results. (ERA citation 02:033812)

Sims, P.L.; Redente, E.F. (1977)

Rehabilitation Potential and Practices of Colorado Oil Shale Lands

Colorado State Univ., Fort Collins. Dept. of Range Science.

Corp. Source Codes: 1828300

Sponsor: Energy Research and Development Administration.

Report No.: CONF-770810-3

4p

Pacific area engineering conference, Denver, Colorado, United States of America (USA), Aug 1977.

NTIS Prices: PC A02/MF A01

Contract No.: EY-76-S-02-4018

ABSTRACT
Considering the problems associated with rehabilitating oil shale disturbed lands in Colorado, a research grant was awarded to Colorado State University by US ERDA. The goal of this research program is to define the rehabilitation potential and practices of Colorado Oil Shale lands. Rehabilitation guidelines are presently being formulated through the study of long-term fertility requirements, soil microorganism dynamics and activity, rate and direction of secondary plant succession, and selection and improvement of plant materials. (ERA citation 02:050982)

Smail, J. (1978)

Separating oil from sea birds: Giving witness or saving lives

Address not stated

Oceans, 11(4), 59-61.

ABSTRACT
Mortality among oiled sea birds results from clogging of the feather structure which causes a loss of buoyancy and extreme heat loss, leading to death from exposure (frequently compounded by ingesting toxic oil). Efforts to rescue birds contaminated by oil spills have met with extremely low success rates, hindered by disagreements over which solvents are suitable. British researchers have demonstrated that simple commercial detergents are preferable to mineral oils and other alternatives, and improved techniques have yielded encouraging results as exemplified by an increase in seabird rehabilitation following recent spills. Bird rescue efforts are presently incorporated into oil spill contingency plans in the United States. The actual impact of such mortalities on seabird populations is detectable, though it appears to reach epidemic proportions in some areas of the world, and future prospects are bleak.

Smith, R.J.; Collins, A.G. (1984)

State-of-the-Art of Microbial Enhanced Oil Recovery: A Review of the Literature

National Inst. for Petroleum and Energy Research, Bartlesville, OK.

Corp. Source Codes: 079684000; 9516859

Sponsor: Department of Energy, Washington, DC.

Report No.: NIPER-12

27p

NTIS Prices: PC A03/MF A01

Country of Publication: United States

Contract No.: FC01-83FE60149

ABSTRACT
This report is an overview of the literature on enhanced oil recovery (EOR) using microorganisms. Microorganisms can contribute to four major areas of oil technology, three of which relate to EOR: (1) microorganisms, because of their ability to grow rapidly and excrete several types of by-products, are used to manufacture biosurfactants and biopolymers for EOR; (2) microorganisms can be injected in situ to recover residual oil; (3) microorganisms can be used to selectively plug high permeability changes received more attention than any other habitat development alternative and techniques have been developed to enable careful planning, design, and propagation of these systems. The development of aquatic habitats on dredged material appears to offer significant potential for the creation of highly productive biological communities and at the same time provide for large disposal quantities. However, aquatic habitat development requires additional research before it is implemented on a large scale. Dredged material islands are recognized as exceptionally important nesting habitats for many species of colonially nesting shore and wading birds and the management of these resources is entirely feasible.

Soule, D. F.; Oguri, M.; Dawson, J. K.; Osborn, R.; McGlade, L. R.; Feldmeth, C. R.; Wicksten, M. K.; Soule, J.D.; Smith, R.W.; Dabelstein, D.; Kurtz, S.; Edmands, F. (1978?)

The significance of the Sansinena incident

Univ. of Southern California, Allan Hancock Foundation 139, Inst. for Marine and Coastal Studies, Harbors Environmental Projects, Los Angeles, CA 90007

Energy/environment '78: A symposium on energy development impacts Los Angeles, CA Aug. 22-24, 1978

Energy/environment '78: A symposium on energy development impacts: Proceedings. Edited by J. Siva-Lindstedt, p. 295

(n.p.)

Abs. only

ABSTRACT

The impact of the Dec. 17, 1976, explosion of the tanker Sansinena and the loss of 20,000-32,000 barrels of Bunker C oil on the marine and coastal environments is investigated. Although the spill was not large in comparison with major disasters, there was a vast fire and thick oil on beaches, marinas, rocky breakwater habitats, pilings, and on the harbor bottom. It was the 1st Bunker C spill in a location with a 5-yr pre-episode data base, allowing the documentation of the impacts of Bunker C on the biota and recovery rates. (AM)

Southward, A.J. (1982)

An ecologist's view of the implications of the observed physiological and biochemical effects of petroleum compounds on marine organisms and ecosystems

The Long-Term Effects of Oil Pollution on Marine Populations, Communities and Ecosystems, London (UK), 28-29 Oct 1981

Mar. Biol. Assoc., UK, Citadel Hill, Plymouth PL1 2PB, UK

Philos. Trans. R. Soc. Lond. Ser. B., Vol. 297, No. 1087, pp. 241-255.

ABSTRACT
The quantity of hydrocarbons in some seas and sediments approaches the concentrations at which oil can be lethal or cause sublethal effects to marine animals in the laboratory. Field studies of the biological consequences of oil spills show good agreement with the experimental data: intertidal and subtidal benthic communities are affected and can take a long time to recover, undergoing slow and subtle changes. The temporal changes seen after oil spills are comparable with the spatial changes observed around chronic discharges, essentially a simplification of the ecosystem with dominance of a few species. These changes cannot be expressed as a single index of diversity or of physiological stress. To understand the long-term consequences of oil pollution it is necessary to monitor the community as a whole, but well defined methods and objectives are required.

Southward, A.J.; Southward, E.C. (1978)

Recolonization of rocky shores in Cornwall after use of toxic dispersants to clean up the Torrey Canyon spill

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1977.

Mar. Biol. Assoc., Citadel Hill, Plymouth, UK, 35(5), 682-706.

Bibliography 135 ref

J. Fish. Res. Board Can.

ABSTRACT
Fourteen thousand tons of Kuwait crude oil, reduced from 18 000 tons by weathering at sea, was stranded along 150 km of the coast of West Cornwall, England, in March 1967. The oil was treated with 10 000 tons of toxic dispersants during cleaning operations. By itself the oil was not very toxic, although it killed some limpets and barnacles, and most of the mortalities that followed cleaning were due to the dispersants. There was a graded effect. Most animals and some algae were killed on the shores treated heavily with dispersants, while a few animals and most algae survived in places less heavily treated. However, long stretches of coast were contaminated to some extent by drifting of patches of oil and dispersants along the shore and by indiscriminate dispersant use in remote coves. The general sequence of recolonization was similar to that which has been found after small-scale experiments, where the rocks were scraped clean, or where limpets were removed, but took longer to complete. There was first a rapid 'greening' by the alga Enteromorpha then a heavy settlement and growth of perennial brown algae (Fucus species), leading to loss of surviving barnacles. A settlement of limpets and other grazing animals followed, with eventual removal or loss of the brown algae. The final phases were a reduction in the limpet population an a resettlement of barnacles. Lightly oiled, wave-beaten rocks that received light dispersant treatment showed the most complete return to normal, taking about 5-8yr heavily oiled places that received repeated application of dispersants have taken 9-10 yr and may not be completely normal yet. Most common species returned within 10 yr, but one rare hermit crab is still missing from places directly treated with dispersants. The early recolonization by algae resulted in a raising of the upper limit of Laminaria digitata and Himanthalia elongata by as mush as 2 m in wave-beaten places, demonstrating that grazing pressure by limpets must be one of the factors controlling the zonation of these plants. Later, other species of plants and animals were found higher up the shore than usual, under the shade and shelter provided by the dense canopy of Fucus. Fluctuations in the populations of algae and herbivorous animals during the course of the recolonization illustrate the importance of biological interactions in controlling the structure of intertidal communities. Pollution disturbance affects the herbivores more than plant

Stevenson, J.C. (1978)

Recovery potential of oiled marine northern environments: Symposium papers

Fisheries and Environment Canada, Scientific and Publications Branch, Ottawa, Ont. K1A 0E6, Can.

Halifax, Nova Scotia, Canada, October 10-14, 1977

In: Canadian Fisheries Research Board Journal 35(5), 499-795, Coden: JFRBAK

illus. refs. for various papers

ABSTRACT
Papers presented at the October, 1977, symposium describe the fate of petroleum hydrocarbon spills with respect to environmental change, degradation, and recovery. Long-term effects from the 1967 Torrey Canyon disaster are reported. (SS)

Stikney, R.R.; Dodd, J.D. (1979)

Artificial propagation of a salt marsh

Address not stated

Sea Front., 25(3), 173-179.

ABSTRACT
This article reports on the feasibility of establishing a marsh on dredge material in Galveston Bay. Sprigs of two species of marsh grass were planted 20 inches apart between high and low water mark in an area surrounded by a sandbag dike to protect the plants from wave and tide erosion. Marshhay cord grass did not do well except at upper elevations while smooth cord grass grew well intertidally. Seeding of both species was successful only at elevations at or above mean high water, where dense stands of both species established and produced seed during the first growing season. Fertilization was of limited value. Smooth cord grass also spread by runners. Population studies of fish and large invertebrates were carried out.

Stover, E.L. (1989)

Coproduced Ground Water Treatment and Disposal Options during Hydrocarbon Recovery Operations

Stover & Associates, OK

Ground Water Monitoring Review, Winter 89, V9, N1, P75(8). The original document is available from Bowker.

ABSTRACT
Water containing dissolved hydrocarbons coproduced during hydrocarbon recovery operations requires treatment prior to reinjection into the aquifer. Costs and efficiencies of various treatment and disposal options for coproduced water are addressed. Treatment technologies are outlined for oil/water separation, inorganics and heavy metals removal, and dissolved hydrocarbon removal. The primary technologies discussed for dissolved hydrocarbon removal include air stripping, activated carbon adsorption, biological treatment, and combinations of these. Treatment costs in a case example ranged from 44 cents to $2.82/Thousand gallons of water treated for the technologies cited. (3 diagrams, 3 graphs, 8 references, 3 tables)

Straube, M. (1989)

Is Full Compensation Possible for the Damages Resulting from the Exxon Valdez Oil Spill?

Env Law Reporter, Aug 89, V19, N8, P10338(13). The original document is available from Bowker.

ABSTRACT
The March 1989 Exxon Valdez oil spill in Prince William Sound, AK, exposed the deficiencies in the array of federal and state laws that establish liability for environmental and economic damages caused by oil spills. This spill is used as an example in analyzing whether full compensation for all parties damaged by tanker oil spills is available under the existing statutory scheme. The potential for full compensation is examined at the various stages of response to such a spill, including mandatory relief to force cleanup, recovery of government response costs, and compensation for natural resource damages and economic loss. The availability of full compensation is unclear. While full compensation is potentially available for response, resource, and economic costs, the federal sector's ability to force oil companies to conduct a proper cleanup may be limited. (137 references)

Straughan, D. (1978)

Biological studies of the Metula oil spill

Presented at the Conference on Assessment of Ecological Impacts of Oil Spills, Keystone, CO (USA), 14 Jun 1978.

Southern California Univ., Inst. Mar. and Coast. Stud., Los Angeles, CA 90007, USA

American Institute of Biological Sciences (USA)

Report Number: p 365-377

ABSTRACT
A brief review is presented of biological studies conducted after the Metula oil spill. The relationship between the distribution and abundance of intertidal invertebrate species and the petroleum in the intertidal quadrats is discussed. The data suggest a continued impact of petroleum in quadrats remaining heavily oiled and recovery of invertebrates in other quadrats where petroleum is being gradually lost. The data are difficult to interpret due to other patterns of abiotic and biotic variability in the area.

Subrahmanyam, C.B. (1984)

Macroinvertebrate colonization of the intertidal habitat of a dredge spoil island in North Florida

Wetland Ecol. Program, Florida A&M Univ., Tallahassee, FL 32307, USA

Northeast Gulf Sci., Vol. 7, No. 1, pp. 61-76.

ABSTRACT
Macroinvertebrate colonization of the intertidal habitat of a dredge spoil island near North Florida (located in the Dickerson Bay), USA, was studied for one year by collecting triplicate 0.0625-m super(2) x 10-cm core samples of substratum from four stations established relative to the slope of the habitat. Fauna first colonized the subtidal site, and after lapses of time appeared at low, mid and high-tide stations respectively. The total abundance and diversity of the assemblage increased significantly in the latter half of the year mainly due to the appearance of late colonizers at low and mid-tide stations. The temporal abundance patterns at the four stations were variable. Several species that initially appeared at low tide station aggregated later at other stations. While no discrete species groups formed at each station, the relative abundances of several species were related to tidal exposure gradient.

Surprenant, N.F.; Battye, W.H.; Fennelly, P.F. (1983)

Fate of hazardous and nonhazardous wastes in used oil disposal and recycling

Final report, GCA Corp., GCA Technol. Div., Bedford, MA, USA

NTIS, Springfield, VA (USA)

ABSTRACT
The primary objective of this program was to identify the hazardous and nonhazardous compounds that might reasonably be found in used oil and to establish their fate under a variety of disposal and recycling scenarios. Those considered were sewer disposal, road oiling, combustion as a fuel, reprocessing by physical methods to produce a specification fuel, and various re-refining processes. A secondary objective was to assess the potential environmental impact of the contaminants in the waste and product streams associated with each scenario. The hazardous and nonhazardous compounds of major interest in waste oil were identified by literature review, interviews with participants in waste oil activities, and by laboratory analysis of 24 samples of waste oils obtained from recyclers and users. The contaminants were prioritized according to their concentrations in the oil and their health impacts, as determined by threshold limit values, drinking water standards or other measures of multimedia health impacts. The prioritized listing formed the basis for the preparation of the composite oil used in the experimental simulation studies of the waste oil disposal and recycling scenarios. The experimental simulation studies were designed to establish the fate, through material balance if possible, of specific contaminants under conditions that were representative of those normally encountered in each situation.

Swift, W.H.; Touhill, C.J.; Haney, W.A.; Nakatani, R.E.; Peterson, P.L. (1969)

Review of Santa Barbara Channel Oil Pollution Incident

(Water pollution control research series)

Battelle-Northwest Richland Wash Pacific Northwest Lab

Corp. Source Codes: 401048

Report No.: USCG-794102/003

165p

Also available as Water Pollution Control Research Series DAST-20.

NTIS Prices: PC A08 MF A01

Contract No.: FWPCA-14-12-530

ABSTRACT

The purpose of the review was to assemble a synopsis of defensive, control and clean-up activities in the Santa Barbara Channel in as much technical detail as possible. The contents include the following topics: Environmental conditions (Geography, prevailing meteorological conditions, oceanographic conditions); Description of the source; Management considerations and contingency planning; Control of released oil (Control at source, control at sea, defense of harbors, defense of beaches); Surveillance (Visual observation, photographic, remote sensors); Distribution and behavior of oil at sea; Beach and harbor problems (Winter storm effects, fire hazards, special constraints, littoral sand transport); Shoreline restoration methods; Disposal of wastes and recovered oil; Biological and ecological surveys and findings (Sea birds, intertidal and nearshore communities, offshore and benthic surveys, marine mammals).

Swift, W.H.; Touhill, C.J.; Haney, W.A.; Nakatani, R.E.; Peterson, P.L. (1969)

Review of Santa Barbara Channel Oil Pollution Incident

(Water pollution control research series)

Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

Corp. Source Codes: 387060

Report No.: FWPCA-15080-EAG-07/69; W70-06320

165p

NTIS Prices: PC A08 MF A01

Contract No.: DI-14-12-530

ABSTRACT
The purpose of the review is to assemble a synopsis of defensive, control and clean-up activities in the Santa Barbara Channel in as much technical detail as possible. The major areas covered include: Environmental conditions; Description of the source; Management considerations; Control of released oil; Surveillance experience; Behavior of oil at sea; Beach and harbor problems; Restoration and disposal; Biology and ecology; Current research and development.

Swift, W.H.; Touhill, C.J.; Templeton, W.L.; Roseman, D.P. (1969)

Oil Spillage Prevention Control and Restoration State of the Art and Research Needs Water Pollution

J Water Pollut Contr Fed 41 (3 PT. 1). 392-412. CODEN: JWPFA

Sylva, D.P. de (1982)

Potential for increasing artisanal fisheries production from floating artificial habitats in the Caribbean

Proceedings of the 34th Annual Gulf and Caribbean Fisheries Institute, Mayaguez, PR (USA), Nov 1981. No. 34., pp. 156-167

Rosenstiel Sch. Mar. Atmos. Sci., Univ. Miami, Miami, FL 33149, USA

ABSTRACT
The term "fish-attracting device" (FAD) has been used for structures that create floating artificial habitats which are suspended at the surface, slightly below the surface, or in midwater between the surface and the bottom. This practice is based upon the concept that pelagic fishes are attracted to floating objects, much in the same way as reef fishes are attracted to artificial benthic habitats. It was formerly believed that FAD merely concentrated pelagic fishes. Now there is evidence that the number of fish and their survival actually increase because of the protection provided by the hiding places. The FAD also acts as habitat for juvenile fishes which otherwise might have perished.

Tagatz, M.E.; Tobia, M. (1978)

Effect of barite ($BaSO_4$) on development of estuarine communities

US Environ. Prot. Agency, Environ. Res. Lab., Gulf Breeze, FL 32561, USA

Estuar. Coast. Mar. Sci., 7(4), 401-407.

ABSTRACT
Barite ($BaSO_4$), the primary component of oil drilling muds, affected the composition of estuarine communities developed from planktonic larvae in aquaria containing sand and flowing estuarine water. Aquaria contained: sand only a mixture (by volume) of 1 part barite and 10 parts sand 1 part barite and 3 parts sand or sand covered by 0.5 cm of barite. For all environments, annelids and molluscs were the numerically dominant phyla collected in a 1-mm-mesh sieve after 10 weeks exposure a total of 3020 animals, representing 59 species, were collected. Significantly fewer animals and species ($a = 0.01$) developed in aquaria sand covered by barite than in aquaria unexposed or exposed to 1 barite:10 sand. Number of animals in aquaria containing 1 barite:3 sand also differed ($a = 0.05$) from that in control aquaria. Annelids were particularly affected and significantly fewer ($a = 0.01$) were found in all treatments than in the control. Molluscs decreased markedly in number only in barite-covered aquaria. Barite, however, did not impede growth (as height) of the abundant clam, Laevicardium mortoni, or decrease abundance of six other phyla. The data indicate that large quantities of this compound, as discharged in offshore oil drilling, possibly could adversely affect the colonization of benthic animals.

Taylor, W.E. (1983)

Restoration of Oil Well Drilling Sites

Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.

Corp. Source Codes: 013386049; 9507893

Report No.: CONF-8306126-7

American Society of Agricultural Engineers Summer Meeting, Bozeman, MT, USA, June 26, 1983, ASAE Paper No. 83-2143. 12 pp.

NTIS Prices: PC A02/MF A01

Country of Publication: United States

ABSTRACT
Preservation of topsoil during the construction and backfilling procedures, and conservation of moisture following seeding are the two most important and expensive components of successful restoration. Procedures and costs are given for various probabilities of success. Seeding dates and rates for various plant species are also given. 2 tables. (ERA citation 09:047440)

Thayer, G.W.; Fonseca, M.S.; Kenworthy, W.J. (1982)

Restoration and enhancement of seagrass meadows for maintenance of nearshore productivity

International Symposium on Utilization of Coastal Ecosystems: Planning, Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982

NOAA, Beaufort Lab., Beaufort, NC 28516, USA

Fundacao Univ. Rio Grande (Brazil) Duke Univ. Mar. Lab., Beaufort, NC (USA)

Atlantica, Vol. 5, No. 2, pp. 118-119.

Special issue. Summary only.

ABSTRACT
Studies have been initiated on the use of transplanting as a means to ameliorate the loss of meadows, and to create seagrass habitat on previously unvegetated areas. Whole mature, vegetative shoots are dug from donor sites, washed free of sediments, attached in clumps to anchors and replanted. This technique yields viable meadows within a growing season at a cost comparable to salt marsh planting in man-hours, on an areal basis. The seagrasses (Zostera marina and Halodure wrightii) used here exhibit an exponential growth and coverage rate until reaching densities comparable to natural meadows. Faunal recolonization is significantly increased in these areas over unvegetated areas. Number of fauna and taxa per core increase linearly with time, and asymptote when shoot density reaches the normal levels for that environment.

Thomas, M.L.H. (1977)

Long-term biological effects of Bunker C oil in the intertidal zone

In: Fate and effects of petroleum hydrocarbons in marine ecosystems and organisms: Proceedings of a symposium held at the Olympic Hotel, Seattle, WA (USA) on 10-12 Nov 1976. Wolfe D.A. (ed) Pergamon New York NY (USA) 1977. p. 238-246

Dept. Biol., Univ. New Brunswick, Saint John, New Brunswick, Canada

ISBN 0-08-021613-7

ABSTRACT
In February, 1970 a large spill of Bunker C oil occurred in Chedabucto Bay, Nova Scotia, Canada when the tanker Arrow grounded. Oil from the tanker has persisted for over six years on rocks and in intertidal sediments on the shores of the bay. During this period mortalities of common species in all major communities on both exposed and sheltered shores have occurred. On rocky shores, the dominant fucoid algae suffered heavy initial mortalities which were more severe at high tidal levels. Recolonization has proceeded from lower to higher levels but has not yet occurred in the high tide zone. Delayed recolonization appears to be related to long term toxicity. In salt-marsh and sheltered lagoonal communities, the dominant grass, salt marsh cord grass, suffered heavy mortality delayed one year from the initial spill, recovery commenced two years later and is proceeding steadily. Soft-shell clams in lagoonal sediments have shown persistent mortalities proportional to oil content of sediments. This pattern appears to be a result of direct toxicity, environmental change caused by oil and sub-lethal metabolic effects.

Thorhaug, A.; Miller, B.; Jupp, B.; Bookers, F. (1985)

Effects of a variety of impacts on seagrass restoration in Jamaica

Dept. Biol. Sci., Florida Intl Univ., Miami, FL 33199, USA

Mar. Pollut. Bull., Vol. 16, No. 9, pp. 355-360.

ABSTRACT
For the first time seagrass rehabilitation was attempted in a tropical nation, Jamaica. Repair to a variety of developmental impact types were attempted with test plots: dredge and fill, bauxite and oil spills, channelization, urban run-off, urban sewage, river bulkheading, jetty construction and artificial beach, industrial lagoons, saline lagoons, thermal effluents, and cement tailings. Three species were routinely planted (Thalassia testudinum, Halodule wrightii, Syringodium filiforme) plus Ruppia maritima in saline lagoons, each by two planting techniques. Types of damage which were successfully attempted to be restored for the first time were from heated wastes, bauxite spills, jettied river mouths, small scale oil spills, and diluted urban wastes. Types of pollution damage previously repaired in subtropics and temperate zones, which could be successfully repaired in the tropics also were dredge and fill and urban run-off. Erosion seagrass restoration repair was partially successful at some sites. Attempts to repair high salinity lagoons and cement tailings were unsuccessful. Functional species were found which could tolerate ongoing pollutant loads is some cases.

DRAFT

Important literature for Aquisition,
As of 5/3/90
listed by page number as in
March 1990 Preliminary Draft of
Ecological Restoratrion
of Prince William Sound and the Gulf of Alaska,
an Annotated Bibliography of Relevant Literature

1
7
11-17
24
26-27
29
30-31
32-33, 34, 35
39-40
46
50-51
60
63
64-65
71
73-75
76-78
81-82
85
86
87
89
(91)
92-94
98
99
100
101
102
105
109
110
112
127-114, 123, 124
135
141-137
143
149-147
151
153
155
158

160-162
163-164
166
169
170-172
173
176
178
(179)
182
(183)
185
(189)
191-192
195
197
200
201
202-203
204
205
206
207
209
213
216-215
218-220
221-224
225
228-239
241
242 246, 247
254-249
260
264
265
286-293
294
298-301 302
307
311
314
321

327
328-329
331-334
338
339
341
342-343, 345
346
348
349
350
352
353
355
357
358
363-364
368-371
376
380
382
383-386, 395, 396, 397
398
404
406
407
410-411
412
414 418, 419 421
416-422, 424, 425
435 432
442
447
448

27 NOT ON DISK!!

Thorhaug, A. (1983)

Habitat restoration after pipeline construction in a tropical estuary: Seagrasses

Dept. Biol. Sci., Florida Int. Univ., Miami, FL 33199, USA

Mar. Pollut. Bull., Vol. 14, No. 11, pp. 422-425

ABSTRACT
In 1981 the Florida Keys Aquaduct Authority permitted the construction of a new water transmission pipeline through the Florida Keys, USA. The seagrasses Halodule wrightii and Thalassia testudinum in an estuary and wetland area north of Key Largo would be removed by a portion of the pipeline construction. Consequently, government construction permit conditions required restoration of these seagrasses. After construction, Halodule shoots were planted over the pipeline trench in an area 6.1 x 975 m on 0.9 m centers. Additional transplantation of Halodule and Thalassia was deemed necessary, especially in areas lateral to the pipeline trench, and was done later in 1981 by a second party. Results after ten months showed that 31.1 plus or minus 0.9% of the area in the pipeline trench was covered by Halodule shoots. 1261 Thalassia seedlings were observed in the entire affected pipeline area. This is the first report of pipeline damage restored with seagrasses.

Thorhaug, A. (1980)

Restoration of seagrass communities: Strategies for lessening man's impact on nearshore marine resources

Dept. Biol., Florida Int. Univ., 600 Grapetree Drive, Suite, 4EN, Key Biscayne, FL 33149, USA

Tropical Ecology and Development. Proceedings of the 5th International Symposium of Tropical Ecology, 16-21 April 1979, Kuala Lumpur, Malaysia. Part 2. Furtado, J.I., ed. Pages 1199-1206.

ABSTRACT
Transplantation of seagrasses can be done by plug, sod or seedling transplant. The various species of seagrass lend themselves differently to these methods. Those with apical meristem only, such as Thalassia testudinum , are most economically restored by seed nursing and planting. Those with rapidly growing meristematic tissue throughout the rhizome system, such as Halodule wrightii and Syringodium filiforme , are easily replanted by plug. Restoration of Thalassia at a series of sites impacted by various substances such as thermal pollution, dredging, lack of oxygen, siltation and general urban runoff and pollution has shown that Thalassia can grow under a series of seemingly adverse conditions, once the pollutant has been removed. Thalassia grew rapidly in the initial stages of restoration at a site adjacent to a power plant after the heat had been permanently removed and after five years, had blade abundances up to 3,000 blades m super(-2) in the restored area. The Halodule spread within two months is four times its original diameter in terms of runner lengths in one of the eight Halodule mitigation places. The Halodule had grown together from the one-foot center plugs and the restoration had completed itself within two months.

Thorsteinson, L.K. (1984)

North Aleutian Shelf Environment and Possible Consequences of Offshore Oil and Gas Development

Proceedings of a Synthesis Meeting held at Anchorage, Alaska on March 9-11, 1982. North Aleutian Shelf Environment and Possible Consequences of Offshore Oil and Gas Development: Synthesis Meeting Anchorage, AK (USA) 9-11 Mar 1982

National Ocean Serv., Rockville, MD (USA). Off. of Oceanography and Mar. Serv., 178 pp.

NTIS Order No.: PB84-209428.

Report Number: NOAA-84061404

ABSTRACT
Results and conclusions of a NOAA/OCSEAP synthesis meeting are summarized herein. Prediction of oil spill behavior and potential effects of several hypothetical oil spills on biota are based on OCS exploration and development scenarios established prior to the meeting by the Minerals Management Service. These scenarios and corresponding physical and biological assumptions formed at the meeting for analyses of potential impacts are described in the introduction and in following chapters documenting the proceedings of individual workshops, respectively. Since the North Aleutian Shelf sale was deferred shortly after this synthesis meeting was held, many assumptions such as recoverable resource and spill estimates and hypothetical oil spill point sources, may differ from those described in this report.

Tyler, J. (1981)

Materials Placement Procedures--Surface to Bottom Transfer

Artificial Reefs: Proceedings of a Conference held September 13-15, 1979, in Daytona Beach, FL. Aska, D.Y., ed. Pages 106-109.

North Carolina Div. Mar. Fish., Morehead City, NC, USA

Rep. Fla. Sea Grant Program

Report Number: FSG-R-41

ABSTRACT
North Carolina was active in artificial reef construction from 1974 through 1977 at a scale of some quarter million dollars annually. Reef activity resumed again in late 1978, but at a much reduced scale. Proper placement of reef materials should be a continuing process of planning and consultation with staff and boat and tug captains before and during offloads. Location sketches of each offload need to be recorded. Each load could represent thousands of dollars and proper placement should be meaningful. Materials placement procedures should include prior planning, the operation itself, and then monitoring to see if everything went as planned. Underwater SCUBA monitoring is essential. Three major goals need to be evaluated separately and together before placing materials on the bottom: arrange the best habitat for fishes maintain an acceptable cost/benefit factor, and provide for optimum angler success and pleasure.

UK Offshore Operations Association, London, UK; DOE, London, UK; MAFF, London, UK (1983)

Environmental effects of oil based mud cuttings

Publisher(s): UK Offshore Operators Assoc., London (UK), 124 pp.

ABSTRACT
Discharges of cuttings from water-based or oil-based drilling can have an adverse effect on the seabed biological community. The extent of biological effect is greater from oil-based mud cuttings than water-based. Beyond the area of physical smothering, the effects of oil-based mud cuttings may be due to organic enrichment of the sediment and/or toxicity of certain fractions such as aromatic hydrocarbons. Despite the scale of inputs, in all fields studied the major deleterious biological effects were confined within the 500-m safety zone and associated primarily with burial under the cuttings. Seabed recovery in this zone is likely to be a long process. Surrounding the area of major impact is a transition zone in which subtle biological effects can be detected, generally within 200 to 1,000 m.

URS Research Co., San Mateo, CA (1970)

Evaluation of Selected Earthmoving Equipment for the Restoration of Oil-Contaminated Beaches

Water pollution control research series, 29 Aug 69 - 1 Jul 70

Corp. Source Codes: 405800

Report No.: W72-04296; EPA-15080-EOS-10/70

174p

Paper copy available from GPO $1.50 as EP2.10:15080EOS10/70-1.

NTIS Prices: PC-GPO/MF A01-NTIS

Contract No.: EPA-15080-EOS

ABSTRACT
Field studies of earthmoving equipment units were conducted to evaluate their use and effectiveness in restoring oil contaminated beaches. Specifically, operating procedures and cost estimates were desired, along with any useful design modifications. Previous beach restoration operations were reviewed prior to initiation of the field tests for information about the type of performance required. The field tests were then performed on each equipment/procedure unit to determine efficiency, flexibility, and performance characteristics under a variety of field conditions. Oil removal effectiveness was greater than 98% for all restoration procedures, with the highest effectiveness being achieved by a motorized grader and a motorized elevating scraper working in combination. Conveyor screening systems can be effectively utilized. Costs for removal are reported. (Author)

URS Research Co., San Mateo, CA (1970)

Preliminary Operations Planning Manual for the Restoration of Oil-Contaminated Beaches

Water pollution control research series

Corp. Source Codes: 405800

Report No.: W70-06319; FWPCA-15080-EOS-3/70

76p

NTIS Prices: PC A05 MF A01

Contract No.: DI-14-12-811

ABSTRACT
An Operations Planning Manual was prepared for use by Federal Water Pollution Control Administration personnel involved in oil-spill cleanup operations. The surface conditions and topography of a beach contaminated with oil and the manner in which the oil has been deposited onto the beach will dictate the choice of equipment to be utilized and the operating procedures to be followed. The procedures tested utilize motorized graders, motorized elevating scrapers, front end loaders, and conveyor-screening systems. A motorized grader and motorized elevating scraper working in combination provide the most rapid means of beach restoration; and in addition, their use results in the removal of the smallest amount of uncontaminated beach material. (WRSIC abstract)

van Gelder-Ottway, S. (1975)

Some Physical and Biological Effects of Oil Films Floating on Water

Presented at Inst of Petroleum/Field Studies Council Meeting on Marine Ecology and Oil Pollution, Scotland, Apr 21-23, 75, P255 (32). The original document is available from Bowker.

ABSTRACT
Investigations to determine the physical and biological effects of oil films floating on water are described. Experiments with simulated rock pools demonstrated that photosynthesis and animal activity may be reduced, oxygen levels decreased, and temperature increased if oil films are present. Experimental plants and animals generally survived during the experiments and later recovered fully in clean sea water. Effects of oil films on the rate of gas exchange are insignificant on the open sea, while such effects are significant in still water, such as rock pools. Temperature and light-reduction effects follow a similar pattern.
(20 graphs, 39 references, 4 table)

Vanderhorst, J.R.; Blaylock, J.W.; Wilkinson, P.; Wilkinson, M.; Fellingham, G. (1980)

Recovery of Strait of Juan de Fuca Intertidal Habitat Following Experimental Contamination With Oil

Battelle Pacific NW Labs., Sequim, WA, Vol. 86,

NTIS, SPRINGFIELD, VA

PB81-112518

ABSTRACT
This is a second year interim report on the effects of experimental oiling with Prudhoe Bay crude oil on recovery of intertidal infauna and epifauna of the Strait of Juan de Fuca, Washington State. It describes completed studies of the recovery of infauna as recovery rate relates to the experimental oiling, site of study, type of sediment, tidal or vertical position on the beach, season of study, and duration of recovery.

Vandermeulen, J.H. (1977)

The Chedabucto Bay Spill-Arrow, 1970

Bedford Inst. of Oceanography, Dartmouth, N.S. B2Y 4A2, Can.

OCEANUS 20(4), 31-39, Coden: OCEAAK

illus. refs.

Sum.

ABSTRACT
Of 200 km of shoreline visibly oiled in Mar. 1970, about 1/3 were clear of obvious oil cover within 3 mo, partly due to cleanup efforts and partly due to natural cleaning by wave action. Self-cleaning was quite rapid, with 75% of the heavily oiled shoreline cleansed by 1973. Though 15% was still oiled in 1976, today J5% of the shoreline remains visibly oiled. An estimate of 1.5-2 yr for a self-cleaning or erosion halflife of Bunker C in this environment seems reasonable. Selfcleaning of Bunker C can be directly related to the amount of wave energy impinging on the shoreline. The relative location of the stranded tar on the beach slope greatly affects its selfcleaning potential. The relationship between wave energy and surface oil cleaning is reflected in the decimation and subsequent recovery of kelp, cordgrass, and softshell clam. The main route of oil reentry to the tidal environment is via the sediments and interstitial water within the shoreline structure. The sediments act as a large sink; oil trapped in these sediments has an extremely high residence time. The aliphatic component of the stranded oil is preferentially degraded by microbial activity, while the aromatic and multiring components remain. The erosion halflife of n-alkanes is about 2 yr in natural sediments, while for aromatics it may be as much as 10 yr. The oil remaining in the sediments today is not that spilled there 8 yr ago, but an aromatic derivative, with a long halflife, long residence time, a largely unknown composition, and potential long-term biological implications. Clams from oiled sediments transferred to oil-free seawater retained N40% of the initial hydrocarbon load after 75 d. (FT)

Vandermeulen, J.H.; Buckley, D.E.; Levy, E.M.; Long, B.; McLaren, P.; Wells, P.G. (1978)

Immediate impact of Amoco Cadiz environmental oiling: Oil behavior and burial, and biological aspects

Bedford Inst. of Oceanography, Marine Ecology Lab., Dartmouth, Nova Scotia B2Y 4A2, Canada

One day session Amoco Cadiz Brest, France Jun 7, 1978

CENTRE NATIONAL POUR L'EXPLOITATION DES OCEANS. ACTES DE COLLOQUES No. 6, Coden: PCNCDH, pp. 159-173

illus. refs.

ISSN: 0335-8259

ABSTRACT
Sediment, oil, and biota samples, collected from the north shore of Brittany within 4 wk of the initial grounding of the Amoco Cadiz, were examined for tissue and sediment hydrocarbons, toxicity, and aryl hydrocarbon hydroxylase (AHH) activity. Oiled birds were obtained from a bird-cleaning clinic; those beyond recovery were sacrificed and the tissues frozen and stored. Oil impinging on the shoreline was present in >=3 identifiable stages of weathering-sheen, early mousse, and late mousse. Examination of several sandy beaches showed oil incorporation into sediments of 2 types-more or less homogeneous contamination of sediments and burial of discrete oil layers within sediments. Acute lethal toxicity of stranded Amoco Cadiz oil was intermediate to Bunker C and of Kuwait crude. Simulated weathering studies suggest, however, that acute toxicity increases directly with weathering. Mortalities in the intertidal zone were highly variable, some species experiencing near total mortality while others, notably burrowing annelids and nemerteans, appeared highly resistant to oiling. Hydrocarbon concentrations and AHH activity of oiled birds, and oiled fish were markedly higher than those in nonoiled species. The implications of weathering on toxicity of stranded and buried oil, and possible ecological and physiological defense mechanisms are discussed. (AM FT)

Vandermeulen, J.H. (1978)

Introduction to the Symposium on Recovery Potential of Oiled Marine Northern Environments

Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1977.

Dept. Fish. Environ., Fish. Mar. Serv., Mar. Ecol. Lab., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada, 35(5), 505-508. 1978.

Special issue of selected papers presented at symposium on Recovery Potential of Oiled Marine Northern Environments.

J. Fish. Res. Board Can.

ABSTRACT
Papers presented at a symposium on the recovery potential of oiled marine environments, held at Halifax in October 1977, present evidence to indicate that oiled marine environments will eventually return to a stable state in 5-15 years. Defence mechanisms of nature include wave action and beach erosion, biological conversion, and microbial degradation. Little, however, is known of the manner in which a foreign compound interferes with normal functioning of living systems. True hydrocarbon-free reference sites apparently no longer exist. Oil has a devastating effect on marine environments, and petroleum hydrocarbons and their biological impact have great persistence. Top workers in the field examine different spill studies in biological, chemical, or ecological terms.

Vanloocke, R.; Berlinde, A-M.; Berstraete, W.; de Borger, R. (1979)

Microbial Release of Oil from Soil Columns

Univ. Ghent, Coupure 533, 9000 Gent, Belgium

Environ Sci Technol 13 (3). 346-348. CODEN: ESTHA

ABSTRACT
The possibility of cleaning up subsurface soil horizons polluted with gas oil by activating microbial processes was investigated. The results obtained from laboratory studies indicate that by irrigating the soil with a nutrient solution containing (NH4)NO3 and peptone, 10-20% of the oil adsorbed in the soil can be recovered in 3-4 mo. The release process is biological. The recovered oil is not emulsified and can be recuperated as a phase.

Versino, C.; Molino, C. (1980)

Protection of the Environment During the Process of Re-refining Used Oils

Univ of Torino, Italy, and Rivalta di Torino, Italy

Presented at CEC Recycling of Used Oils 2nd Sym, Paris, Sep 30-Oct 2, 80, p310 (22). The original document is available from Bowker.

ABSTRACT
Acid sludges and spent bleaching wastes are generated during the acid pretreatment and rerefining of used lubricating oils. An advanced technique for treating such sludges is explained. Sulfuric acid is eliminated from the sludge while valuable hydrocarbon compounds are recovered. The treatment processes involves compression and chemical treatment. (in Italian) (5 diagrams, 5 graphs, 14 references, 3 tables)

Vervalin, C.H. (1989)

Bioremediation on the Move

Hydrocarbon Processing-International, Aug 89, V68, N8, P50(3). The original document is available from Bowker.

ABSTRACT
Bioremediation technology promises to be a boon to the hydrocarbon processing industries. Recent r&d has demonstrated the ability of certain microorganisms to decontaminate waste streams and waste disposal sites. In many cases, bioremediation is emerging as the most efficient and cost-effective means of controlling problem wastes. While incineration often costs $250-500/ton of waste, biological methods can cost as little as $40-70/ton. Biological materials and cultures have been devised to degrade pcbs, remove and recover toxic heavy metals from wastewaters, reduce phenol concentrations in effluents, and destroy oily sludges. Specialized bioreactors are now available for treatment of contaminated groundwater and organic vapors from air strippers and soil vents.

Wagenet, R.J.; McKell, C.M.; Malek, A.; Fransway, D.F. (1982)

Hydrologic Properties of Processed Oil Shale

Utah State Univ

Reclamation & Revegetation Research, Jun 82, V1, N1, P33 (18)

ABSTRACT
Water harvesting offers promise for providing water to aid in the establishment of revegetation plantings. Incorporating water harvesting techniques into plans for rehabilitating disposal piles of processed oil shale appears to be a logical way to maximize water supplies. However, a problem of such harvesting on a saline medium such as oil shale is the possibility of harvesting salts along with the water. A series of runoff and leaching experiments was conducted to investigate this problem. Surface treatment of shale piles and control of water quantities applied can reduce salt contributions to surface and ground waters.
(2 diagrams, 4 graphs, 1 map, 22 references, 3 tables)

Wallenberg, B. (1977)

The Ekofisk accident: Its environmental and political implications

OECD, Energy and Environment Div., 2 rue Andre-Pascal, 75775 Paris Cedex 16, Fr.

OECD OBSERVER 88, 9-12, Coden: OECOAW

illus. no refs.

No abs.

ABSTRACT
An uncontrolled blowout on the Bravo platform in the Norwegian Ekofisk oilfield is discussed. Before it was finally capped, an estimated 15,000-21,000 T of oil escaped, of which only 800-1,000 T has been recovered due to the inability of existing equipment to function efficiently in rough seas. Participants in the Bonn Agreement, recognizing the need for more effective national emergency arrangements in the North Sea region, have decided to meet early in 1978 to discuss the following: further mutual assistance and joint emergency arrangements for the area; encouragement of North Sea offshore operators to develop a joint organization to combat oil spills; evaluation of the efficiency of existing chemical and mechanical recovery methods and their impact on the environment; coordination of an effort to improve various means of combating oil pollution; and organization of a permanent secretariat to facilitate cooperation under the Bonn Agreement. This blowout, coupled with numerous offshore tanker accidents, reinforced public concern and scientific interest in the long-term effects of oil on marine and estuarine ecosystems. It is important to remember that the potential for more environmentally damaging and economically costly oil spills is present, and that it is necessary to be continually aware of the risk. (FT)

Walsh, W.J. (1985)

Reef fish community dynamics on small artificial reefs: The influence of isolation, habitat structure, and biogeography

Dept. Zool., Univ. Hawaii, Honolulu, HI 96822, USA

Bull. Mar. Sci., Vol. 36, No. 2, pp. 357-376.

ABSTRACT
The development and dynamics of fish communities on six concrete block reefs in Kona, Hawaii were investigated by visual censuses over 27 months. To extent construction industry can be traced to passage of the Fishery Conservation and Management Act (FCMA) in 1976 . This statute claims exclusive U.S. control over virtually all living marine resources within 200 miles of U.S. shores. The Act creates a 197-mile wide "Fishery Conservation Zone" (FCZ), enclosing 2,250,000 square miles of ocean space and severely limiting foreign fishing. By giving priority to domestic fishermen and processors, the FCMA effectively controls exploitation of approximately 20 percent of the world's marine fish resource. The author reviews the conservation oriented FCMA.

Walsh, J.P. (1979)

Marine habitat protection: tougher fights ahead

Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979.

US Natl. Ocean and Atmos. Admin., Washington, DC, USA

Gen. Tech. Rep. U.S. Dept. Agric.

US Dept. Agriculture Fort Collins, CO (USA)

Report Number: p 59-62

ABSTRACT
The job of protecting and conserving marine and estuarine habitat is going to get tougher. Conflicts between protection and development continue to multiply in coastal zones, especially conflicts over the use of dwindling wetlands. Three major areas of NOAA's activities to protect and conserve marine and estuarine habitats are: (1) habitat protection activities, led by the National Marine Fisheries Service (2) coastal zone management programs, including estuarine and marine sanctuaries and (3) broader pollution research efforts.

Ward, D.M.; Winfrey, M.R.; Beck, E.; Boehm, P. (1982)

Amoco Cadiz pollutants in anaerobic sediments: Fate and effects on anaerobic processes

NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill Biological Studies after the Amoco Cadiz Oil Spill Charleston, SC (USA). Brest (France) 17 Sep 1981. 28 Oct 1981

Dept. Microbiol., Montana State Univ., Bozeman, MT 59717, USA

Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission.

Gundlach, E.R.; Marchand, M., eds. Pages 159-190

ABSTRACT
The chemistry of hydrocarbons present in the various sediments one year after the spill indicated the presence of oil highly altered by evaporation and biodegradation. The levels observed in the environment were also lower than the levels added in experiments to simulate heavy oiling. Possibly a temporary inhibition of acetate oxidation could have resulted from very heavy oiling of relatively fresh oil. Such conditions could have existed at all polluted sites immediately following the Amoco Cadiz spill, although rapid loss of volatile compounds probably occurred between spillage and beaching of oil. Any inhibitory effect would then have been reduced as cleanup or transport of hydrocarbons out of the sediments decreased hydrocarbon amount, and as evaporation, dissolution and biodegradation altered the remaining sediment hydrocarbons. By the time site comparison experiments could be performed, recovery from any negative effects which might have occurred had apparently taken place. The inhibitory effects on acetate oxidation observed may be significant in extremely cold regions where slow rates of evaporation would occur.

Whitlatch, R.B.; Zajac, R.N. (1985)

Biotic interactions among estuarine infaunal opportunistic species

Univ. Connecticut, Dept. Mar. Sci., Mar. Sci. Inst., Avery Point, Groton, CT 06340, USA

Mar. Ecol. (Prog. Ser.), Vol. 21, No. 3, pp. 299-311.

Incl. 45 ref.

ABSTRACT
Biotic interactions among soft-sediment infauna were investigated in a small New England estuary in order to determine what effect(s) established opportunistic species had on subsequent recolonization. Adults of the opportunistic polychaetes Streblospio benedicti, Polydora ligni and Hobsonia florida were added at 2 densities to separate cores containing defaunated sediment. Subsequent infaunal colonization densities of the polychaetes seeded to the cores, and Capitella capitata, Corophium insidiosum, Microdeutopus gryllotalpa and Nematostella vectensis - were analyzed for differences in recolonization with respect to the initial density of each of the established species. While biotic interactions among opportunistic species may play an important role in controlling successional dynamics, the specific type of interaction that occurs most likely depends on the species present, their density and habitat conditions. There appears to be no "characteristic" type of biotic interaction which influences soft-bottom successional dynamics.

Whittle, K.J.; Mackie, P.R.; Farmer, J.; Hardy, R. (1978)

The effects of the Ekofisk blowout on hydrocarbon residues in fish and shellfish

Presented at the Conference on Assessment of Ecological Impacts of Oil Spills, Keystone, CO (USA), 14 Jun 1978.

Torry Res. Stn., Aberdeen AB9 8DG, UK

American Institute of Biological Sciences (USA)

Report Number: p 541-559

ABSTRACT
Demersal fish were trawled in the Ekofisk area in May just after the Ekofisk Bravo Well was capped and again some two months later in July. In addition, cages containing mussels were suspended in the water column near the bottom and recovered a few days later. The fish flesh was assessed for oily taints after cooking and samples of muscle and liver tissues were analyzed for aliphatic and aromatic hydrocarbons. Although two samples of haddock caught initially showed signs of tainting at a low level, no taint was detected two months later. On both occasions the alkane concentrations in muscle and liver remained very similar to those found some years earlier during a baseline survey covering the North Sea. In May, but not in July, some analyses of the gut contents showed the presence of oily residues. The tissue samples which were analyzed for selected two- to five-ring aromatic components gave individual concentrations below one nanogram.

Wilcox, C.G. (1986)

Comparison of shorebird and waterfowl densities on restored and natural intertidal mudflats at Upper Newport Bay, California, USA

California Dept. Fish and Game, P.O. Box 47, Yountville, CA 94599, USA

Colonial Waterbirds, Vol. 9, No. 2, pp. 218-226.

ABSTRACT
As part of a combined wetlands restoration/sediment control project completed in November 1982, 16.5 hectares of lower intertidal habitat were created in the Upper Newport Bay Ecological Reserve, California, USA. Following completion of the project, the restored area was included in an ongoing shorebird and waterfowl censusing program at the reserve. In the three years following the project, use of the restored area increased gradually. Use by shorebirds differed seasonally from that observed in the remainder of the Upper Bay. During the third year, use appeared to be extending later into the year. After three years shorebird use had not reached levels encountered on natural mudflats within the Upper Bay.

Wilde, P.A.W.J.de; Kuipers, B.R. (1977)

A large indoor tidal mud-flat ecosystem

Netherlands Inst. Sea Res., Texel, Netherlands

Helgol. Wiss. Meeresunters., 30(1-4), 334-342.

ABSTRACT
This paper presents a technical description and some preliminary results of a relatively large experimental tidal mud-flat ecosystem, constructed in parallel set ups in the experimental aquarium of the Netherlands Institute voor Onderzoek der Zee (NIOZ). The system was built in 1975, filled with sea water and natural sediment from a typical Arenicola marina habitat. After introducing micro-phytobenthos and juvenile A.marina, the development in both systems, without correcting interventions, were followed for about 2 yr. Studies on nutrient concentrations and organic matter, primary productivity, fluctuations in biomass, density of secondary producers and activity of microorganisms reveal the systems to be self-pertaining and fairly stable. The study of assemblages of hardy inhabitants of the stressful intertidal environment seems to be a promising starting point for further micro-system research.

Williams, U.P.; Kiceniuk, J.W. (1987)

Feeding reduction and recovery in cunner Tautogolabrus adspersus following exposure to crude oil

Dept. Fish. and Oceans, P.O. Box 5667, St. John's, Nfld. A1C 5X1, Canada

Bull. Environ. Contam. Toxicol., Vol. 38, No. 6, pp. 1044-1048.

ABSTRACT
Exposure of fish to relatively high concentrations of oil can result in a number of diverse and deleterious biological changes, one result of which is a depression of feeding. This study shows that a concentration in the 150-250 mu g/L range for 4-5 weeks is required for the onset of feeding depression and recovery can occur in as few as 2-3 weeks. A particular population of cunners would have to be exposed to relatively high concentrations of oil for a prolonged period of time while they are actively feeding, before there would be an effect on the productivity of that population.

Williams, Thomas D. (1978)

Chemical Immobilization, Baseline Hematological Parameters and Oil Contamination in the Sea Otter

Final Report to Marine Mammal Commission, Washington, DC

Williams (Thomas D.), Pacific Grove, Calif.

Report No.: MMC-77/06

33p

NTIS Prices: PC A03/MF A01

Contract No.: MM7AD094

ABSTRACT
Field work on the sea otter Enhydra lutris was conducted in Prince William Sound, Alaska, in July, 1977. The focus of the investigation was to compare techniques of chemical immobilization, investigate baseline blood parameters and explore the effects of oil contamination upon the sea otter. Blood collection methods were established and normal hematology and chemistry for fourteen parameters were reported. An otter totally contaminated with Alaska crude oil was treated, cleaned, fitted with telemetry transmitter and released. Initial studies of three intramuscular anesthetics indicated that Etorphine and CI744 have potential for safe field use with otters.

Williams, T.M.; Kastelein, R.A.; Davis, R.W.; Thomas, J.A. (1988)

The Effects of Oil Contamination and Cleaning on Sea Otters Enhydra-Lutris I. Thermoregulatory Implications Based on Pelt Studies

Sea World Research Institute, Hubbs Marine Res. Cent., 1700 S. Shores Road, San Diego, CA 92109

Can J Zool 66 (12). 2776-2781. CODEN: CJZOA

ABSTRACT
The contamination of sea otter (Enhydra lutris) fur with crude oil or dispersants reduces its insulation and could subject the animal to hypothermia. This study tested methods for removing crude oil from sea otter pelts, and measured changes in insulation caused by oil contamination and subsequent cleaning. Four detergents and two pretreatments were tested on sea otter pelts soiled with fresh crude, 5-day weathered crude, and an oil-dispersant (COREXIT 9527) solution. To examine the effects of oiling and cleaning on the thermal properties of the fur, the thermal conductance of untreated, oiled, and cleaned pelt samples was determined with a heat-flow transducer. Changes in lipid concentration in the fur resulting from contamination and cleaning were also assessed. The results demonstrated that Dawn dishwashing detergent was the most effective agent in removing crude oil from sea otter fur. This detergent removed similar amounts of oil with 15 or 40.degree. C rinse water, and was less effective when used in conjunction with mineral oil or soap pretreatments. Oil contamination caused a two- to four-fold increase in thermal conductance over base-line levels (7.64 .+-. 1.30 W/(m2 C)). Following cleaning, the thermal conductance of the pelt was not significantly different from that of untreated fur. However, mean lipid weight decreased from 7.4 mg lipid/g fur in untreated pelts to 2.0 mg lipid/g fur in cleaned pelts. This study demonstrated that even though natural oils may be lost during the cleaning process, proper cleaning and rinsing restores the water repellency of the sea otter pelt after exposure to crude oil.

Williams, A.S. (1977)

Current methods of oiled bird rehabilitation

Presented at the Oil Spill Response Workshop, Metairie, LA (USA), 15 Feb 1977.

Internatl. Bird Rescue Res. Cent., Berkeley, CA 94710, USA

In: Proceedings of the 1977 Oil Spill Response Workshop

Fore, P.L., ed.

Publisher(s): U.S. Fish and Wildlife Service, Biological Services Program NSTL Station, MS

Report Number: p 125-134

ABSTRACT
An overview of the methods of rehabilitation that are used at the International Bird Rescue Research Center is presented. In an emergency, the process is more complicated that this presentation may suggest, particularly when large numbers of birds are involved. In the case of a large number of birds, most of the activities of medical treatment, cleaning, drying, feeding, routine hydrating, and other aspects of care must go on simultaneously, requiring a high degree of coordination, a sufficient number of supervisory personnel to direct each activity, and enough workers to carry out each job. The plan needed to site the needs of each area will differ, depending on available personnel, facilities, supplies, and equipment, as well as local species and geography. It has become almost a maxim of rehabilitation, however, that some degree of advanced planning is essential to help make the effort more productive when an emergency does occur.

Williams, A.S.; Brundage, S.C.; Anderson, E. (1978)

Saving oiled seabirds: A manual for cleaning and rehabilitating oiled waterfowl

American Petroleum Institute Washington, DC (USA)

Price $0.35.

Report Number: 35 p

No abstract text.

Wilson, T.C.; Krenn, S.J. (1986)

Construction and evaluation of an artificial reef designed to enhance nearshore rockfish production

Oceans '86 Conference Record: Science-Engineering-Adventure, Washington, DC (USA), 23-25 Sep 1986. Vol. 2. Data Management, Instrumentation and Economics, pp. 547-551

Pacific Gas and Electric Co., Biol. Lab., P.O. Box 117, Avila Beach, CA 93424, USA

Report Number: IEEE-86CH2363-0

ABSTRACT
Material from a storm damaged breakwater was used to construct an artificial reef to evaluate potential to enhance select rockfish (Sebastes) species through recruitment. Site selection differed from previous artificial reefs by selecting sand substrate in close proximity to natural rock reefs, rather than placement in areas of low productivity. The substrate heterogeneity of the artificial reef exceeded that of the natural reefs. Algal development of the overstory canopies differed. Early evidence suggests that properly designed artificial reefs may have a beneficial effect on rockfish by creating nursery habitat for early development.

Woodward, D.F.; Riley, R.G.; Henry, M.G.; Meyer, J.S.; Garland, T.R. (1985)

Leaching of retorted oil shale: Assessing the toxicity to Colorado squawfish, fathead minnows, and two food-chain organisms

Columbia Natl. Fish. Res. Lab., Field Res. Lab.-Jackson, P.O. Box 1089, Jackson, WY 83001, USA

Trans. Am. Fish. Soc., Vol. 114, No. 6, pp. 887-894.

ABSTRACT
Development of a large shale-oil industry in Colorado, Utah, and Wyoming would result in disposal of large volumes of restored shale. Water percolating through these wastes could leach toxicants into surface waters of the upper Colorado River system. In 96-h exposures, undiluted leachate was not toxic to fathead minnows Pimephales promelas or Colorado squawfish Ptychocheilus lucius , and was only slightly toxic to the mayfly Hexagenia bilineata and to Daphnia magna . In 30-d exposures to different concentrations of the leachate, a concentration of 6:94 (percent leachate: percent dilution water) caused reduced growth of fathead minnows and reduced survival of mayflies. The highest test concentration not causing toxic effects was 3:97.

Wyers, S.C.; Frith, H.R.; Dodge, R.E.; Smith, S.R.; Knap, A.H.; Sleeter, T.D. (1986)

Behavioral Effects of Chemically Dispersed Oil and Subsequent Recovery in Diploria-strigosa

Bermuda Biol. Station Res., Ferry Reach 1-15, Bermuda

Mar Ecol (Publ Stn Zool Napoli I) 7 (1). 23-42. CODEN: MAECD

ABSTRACT
Survival and behavior of the hermatypic coral Diploria strigosa was studied during 6-24 h doses with water-accommodated fractions of chemically dispersed crude oil, and for a subsequent recovery period of 1 month. Experiments utilized a flow-through laboratory dosing procedure and incorporated petroleum hydrocarbon measurements in order to simulate a major but short-term oil spill in shallow subtidal benthic reef environments. Chemically dispersed oil treatments consisted of Arabian Light Crude oil with Corexit 9527 or BP1100WD at 1-20 ppm concentrations of oil. In general, effects observed were sub-lethal, temporary, and associated with the highest concentrations tested. Responses to the presence of dispersed oil at 20 ppm for 24 h included mesenterial filament extrusion, extreme tissue contraction, tentacle retraction and localized tissue rupture. The nature and severity of reactions during the dosing phase varied between colonies and treatments, but colonies typically resumed normal behavior within 2 h to 4 d of the recovery period. It therefore seems unlikely that observed biological effects would impair long-term viability.

Yanez-Arancibia, A.; Lara-Dominguez, A.L.; Chavance, P.; Flores Hernandez, D. (1983)

Comportamiento ambiental del sistema ecologico de la Laguna de Terminos Campeche Mexico

(Environmental behavior of Terminos Lagoon, ecological system, Campeche, Mexico)

Simposio Internacional IXTOC-1 Mexico D.F., Mexico, 2 Jun 1982

Univ. Nac. Auton. Mex., Inst. Cienc. Mar Limnol., Lab. Ictiol. Ecol. Estuar., Mexico D.F. Mexico

An. Inst. Cienc. Mar Limnol. Univ. Nac. Auton. Mex. (Zool.), Vol. 10, No. 1, pp. 137-176.

ABSTRACT
The processes and important components which determine the relationships of the Terminos Lagoon ecosystem's dynamics, are described. The lagoon presents a moderate seasonal pulse of temperature and light and the area has a high semi-permanent physical-chemical gradient as well as a high diversity of estuarine habitats. Prevailing winds, littoral currents and the discharge of rivers cause a net entrance flow at the east inlet (Puerto Real) and a net outlet flow through the west inlet (El Carmen), the latter creating elevated salinity conditions and sandy sediments towards the northeast of the Lagoon. Major river discharges have been found towards the west of the Lagoon, creating conditions of turbid waters rich in nutrients and low in salinity. An inner delta of calcareous sediments at the eastern inlet of the Lagoon and another of terrigenous sediments are formed towards the sea at the western inlet. 5 subsystems or habitats were delimited through cluster analysis.

Young, C. (1988)

Instant reefs

Publ. and Ext. Serv., Fish. Dept., 108 Adelaide Terrace, Perth, W.A., Australia

Fins., Vol. 21, No. 2, pp. 12-17.

ABSTRACT
Details are given of activities conducted regarding the creation of an artificial reef off Busselton, Western Australia, which involved the dumping of some 34,000 tires about 8 nautical miles from Busselton off Quindalip in about 20 m of water. The reef was made for recreational line fishermen and sport divers professional fishermen and spear fishing is banned. It is expected that the reef will increase the catches of recreational fishermen and provide extra opportunities for recreational diving, thus increasing tourism to the region.

Zentner, J. (1985)

Wetland restoration in coastal California: A decade of management lessons

8th Biennial International Estuarine Research Conference, Durham, NH (USA), 28 Jul 1985

Larry Seeman Assoc., Inc., Berkeley, CA, USA

Estuaries, Vol. 8, No. 2B, p. 30A.

Abstract only.

ABSTRACT
Ten years ago, the first restoration project in coastal California began a trend which has grown tremendously today over $100 million is already committed for as many as 100 coastal wetland restoration projects to be built in the next few years. The lack of research data often creates conflicting and expensive permit conditions and monitoring programs which are unevenly applied exacerbating inter-agency and public-private conflicts. This study further concludes that the procedures of requiring wetland restoration as mitigation for wetland loss is at an early enough stage that lessons from other projects could be applied with positive results.

Zieman, J.C.; Orth, R.A.; Phillips, R.C.; Thayer, G.; Thorhaug, A. (1984)

The effects of oil on seagrass ecosystems

Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981

Dept. Environ. Sci., Univ. Virginia, Charlottesville, VA 22903, USA

Restoration of Habitats Impacted by Oil Spills

Cairns, J., Jr., Buikema, A.L., eds. Pages 37-64

Report Number: ISBN 0-250-40551-2

ABSTRACT
The varied functions of sea grasses in coastal marine ecosystems and the effects of oil pollution on those ecosystems are discussed.

Zwirbla, M.C.; Borie, E.T.L.; Haney, B.J. (1980)

LOOP's Environmental Impact Closely Studied

LOOP, Inc., LA

Oil & Gas J, Vol. 78, No. 38, p. 84 (4)

ABSTRACT
The Louisiana Offshore Oil Port (LOOP) Project, because of its size and unique nature, has been subjected to stringent, in-depth environmental review. An environmental baseline study was conducted before a permit application was submitted. An environmental analysis that included the results of ambient air, brine disposal, oil spill recovery, and meteorological studies was prepared as part of the permit application commitment. A detailed environmental monitoring plan was formulated to detect any adverse environmental impacts of construction or operation. Environmental safeguards have been implemented to ensure that adverse impacts will be minimized. (1 diagram, 1 map)

Addy, J.M.; Levell, D. (1975). *Sand and mud fauna and the effects of oil pollution and cleansing.* Presented at the Institute of Petroleum/Field Studies Council Meeting on Marine Ecology and Oil Pollution, Scotland, April 21-25, 1975, P91 (100).

Adey, W.H. (1987). *Marine microcosms.* Restoration Ecology: A Synthetic Approach to Ecological Research Jordan, W.R., III; Gilpin, M.E.; Aber, J.D., eds. Pages 133-149. Report Number: ISBN 0-521-33110-2

Akeda, S.; Uekita, Y. (1987). *Studies on reduction effect of velocity on the shape and arrangement of artificial reef.* Technical Report, Natl. Res. Inst. Fish. Eng., Hasaki, Kashima, Ibaragi 314-04, Japan. Suikoken Giho Suisandoboku, No. 8, pp. 101-109

Anderson, B.W.; Ohmart, R.D. (1985). *Riparian revegetation as a mitigating process in stream and river restoration.* The Restoration of Rivers and Streams: Theories and Experience. Gore, J.A. (ed). pp. 41-80. Butterworth Publishers, Stoneham, MA (USA).

Anderson, D.C. (1987). *Evaluation of habitat restoration on the Naval Petroleum Reserve No. 1, Kern County, California.* Sponsor: Department of Energy, Washington, DC. Report No.: EGG-10282-2179. 107 pp. Contract No.: AC08-83NV10282

Anderson, E.P. (1985). *Use by juvenile chinook salmon of artificial habitat constructed from dredged material in the Campbell River Estuary.* Ocean Dumping R and D Pacific Region. Department of Fisheries and Oceans, 1983 - 1984 Sidney, B.C. (Canada), 7 Dec 1984. Can. Contract. Rep. Hydrogr. Ocean Sci., No. 20, pp. 4-15

Anderson, R.C. (1983). *Economic perspectives on oil spill damage assessment.* Oil Petrochem. Pollut., Vol. 1, No. 2, pp. 79-84

Anonymous (1971). *Second annual report of the Advisory Committee on Oil Pollution of the Sea.* Second Annual Report. University of Newcastle upon Tyne, Dept. of Zoology, Research Unit on the Rehabilitation of Oiled Seabirds, Advisory Committee on Oil Pollution of the Sea, England. 38 pages.

Anonymous (1972). *Recommended treatment of oiled seabirds.* Report. University of Newcastle upon Tyne, Dept. of Zoology, Research Unit on the Rehabilitation of Oiled Seabirds, Advisory Committee on Oil Pollution of the Sea, England. 11 pages.

Anonymous (1973). *Oil and penguins don't mix.* National Geographic Magazine. Washington, DC, 143(3):384-397, March 1973

Anonymous (1974). *Fifth annual report.* University of Newcastle upon Tyne, Department of Zoology, Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. Annual Report, 28 pp.

Anonymous (1976). *Draft environmental impact report for proposed gas pipeline from Sacramento Airport to Martinez, California.* Shell Oil Company Environmental Impact Report Aug 15, 1975; Feb 20, 1976, Vol. 2 (421).

Anonymous (1977). *Oil kills North Sea birds.* Mar. Pollut. Bull. 8(8):173

Anonymous (1978). *Oiled seabirds get in the swim.* New Scientist 78(1100):213

Anonymous (1979). *Alaska pipelines first oil spills.* New Scientist, 84(1176), 96.

Anonymous (1979). *Pollution control plan.* Ship Boat Int., 32(10), 59.

Anonymous (1986). *Artificial reefs.* Technology, Vol. 8, No. 6. Publisher(s): PCARRD, Los Banos (Philippines), 16 pp. Report Number: ISSN 0115-7787

Anonymous (1986). *Dredged material management: Beneficial use initiative.* Info. Exch. Bull. U.S. Army Corps of Engineers, Waterways Experimental Station, Vol. D-86-3, p. 1.

Anonymous (1988). *Basic research for Japanese ocean farming.* World Fish., Vol. 37, No. 7, p. 46.

Anonymous (1989). *Political, economic fallout spreads from Exxon Valdez crude oil spill.* Oil & Gas J, Apr 10, 89, V87, N15, P13(4)

Ardizzone, G.D.; Bombace, G. (1983). *Artificial reef experiments along a Tyrrhenian sea coast.* Seminar on Scientific Aspects of Artificial Reefs and Floating Mariculture in the Mediterranean, Cannes, December 7, 1982.

Armstrong, D.A.; Incze, L.S.; Armstrong, J.L.; Wencker, D.C.; Dumbauld, B.R. (1981). *Distribution and abundance of decapod crustacean larvae in the S.E. Bering Sea with emphasis on commercial species.* Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators for the Year Ending March 1981. Volume 2. Receptors - Benthos. Publisher(s): NOAA/OMPA, Boulder, CO (USA), pp. 365-596. Report Number: NOAA-OMPA-AR-81-2

Armstrong, N.E. (1982). *Spill cleanup. Part 3, biological measures.* In: Hazardous Materials Spills Handbook. McGraw-Hill Book Co., NY

Armstrong, N.E.; Gloyna, E.F.; Wyss, O. (1984). *Biological countermeasures for the control of hazardous material spills.* NTIS, Springfield, VA (USA). Report Number: NTIS PB84-140276

Army Engineer District, Mobile, AL (USA). (1984). *Exploration and production of hydrocarbon resources in coastal Alabama and Mississippi.* Final Generic Environmental Impact Statement. 1006 pp. NTIS Number: AD-A154 316/4/GAR. Report Number: COESAM/PD-EE-84-009

Ash, C.; Garrett, C.; Gray, S. (1989). *Prevention and cleanup of petroleum contamination of ground water Florida's Super Act.* Fla Sci 52 (4). 225-229.

Aska, D.Y. (editor). (1981). *Artificial reefs: Proceedings of a Conference Held September 13-15, 1979, in Daytona Beach, Florida.* Conference on Artificial Reefs Daytona Beach, FL (USA) 13 Sep 1979. Rep. Fla. Sea Grant Program. Publisher(s): FSG, Gainesville, FL (USA), 235 pp. Report Number: FSG-R-41

Atlas, R.M. (1978). *Potential interaction of microorganisms and pollutants from petroleum development.* In: Marine Biological Effects of OCS Petroleum Development. Wolfe, D.A., ed. . Presented at the Formal Scientific Review of Biological Effects Studies, Seattle, WA (USA), Nov 29, 1977. Report Number: NOAA-TM-ERL-OCSEAP-1. pp. 156-166. Publisher(s): NOAA ERL, Boulder, CO (USA).

Atlas, R.M.; Horowitz, A.; Busdosh, M. (1978). *Prudhoe crude oil in arctic marine ice, water, and sediment ecosystems: Degradation and interactions with microbial and benthic communities.* Presented at the Symposium on Recovery Potential of Oiled Marine Norther Environments Halifax (Canada) 10 Oct 1977. J. Fish. Res. Board Can. 35(5), 585-590

Axiak, V.; George, J.J. (1987). *Behavioral responses of a marine bivalve (Venus verrucosa) to pollution by petroleum hydrocarbons.* Water Air Soil Pollut., Vol. 35, No. 3-4, pp. 395-410.

Backman, T.W.H. (1985). *Selection of Zostera marina L. ecotypes for transplanting.* "Engineering and the Environment" San Diego, CA (USA) 12-14 Nov 1985. Oceans' 85 Proceedings: Ocean Engineering and the Environment. Vol. 2, pp. 1088-1093

Baden, S.; Hagerman, L. (1981). *Ventilatory responses of the shrimp Palaemon adspersus to sublethal concentrations of crude oil extract.* Mar. Biol., Vol. 63, No. 2, pp. 129-133

Baker, J.M. (1975?). *The Field Studies Council Oil Pollution Research Unit.* Presented at Inst of Petroleum/Field Studies Council Meeting on Marine Ecology and Oil Pollution, Scotland, Apr 21-23, 1975, P17 (3).

Bakke, T. (1986?). *Experimental long term oil pollution in a boreal rocky shore environment.* Env Canada 9th Arctic Marine Oil Spill Technical Seminar, Edmonton, Jun 10-12, 1986, P167(12).

Ballou, T.G.; Dodge, R.E.; Hess, S.C.; Knap, A.H.; Sleeter, T.D. (1987). *Effects of a dispersed and undispersed crude oil on mangroves, seagrasses and corals.* Research Planning Institute Inc., Columbia, South Carolina and Bermuda Biological Station for Research, Bermuda. Publisher(s): American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Report Number: API 4460

Banner, A. (1979). *Mitigation under the Corps regulatory program.* Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979. Gen. Tech. Rep. US Dept. Agriculture Fort Collins, CO (USA). p 396-399.

Bartha, R.; Atlas, R.M. (1977). *The microbiology of aquatic oil spills.* Adv. Appl. Microbiol., No. 22, 225-266.

Battelle Northwest Laboratories (1967). *Oil spillage study - literature search and critical evaluation for selection of promising techniques to control and prevent damage: BNPG-319.* Sponsor: Coast Guard, Washington, DC. NTIS Report Number: AD-786 403/6

Beck, R.; Shore, R.; Scriven, T.A.; Lindquist, M. (1981). *Potential environmental problems of enhanced oil and gas recovery techniques.* NTIS, Springfield, VA. Report Number: PB81-240186.

Begley, S.; Drew, L.; Hager, M. (1989). *Smothering the waters.* Newsweek, Apr 10, P54(4)

Beillois, P.; Desaunay, Y.; Dorel, D.; Lemoine, M. (1979). *Pollution effects after the Amoco Cadiz grounding: Conditions of fishery resources in the Bays of Morlaix and Lannion.* Report Institut Scientifique et Technique des Peches Maritimes, Nantes, France, January, 1979.

Bell, J.D.; Steffe, A.S.; Westoby, M. (1985). *Artificial seagrass: How useful is it for field experiments on fish and macroinvertebrates?.* J. Exp. Mar. Biol. Ecol., Vol. 90, No. 2, pp. 171-177.

Bell, J.D.; Steffe, A.S.; Westoby, M. (1988). *Location of seagrass beds in estuaries: Effects on associated fish and decapods.* J. Exp. Mar. Biol. Ecol., Vol. 122, No. 2, pp. 127-146.

Bell, J.D.; Westoby, M. (1986). *Importance of local changes in leaf height and density to fish and decapods associated with seagrasses.* J. Exp. Mar. Biol. Ecol., Vol. 104, No. 1-3, pp. 249-274.

Bell, J.D.; Westoby, M. (1986). *Variation in seagrass height and density over a wide spatial scale: Effects on common fish and decapods.* J. Exp. Mar. Biol. Ecol., Vol. 104, No. 1-3, pp. 275-295.

Bell, J.D.; Westoby, M. (1987). *Effects of an epiphytic alga on abundances of fish and decapods associated with the seagrass Zostera capricorni.* Aust. J. Ecol. 12 (4):333-338.

Bell, J.M. (1981?). *Industrial waste.* Purdue Univ. et al. Industrial Waste 36th Conf Proceedings, Lafayette, IN, May 12-14, 1981 (1008)

Bell, P.R.; Greenfield, P.F.; Nicklin, D.J. (1983?). *Chemical and physical characterization of effluent streams from the processing of Australian oil shale.* Colorado School of Mines Oil Shale 16th Sym, Golden, CO, Apr 13-15, 1983, P477 (10).

Belsky, J. (1982). *Diesel oil spill in a subalpine meadow: 9 years of recovery.* Canadian J Botany, 60(6):906.

Bender, M.E.; Hudgins, J.G.; Jordan, R.A., editors, (1981). *Fate and effects of experimental oil spills in an eastern coastal plain marsh system.* Publisher(s): American Petroleum Institute, 1220 L Street, NW, Washington, DC. Report Number: API 4342

Bender, M.E.; Shearls, E.A.; Ayres, R.P.; Hershner, C.H.; Huggett, R.J. (1977). *Ecological effects of experimental oil spills on eastern coastal plain estuarine ecosystems.* Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977. Publisher(s): American Petroleum Inst., Washington, DC (USA), p.505-509. Report Number: API-Publ--4284

Bender, M.E.; Shearls, E.A.; Murray, L.; Huggett, R.J. (1980). *Ecological effects of experimental oil spills in eastern coastal plain estuaries.* Environ. Int., 3(2):121-133.

Bendock, T.N. (1979). *Beaufort Sea estuarine fishery study.* In: Environmental assessment of the Alaskan continental shelf. Final reports of principal investigators. Volume 4. biological studies. Publisher(s): NOAA Environmental Research Laboratories, Boulder, CO (USA), Outer Continental Shelf Environmental Assessment Program. Contract No. 03-5-022-69.

Berge, J.A.; Johannessen, K.I.; Reiersen, L.-O. (1983). *Effects of the water soluble fraction of North Sea crude oil on the swimming activity of the sand goby, Pomatoschistus minutus (Pallas).* J. Exp. Mar. Biol. Ecol., Vol. 68, No. 2, pp. 159-167.

Bergman, H.L.; DeGraeve, G.M.; Anderson, A.D.; Farrier, D.S. (1980). *Effects of complex effluents from in situ fossil fuel processing on aquatic biota.* First Annl. Oak Ridge Nat. Lab. Life Sci. Symp., Oak Ridge, TN, Sep. 25-28, 1978. In: Synthetic Fossil Fuel Tech. -- Potential Health & Environ. Effects, pp. 204-211. Ann Arbor Sci. Publ., Inc., 230 Collingwood, P.O. Box 1425, Ann Arbor, MI 48106

Berkner, A.B. (1979). *Wildlife rehabilitation techniques: Past, present, and future.* Presented at the US Fish & Wildlife Service Pollution Response Conf, St. Petersburg, May 8-10, 1979, P127 (7).

Berkner, A.B.; Smith, D.C.; Williams, A.S. (1977). *Cleaning agents for oiled wildlife.* Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977. Publisher(s): American Petroleum Inst., Washington, DC (USA), p.411-415. Report Number: API-Publ--4284

Berliner, N. (1989). *The year of the spills.* Environ. Action, V21, N2, P12(4).

Beynon, L.R.; Goedjen, H.; Lilie, R.H. (1983). *Field guide to inland oil spill clean-up techniques.* CONCAWE'S Oil Spill Clean-up Technol., Spec. Task Force No. 3. Report Number: 10/83.

Bodennec, G.; Glemarec, G.; Grizel, M.; Kaas, H.; Legrand, R.; Le Moal, V.; Michel, P.; Miossec, P.; et al. (1983). *Oil pollution impact on marine fauna and flora.* Impact des hydrocarbures sur la flore et la faune marines. Rapport collectif. (Oil pollution impact on marine flora and fauna. A collective report.). Michel, P. ed., 1983., pp. 105-182. Contract CEE/ISTPM: BG/82/614 (629).

Bodin, P. (1988). *Results of ecological monitoring of three beaches polluted by the Amoco Cadiz oil spill: Development of meiofauna from 1978 to 1984.* Mar. Ecol. Prog. Ser., Vol. 42, No. 2, pp. 105-123

Bodin, P.; Boucher, D. (1982). *Mid-term evolution of meiobenthos and microphytobenthos on beaches touched by the Amoco Cadiz oil spill.* NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill, Charleston, SC (USA), 17 Sep, 1981, and Brest (France), 28 Oct, 1981. Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Gundlach, E.R.; Marchand, M., eds. Pages 245-268

Bodin, P.; Boucher, D. (1983). *Medium-term evolution of meiobenthos and chlorophyll pigments on some beaches polluted by the Amoco Cadiz oil spill.* Oceanol. Acta, Vol. 6, No. 3, pp. 321-332

Bohme, V.E.; Brushett, E.R. (1977?). *Oil spill control in Alberta.* 1977 Oil Spill Conference, New Orleans, LA, Mar. 8-10, 1977. American Petroleum Institute. Publication 4284, pp. 91-94

Bokn, T. (1987). *Effects of diesel oil and subsequent recovery of commercial benthic algae.* Hydrobiologia, N151-152, P277(8).

Bombace, G. (1977?) . *Theoretical and experimental aspects relating to artificial reefs.* Atti del 9o Congresso della Societa Italiana di Biologia Marina, Lacco Ameno d'Ischia, 19-22 Maggio 1977. (Proceedings of the 9th Congress of the Italian Society of Marine Biology, Lacco Ameno d'Ischia, Italy, 19-22 May 1977). Cinelli, F.; Fresi, E.; Mazzella, L., eds. Pages 29-41.

Bombace, G. (1979). *Experiments on artificial reefs in the central Adriatic (SE Conero, Ancona).* 1st Convegno Scientifico Nazionale del Progetto Finalizzato "Oceanografia e Fondi Marini" Rome (Italy) March 5, 1979. Atti del Convegno Scientifico Nazionale (Roma 5-6-7 Marzo 1979). [Proceedings of the National Scientific Meeting (Rome 5-6-7 March)], Vol. 1, pp. 185-198

Bondev, I.A.; Simeonov, S.Y. (1979). *Effect of contamination on the dynamics of the higher swamp vegetation in the Poda locality near Bourgas, Bulgaria.* Ekologiya (Sofia) 0 (5):3-10.

Bonsdorff, E. (1981). *The Antonio Gramisci oil spill impact on the littoral and benthic ecosystems.* Mar. Pollut. Bull., Vol. 12, No. 9, pp. 301-305

Borum, J. (1985). *Development of epiphytic communities on eelgrass (Zostera marina) along a nutrient gradient in a Danish estuary.* Mar. Biol., Vol. 87, No. 2, pp. 211-218.

Botero, A.J.; Garzon, F.J.; Gutierrez, M.G. (1981). *Establishment and development of a fish community in an artificial reef made from scrap tires.* Bol. Mus. Mar. Bogota, No. 10, pp. 63-81.

Boucher, G.; Cabioch, L.; Chamroux, S.; Dauvin, J.C. (1983). *Ecological survey of the coasts of Britanny: Study of macrobenthos, meiofauna, and bacteria in the Bay of Morlaix.* Publisher(s): Station Biologique, Roscoff, France, 57 pp. Contracts CNEXO 81-6597 and 82-2606.

Boucher, G.; Chamroux, S.; Riaux, C. (1984). *Modifications of physiological and biological characteristics of a sublittoral sand polluted by hydrocarbons.* Mar. Environ. Res., Vol. 12, No. 1, pp. 1-23.

Brand, D. (1973). *Dry cleaning's helpful if ocean slick leaves oily bird unflappable.* Wall Street Journal 1:25, April 13, 1973. New York.

Brenk, V. (1987). *The concept of research for sea pollution by the transport of hazardous material on sea from the Federal Environmental Agency.* Texte., No. 6, (1987). Meereskundliche Untersuchung von Oelunfaellen. Tagung Der Arbeitsgruppe Zur Meereskundlichen Untersuchung von Oelunfaellen in Loccum, 18-20 September, 1985, pp. 45-57. (Marine Research Investigations of Oil Accidents. Meeting of the Working Group of Marine Research Investigations on Oil Accidents in Loccum, 18-20 Sep., 1985.)

Breslin, V.T.; Roethel, F.J.; Schaeperkoetter, V.P. (1988). *Physical and chemical interactions of stabilized incineration with the marine environment.* 81st APCA Annual Meeting & Exhibition Dallas, TX (USA), June 19-24, 1988, p. 22

Broman, D.; Ganning, B.; Lindblad, C. (1983). *Effects of high pressure, hot water shore cleaning after oil spills on shore ecosystems in the northern Baltic proper.* Mar. Environ. Res., Vol. 10, No. 3, pp. 173-187.

Bromley, M. (1985). *Wildlife management implications of petroleum exploration and development in wildland environments.* Gen. Tech. Rep., Intermountain Research Station, 48 pp. NTIS Number: PB86-121290/GAR. Report Number: FSGTR/INT-191

Bronfman, A.M.; Aldakimova, A.Y.; Makarova, G.D.; Tolokonnikova, L.I. (1976). *Distinctive features of self purification of water and sediments of a shallow sea as exemplified by the Sea of Azov Russian-SFSR USSR.* Okeanologiya 16 (1):91-97.

Broome, S.W.; Seneca, E.D.; Woodhouse, W.W., Jr. (1988). *Tidal salt marsh restoration.* Aquat Bot 32(1-2):1-22.

Brown, C.H. (1978). *The role of the U.S. Fish and Wildlife Service in responding to oil spills.* Presented at: Energy/Environmnt '78 Los Angeles (USA) 22 Aug 1978. Dep. Interior, US Fish & Wildlife Serv. (ES), National Oil & Hazardous Substances Spill Coordinator, Washington, DC 20240, USA. In: Proceedings: Energy/Environment '78: a symposium on energy development impacts. Lindstedt-Siva, J. ed., Society of Petroleum Industry Biologists Los Angeles (USA). p 321.

Brown, D.J.S.; Baxter, A. (1984). *August 1980 oil spill clean-up project -- Bahrain report summary of task force operations.* UNEP Reg. Seas Rep. Stud., No. 44. Combating Oil Pollution in the Kuwait Action Plan Region, pp. 125-146

Brown, J.; West, G.C. (1970). *Tundra biome research in Alaska - the structure and function of cold-dominated ecosystems.* Tundra Biome Analysis of Ecosystems College Alaska. Sponsor: Cold Regions Research and Engineering Lab., Hanover, N.H. Report No.: 70-1. 157 pp. NTIS Number: PC A08/MF A01

Brown, R.D. (1981). *Health and environmental effects of synthetic fuel technologies: Research priorities.* NTIS, Springfield, VA. Report Number: PB81-212474

Brownlee, M.J.; Mattice, E.R.; Levings, C.D. (1984). *The Campbell River Estuary: A report on the design, construction and preliminary follow-up study findings of intertidal marsh islands created for purposes of estuarine rehabilitation.* Can. Manuscr. Rep. Fish. Aquat. Sci., No. 1789, 63 pp. Report Number: ISSN 0706-6473

Buhite, T.R. (1979). *Cleanup of a cold weather terrestrial pipeline spill.* Presented at the 1979 Oil Spill Conference Los Angeles, CA (USA) 19 Mar 1979. Proc. Oil Spill Conf. American Petroleum Institute Washington, DC (USA). pp. 367-369.

Buhrer, H. (1979). *Influence of hydrocarbons on ecology of bacteria in aerobic lake sediment.* Schweiz. Z. Hydrol. Rev. Suisse Hydrol. Swiss J. Hydrol., 41(2):315-355.

Butler, J.N.; Levy, E.M. Chairmen. (1978). *Summary and overview: Long-term fate of petroleum hydrocarbons after spills - compositional changes and microbial degradation.* Session 1. Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977. J. Fish. Res. Board Can. 35(5):604-605.

Butler, W.H. (1985). *Multiple land use: An essential part of environmental planning.* Apea J, Vol. 25, No. 1, P311(5).

Cadena, F.C. (1988). *Treatment of water supplies contaminated with toxic pollutants using tailored soils.* Sponsor: New Mexico State Univ., Las Cruces, NM; Water Resources Div., Geological Survey, Reston, VA. Report No.: WRRI-235. 63 pp. Prepared in cooperation with New Mexico State Univ., Las Cruces, NM. Sponsored by Water Resources Div., Geological Survey, Reston, VA. NTIS Number: PB89-151443/XAB

Cairns, J., Jr. (1978). *Waterway recovery.* Water Spectrum, 3, 28-32.

Cairns, J., Jr.; Buikema, A.L. (1984). *Restoration of habitats impacted by oil Spills: Workshop summary.* Restoration of Habitats Impacted by Oil Spills Symposium Blacksburg, VA (USA) 9-11 Nov 1981. Dept. Biol., Univ. Cent. Environ. Stud., Virginia Polytech. Inst. and State Univ., Blacksburg, VA 24061, USA. Restoration of habitats impacted by oil spills. Cairns, J., Jr., and Buikema, A.L., eds. Pages 173-180. Report Number: ISBN 0-250-40551-2

Cairns, J., Jr.; Dickson, K.L.; Herricks, E.E. (1977). *Recovery and restoration of damaged ecosystems.* International Symposium on the Recovery of Damaged Ecosystems Blacksburg, VA, March 23-25, 1975, 531 pp. Publisher(s): University Press of Virginia, Charlottesville, VA

Campbell, D.A. (1981). *Enhanced oil recovery and its environmental and economic implications in the United States.* Environ. Conserv Vol. 8, No. 1, pp. 5-18

Canevari, G.P. (1979). *The restoration of oiled shorelines by the proper use of chemical dispersants.* Presented at the 1979 Oil Spill Conference, Los Angeles, CA (USA), 19 Mar 1979. Proc. Oil Spill Conf. American Petroleum Institute Washington, DC (USA). p 443-446.

Capuzzo, J.M. (1981). *Crude oil effects to developmental stages of the American lobster.* Sponsor: Bureau of Land Management.; Washington, DC. Report No.: WHOI-81-75. 108 pp. NTIS Number: PB82-117656. Contract No.: DI-AA551-CT9-5

Capuzzo, J.M.; Derby, J.G.S. (1982). *Drilling fluid effects to developmental stages of the American lobster.* Woods Hole Oceanogr. Inst., Woods Hole, MA, USA. NTIS, Springfield, VA. Report Number: PB82-220740

Carlisle, J.G., Jr. (1976). *Artificial modification of the ecosystem.* 1. Artificial reefs. 2. Offshore oil drilling platforms. Joint Oceanographic Assembly, Edinburgh (UK), September 13, 1976.

Carr, R.S.; Linden, O. (1984). *Bioenergetic responses of Gammarus salinus and Mytilus edulis to oil and oil dispersants in a model ecosystem.* Mar. Ecol. (Prog. Ser.), Vol. 19, No. 3, pp. 285-291

Carter, J.; Lamarra, V. (1983). *Environmental management — A data based ecosystem approach from the oil shale industry.* J. Environ. Manage., Vol. 17, No. 1, pp. 17-34

Castle, R.W. (1977). *Restoration of oil-contaminated shorelines.* Presented at the Oil Spill Response Workshop, Metairie, LA (USA), February 15, 1977. In: Proceedings of the 1977 Oil Spill Response Workshop. Fore, P.L, ed. p 105-112. Publisher(s): U.S. Fish and Wildlife Service, Biological Services Program NSTL Station, MS.

CEQ Report (1974). *OCS oil and gas — an environmental assessment.* CEQ Report, Apr 74, V5 (190)

Chamberlain, G. (1989). *Technology tackles the oil spill.* Design News, Jun 19, 89, P90(6).

Chauvin, D.J. (1980). *Impact of non-toxic mud on Gulf Coast drilling.* Pet. Eng. Int., 52(10), 34, 38, 42

Chemical Week (1980). *Biotechnology: research that could remake industries.* Chemical Week, OCT 8, 80, V127, N15, P23 (8)

Choi, D.R. (1984). *Ecological succession of reef cavity-dwellers (coelobites) in coral rubble.* Bull. Mar. Sci., Vol. 35, No. 1, pp. 72-79

Church, G.J. (1989). *The big spill.* Time, Apr 10, V133, N15, P38(4)

Clark, J.R. (1976). *Assuring ecological soundness in coastal energy developments.* Trans. North Am. Wildl. Nat. Resour. Conf., 41, 356-360

Clark, R.B. (1978). *Oiled seabird rescue and conservation.* Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977. J. Fish. Res. Board Can. 35(5), 675-678.

Clark, R.B. (1982). *Biological effects of oil pollution.* Water Science and Technology, Vol. 14, No. 9-11, p. 1185. NOTE: Proceedings of the Eleventh Biennial Conference of the International Association on Water Pollution Research and Control, Cape Town 29th March--2nd April 1982

Clark, R.C., Jr.; Patten, B.G.; DeNike, E.E. (1978). *Observations of a cold-water intertidal community after 5 years of a low-level, persistent oil spill from the General M.C. Meigs.* Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977. J. Fish. Res. Board Can. 35(5), 754-765

Coenen, N.L.; Cortright, B. (1979). *Mitigation in the Oregon Coastal Management Program.* Presented at: The Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA) 16 Jul 1979. Gen. Tech. Rep. U.S. Dep. Agric., U.S. Dep. Agriculture, Fort Collins, CO (USA). p. 103-107.

Cole, T. (1978). *Preliminary ecological-genetic comparison between unperturbed and oil-impacted Urosalpinx cinerea (Prosobranchia: Gastropoda) populations: Nobska Point (Woods Hole) and Wild Harnor (West Falmouth), Massachusetts.* Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977. J. Fish. Res. Board Can. 35(5), 624-629

Cole, J. (1979). *Scientists gauge extent of recovery after an oil spill.* Smithsonian, V10, N7, P68 (7).

Cook, C.B.; Knap, A.H. (1983). *Effects of crude oil and chemical dispersant on photosynthesis in the brain coral Diploria strigosa.* Mar. Biol., Vol. 78, No. 1, pp. 21-27.

Cooke, T.S. (1978). *Outer continental shelf oil spill impact on southern California resources.* In: Proceedings Energy/Environment '78: A Symposium on Energy Development Impacts, Los Angeles (USA), August 22, 1978. Lindstedt-Siva, J., ed. Society of Petroleum Industry Biologists Los Angeles (USA). Page 257.

Costa, D.P.; Kooyman, G.L. (1981). *Effects of oil contamination in the sea otter, Enhydra lutris.* Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Volume 10: Biological Studies. Publisher(s): NOAA/OMPA, Boulder, CO (USA), pp. 65-107. Report Number: NOAA-OMPA-FR-81-10

Cox, G.V.; Cowell, E.B. (1979). *Mitigating oil spill damage - ecologically responsible clean-up techniques.* Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), July 16, 1979. Gen. Tech. Rep. U.S. Dept. Agric. U.S. Dept. Agriculture, Fort Collins, CO (USA). p. 121-128.

Crabtree, A.F. (1979). *Pipelines in streams and wetlands.* Ecolibrium, Winter 79, V8, N1, P13 (4).

Craig, P.C.; Haldorson, L. (1979). *Beaufort Sea barrier island-lagoon ecological process studies: Ecology of fishes in Simpson Lagoon, Beaufort Sea, Alaska.* Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1979. Vol. 6: Effects. p. 363-470. Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA). Outer Continental Shelf Environmental Assessment Program

Culley, J.L.B.; Dow, B.K.; Presant, E.W.; MacLean, A.J. (1982). *Recovery of productivity of Ontario soils disturbed by an oil pipeline installation.* Can. J. Soil Sci., Vol. 62, No. 2, pp. 267-279

Cushman, R.M.; Goyert, J.C. (1984). *Effects of a synthetic crude oil on pond benthic insects.* Environ. Pollut. (A Ecol. Biol.), Vol. 33, No. 2, pp. 163-186

Dauvin, J.-C. (1987). *Long term evolution (1978-1986) of the amphipod populations of the fine sand community of Pierre Noire (Bay of Morlaix, western English Channel) after the Amoco Cadiz disaster.* Mar. Environ. Res., Vol. 21, No. 4, pp. 247-273.

Davidson, J.W. (1976). *Environmental difficulties encountered in shale oil production.* Alternate Fuels Symposium. Mimeographed Papers. (n.p.)

Davis, R.W.; Williams, T.M.; Thomas, J.A.; Kastelein, R.A.; Cornell, L.H. (1988). *The effects of oil contamination and cleaning on sea otters (Enhydra lutris). 2. Metabolism, thermoregulation, and behavior.* Can. J. Zool., Vol. 66, No. 12, pp. 2782-2790.

Davis, W.P.; Hoss, D.E.; Scott, G.I.; Sheridan, P.F. (1984). *Fisheries resource impacts from spills of oil or hazardous substances.* Proceedings of the Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), November 9-11, 1981. Cairns, J., Jr.; Buikema, A.L., eds. Pages 157-172. Report Number: ISBN 0-250-40551-2

de Jong, E. (1980). *The effect of a crude oil spill on cereals.* Environmental Pollution. Series A: Ecological and Biological, 22(3), 187-196

Deis, D.R.; Dial, R.S.; Quammen, M.L. (1987). *The use of mitigation in environmental planning for port development.* Proceedings of the 10th National Conference on Estuarine and Coastal Management: Tools of the Trade, New Orleans, LA (USA), October 12-15, 1986. Vol. 2. Lynch, M.P.; McDonald, K.L., eds. Pages 707-718.

Dennison, W.C. (1987). *Effects of light on seagrass photosynthesis growth and depth distribution.* Aquat Bot 27(1):15-26.

Dennison, W.C.; Alberte, R.S. (1986). *Photoadaptation and growth of Zostera marina L. (eelgrass) transplants along a depth gradient.* J. Exp. Mar. Biol. Ecol., Vol. 98, No. 3, pp. 265-282.

Dewling, R.T.; McCarthy, L.T. (1980). *Chemical treatment of oil spills.* Environ. Int., 3(2), 155-162.

Dial, R.S.; Deis, D.R. (1986). *Mitigation options for fish and wildlife resources affected by port and other water-dependent developments in Tampa Bay, Florida.* NTIS Number: PB87-140703/GAR. 171 pp.

Diamant, A.; Tuvia, A.B.; Baranes, A.; Golani, D. (1986). *An analysis of rocky coastal Eastern Mediterranean fish assemblages and a comparison with an adjacent small artificial reef.* J. Exp. Mar. Biol. Ecol., Vol. 97, No. 3, pp. 269-285.

Diaz, R.J.; Boesch, D.F. (1977). *Habitat development field investigations, Windmill Point Marsh Development Site, James River, Virginia. Appendix C. Environmental impacts of marsh development with dredged material: Acute impacts on the macrobenthic community.* Technical Report, U.S. Army Corps of Engineers, Waterways Experimental Station. 158 p. Publisher(s): U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, VA (USA), November, 1977. Contract No. DACW66-75-C-0053

Dibble, J.T.; Bartha, R. (1979). *Rehabilitation of oil inundated agricultural land a case history.* Soil Sci 128 (1). 56-60.

Dicks, B.; Iball, K. (1981?). *Ten years of saltmarsh monitoring — the case history of a Southampton water saltmarsh and a changing refinery effluent discharge.* Presented at EPA/API/USCG 1981 Oil Spill Conf, Atlanta, Mar 2-5, 81, P361 (14).

Dillmann, B. (1985). *Mitigation as affected by geographical factors.* 8th Biennial International Estuarine Research Conference, Durham, NH (USA), July 28, 1985. Estuaries, Vol. 8, No. 2B, p. 110A

Ditton, R.B. (1981). *Social and economic considerations for artificial reef deployment and management.* Proceedings of a Conference on Artificial Reefs, Daytona Beach, FL (USA), September 13-15, 1979. Aska, D.Y., ed. Pages 23-32. Report for the Florida Sea Grant Program. Report Number: FSG-R-41

Dolah, R.F. van; Wendt, P.H.; Wenner, C.A.; Martore, R.M.; Sedberry, G.R. (1987). *Environmental impact research program: Ecological effects of rubble weir jetty construction at Murrells Inlet, South Carolina. Volume 3. Community structure and habitat utilization of fishes and decapods associated with the jetties.* Army Corps of Engineers, Waterways Experimental Station, Vicksburg, MS (USA), 163 pp. NTIS Number: AD-A187 676/2/GAR.

Donaldson, E.C. (1979). *Environmental aspects of enhanced oil recovery.* Environmental Control Symposium Washington, DC Nov 1978. Energy Sources 4(3), 213-229. ISSN: 0090-8312.

Eidam, C.L.; Hancock, J.A.; Jones, R.G.; Hanson, J.R.; Smith, D.C.; Hay, K.G.; Mcneil, C.S.L. (1975?). *Oil spill cleanup.* Presented at EPA/API/USCG Conf on Prevention & Control of Oil Pollution, San Francisco, Mar 25-27, 1975, P217 (52).

Elouard, B.; Desrosiers, G.; Brethes, J.C.; Vigneault, Y. (1983). *A study of a fish habitat created around islets of dredged material Grande-Entree lagoon, Magdalen Islands.* Rapp. Tech. Can. Sci. Halieut. Aquat., No. 1209F. 77 pp. Report Number: ISSN 0706-6570

Engelhardt, F.R.; Gilfillan, E.S.; Boehm, P.D.; Mageau, C. (1985). *Metabolic effects and hydrocarbon fate in Arctic bivalves exposed to dispersed petroleum.* Proceedings of the 3rd International Symposium on Responses of Marine Organisms to Pollutants Plymouth (UK) 17 Apr 1985. Moore, M.N., ed. Mar. Environ. Res., Vol. 17, No. 2-4, Pages 245-249.

Environmental Protection Agency (1980). *Emergency spills research strategy 1980-1984.* EPA Report EPA-600/9-80-063, (20)

Erwin, K.L. (1979). *Restoration and revegetation of exploratory oil well sites in the wetlands of south Florida USA.* Fla. Sci. 42(SUPPL 1):31.

Erwin, K.L.; Best, G.R. (1985). *Marsh community development in a central Florida phosphate surface-mined reclaimed wetland.* 8th Biennial International Estuarine Research Conference, Durham, NH (USA), July 28, 1985. Estuaries, Vol. 8, No. 2B, p. 111A.

Farrington, J.W. (1985). *Oil pollution: A decade of research and monitoring.* Oceanus, Fall 85, V28, N3, P2(11).

Faucher, C. (1983). *Quantitative comparison of benthic populations on St. Efflam beaches.* Etude de la Macrofaune du Microphytobenthos de la Meiofaune des Estrans et Etude des Chenaux des Abers, pp. 1-11. (Ecological Survey of Macrofauna, Microphytobenthos and Meiofauna of the Foreshore, and Survey of the Channels of the Abers Estuaries). Report Number: Contract CNEXO82/2604

FEA Report (1977). *Strategic petroleum reserve environmental impact statement.* FEA Report, Dec 76-Jan 77 (4107)

Federle, T.W.; Vestal, J.R.; Hater, G.R.; et al. (1979). *Effects of Prudhoe Bay crude oil on primary production and zooplankton in arctic tundra thaw ponds.* Marine Environmental Research 2(1), 3-18.

Fedkenheuer, A.W.; Heacock, H.M.; Lewis, D.L. (1980). *Early performance of native shrubs and trees planted on amended Athabasca Oil Sand tailings.* Reclamation Review, V3, N1, P47 (9).

Flower, R.J. (1983). *Some effects of a small oil spill on the littoral community at Rathlin Island, Co. Antrim.* Ir. Nat. J., Vol. 21, No. 3, pp. 117-120

Foley, J.P.; Tresidder, S.J. (1977?). *The St. Lawrence River oil spill of June 23, 1976-are you ever truly ready?.* 1977 Oil Spill Conference, New Orleans, LA, March 8-10, 1977. American Petroleum Institute Publication 4284, pp. 81-85

Fonseca, M.S. (1989). *Regional analysis of the creation and restoration of seagrass systems.* In: J.A. Kusler and M.E. Kentula (editors). Wetland Creations and Restoration: The Status of the Science. Volume I: Regional Reviews. EPA/600/3-89/038. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR 97333. pp. 175-198.

Fonseca, M.S.; Kenworthy, W.; Phillips, R.C. (1982). *A cost-evaluation technique for restoration of seagrass and other plant communities.* Environ. Conserv., Vol. 9, No. 3, pp. 237-242.

Fonseca, M.S.; Thayer, G.W.; Kenworthy, W.J. (1985). *The use of ecological data in the implementation and management of seagrass restorations.* Eighth Biennial International Estuarine Research Conference Durham, NH (USA) 28 Jul 1985. Estuaries., Vol. 8, No. 2B, p. 125A.

Franco, P.J.; Giddings, J.M.; Herbes, S.E.; Hook, L.A.; Newbold, J.D.; Roy, W.K.; Southworth, G.R.; Stewart, A.J. (1984). *Effects of chronic exposure to coal-derived oil on freshwater ecosystems: 1. Microcosms.* Environ. Toxicol. Chem., Vol. 3, No. 3, pp. 447-463

Fricke, A.H.; Hennig, H.F-K.O.; Orren, M.J. (1981). *Relationship between oil pollution and psammolittoral meiofauna density of two South African beaches.* Marine Environ. Res., Vol. 5, No. 1, pp. 59-77

Frink, J.; Dein, F.J.; Lauer, D.M. (1982). *Rehabilitation of ruddy ducks contaminated with oil.* J. Amer. Vet. Med. Assoc., Vol. 181, No. 11, pp. 1398-1399.

Frink, L.S. (1982). *A new approach to oiled bird rehabilitation after oil spills on the East Coast USA.* In: Land and Water Issues Related to Energy Development. Proceedings of the 4th Annual Meeting of the International Society of Petroleum Industry Biologists, Denver, CO, USA, Sept. 22-25, 1981. Rand, P.J., ed. P257-262. Ann Arbor Science Publishers, Woburn, MA, USA; Butterworths, Ltd., Sevenoaks, Kent, England

Fryberger, J.S. (1975). *Investigation and rehabilitation of a brine-contaminated aquifer.* Ground Water, Mar-Apr 75, V13, N2, P155 (6).

Fucik, K.W.; Bright, T.J.; Goodman, K.S. (1984). *Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil.* Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981. Cairns, J., Jr.; Buikema, A.L., eds. Pages 115-134. Report Number: ISBN 0-250-40551-2

Fukuda, T. (1987). *Development of the techniques for marine macrophyte (Zostera marina) bed creation. 5. Shoot distribution and surrounding conditions.* Bull. Fish. Exp. Stn., Okayama Prefect, No. 2, pp. 21-26.

Fukuda, T. (1987). *Development of the techniques for marine macrophyte (Zostera marina) bed creation. 7. Depth of seeding.* Bull. Fish. Exp. Stn. Okayama Prefect., No. 2, pp. 32-34.

Fukuda, T.; Sato, J. (1987). *Development of the techniques for marine macrophyte (Zostera marina) bed creation. 6. Differences of germination rate among the density of seeding, and between the seeds obtained from different places.* Bull. Fish. Exp. Stn. Okayama Prefect., No. 2, pp. 27-31.

Ganning, B.; Reish, D.J.; Strughan, D. (1984). *Recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spills.* Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981. Cairns, J., Jr.; Buikema, A.L., eds. Pages 7-36. Report Number: ISBN 0-250-40551-2

Gannon, J.E.; Danehy, R.J.; Anderson, J.W.; Merritt, G.; Bader, A.P. (1986). *The ecology of natural shoals in Lake Ontario and their importance to artificial reef development.* Artificial Reefs -- Marine and Freshwater Applications. D'Idri, F.M., ed. Pages 113-139. Report Number: ISBN 0-87371-010-X

Gehu, J.M. (1981). *Phytoecological survey of the Amoco Cadiz oil spill impact in the coastal salt-meadows of northern Brittany.* Publisher(s): Institut Europeen d'Ecologie, Metz (France), 43 pp.

Getter, C.D.; Cintron, G.; Dicks, B.; Lewis, R.R., III; Seneca, E.D. (1984). *The recovery and restoration of salt marshes and mangroves following an oil spill.* Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981. Cairns, J., Jr.; Buikema, A.L., eds. Pages 65-114. Report Number: ISBN 0-250-40551-2

Giddings, J.M. (1982). *Effects of the water-soluble fraction of a coal-derived oil on pond microcosms.* Archives Env Contam & Tox, Nov 82, V11, N6, P735 (13)

Giroux, J.-F. (1981). *Use of artificial islands by nesting waterfowl in southeastern Alberta.* J. Wildl. Manage., Vol. 45, No. 3, pp. 669-679.

Gladfelter, W.B.; Gladfelter, E.H. (1978). *Fish community structure as a function of habitat structure on West Indian patch reefs.* Presented at the Simposio sobre Ciencias Marinas en las Americas San Jose (Costa Rica) 3 Jul 1977. Rev. Biol. Trop. 26(Suppl.1), 65-84.

Glemarec, M.; Husenot, E. (1982). *Response of subtidal populations to perturbations caused by the Amoco Cadiz in the Benoit and Wrac'h estuaries.* NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill; Biological Studies after the Amoco Cadiz Oil Spill. Charleston, SC (USA), October 28, 1981; Brest (France), September 17, 1981. Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Gundlach, E.R.; Marchand, M., eds. Pages 191-204.

Glemarec, M.; Hussenot, E.; Moal, Y.Le (1982). *Utilization of biological indications in hypertrophic sedimentary areas to describe dynamic process after the Amoco Cadiz oil spill.* International Symposium on Utilization of Coastal Ecosystems: Planning, Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982. Fundacao Univ., Rio Grande (Brazil); Duke Univ. Mar. Lab., Beaufort NC (USA). Atlantica, Vol. 5, No. 2, p. 48. Special issue. Summary only.

Gomoiu, M.T. (1983). *Some ecological aspects of artificial reef construction along the coasts of north-western Black Sea.* Journee d'Etudes sur les Aspects Scientifiques Concernant les Recifs Artificiels et la Mariculture Suspendue, Cannes, France, 7 Decembre 1982. Pages 113-119. (Seminar on Scientific Aspects of Artificial Reefs and Floating Mariculture in the Mediterranean, Cannes, France, December 7, 1982)

Goodman, K.S.; Baker, J., editors, (1982). *A preliminary ecological survey of the coastline of Abu Dhabi, United Arab Emirates.* A report prepared for the Abu Dhabi Marine Operating Company (ADMA-OPCO) by BP International, Ltd., Environmental Control Centre, London. Volume 1. Text, tables and figures. Volume 2. Photographs. Publisher(s): British Petroleum International Ltd., London (UK). 178 pp.

Goodman, K.S.; Nunn, R.M. (1982). *The littoral ecology of the area around Mongstad Refinery, Fensfjorden, Norway, 1981.* An Interim Report to Rafinor A/S and Co. by BP International Limited. Publisher(s): BP International Ltd., Brittanic House, Moor Lane, London EC2Y 9BU, UK, 63 pp.

Gordon, W.G. (1981). *Artificial reefs and the FCMA.* Proceedings of a Conference on Artificial Reefs, Daytona Beach, FL (USA), September 13, 1979. Aska, D.Y., ed. Pages 75-77. Rep. Fla. Sea Grant Program. Report Number: FSG-R-41

Gordon, W.G. (1986). *NMFS and Army Corps of Engineers restore fisheries habitats: A cooperative venture.* Fisheries, Sep-Oct 1986, V11, N5, P2(6).

Gore, J.A. editor. (1985). *The restoration of rivers and streams: Theories and experience.* Butterworth Publishers, Stoneham, MA (USA)

Gore, J.A.; Johnson, L.S. (1979). *Biotic recovery of a reclaimed river channel after coal strip mining.* Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), July 16, 1979. Gen. Tech. Rep. US Dept. Agriculture, Fort Collins, CO (USA). p 239-244.

Gossen, R.G.; Mann, G.J. (1979). *Environmental Considerations in the Cold Lake Project.* Presented at UN Inst for Training & Research et al. Future of Heavy Crude Oils & Tar Sands 1st Intl Conf, Edmonton, Jun 4-12, 79, P729 (5).

Gourbault, N.; Helleouet, M.N.; Naim, O.; Renaud-Mornant, J. (1980). *Amoco Cadiz oil pollution.* Contract COB-MUSEUM 79 5975. Effets de la pollution sur la meiofaune de Roscoff (greve de Roscoff chenal de la riviere de Morlaix). Deuxieme annee. Premiers resultats. [Research contract COB-MUSEUM 79/5975. Pollution effects on the meiofauna in Roscoff (Roscoff beach, Morlaix river channel). Preliminary results after two years study. 6 pp.]. Mus. Natl. Hist. Nat., Prog. Zool.-Vers, Paris, France. (Museum National d'Histoire Naturelle Paris, France)

Greenberg, D.; Hellman, R.A. (1978). *Israel in the Mediterranean ecosystem.* Presented at the Conference of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea, Monaco (Monaco), January 9, 1978. Publisher(s): Environ. Protect. Serv., Jerusalem, Israel. 70 pp.

Griffiths, W.B.; Dillinger, R.E. (1981). *Beaufort Sea Barrier Island-Lagoon ecological process studies: Final report, Simpson Lagoon, Part 5 - Invertebrates.* Environmental Assessment of the Alaskan Continental Shelf. Final Reports of Principal Investigators. Volume 8: Biological Studies. Publisher(s): NOAA/OMPA, Boulder, CO (USA), Vol. 8, pp. 1-198. Report Number: NOAA-OMPA-FR-80-8

Grove, R.S. (1982). *Artificial reefs as a resource management option for siting coastal power stations in southern California.* Mar. Fish. Rev., Vol. 44, No. 6-7, pp. 24-27.

Grove, R.S.; Yuge, J.E.; Sonu, C. (1983). *Artificial reef technology: A strategy for active impact mitigation.* Proceedings of Oceans '83: Effective Use of the Sea — An Update, San Francisco, CA, August 29 - September 1, 1983. Volume 2: Technical Papers. Mineral Resources and Energy, Non-Mineral Resources, Transportation. Pages 951-956. Report Number: IEEE-83CH1972-9

Grula, M.M.; Grula, E.A. (1983). *Biodegradation of materials used in enhanced oil recovery.* Final report, July 1, 1978, to November 30, 1981. Oklahoma State Univ., Stillwater, OK 74074, USA. NTIS, Springfield, VA (USA). Number: DE84002019.

Gudin, C.; Syratt, W.J. (1975). *Biological aspects of land rehabilitation following hydrocarbon contamination.* Env. Pollution, V8, N2, P107 (6)

Gumtz, G.D. (1972). *Restoration of beaches contaminated by oil.* Report Number: EPA-R2-72-045. 129 pp. NTIS Number: PB-214 419/4 . Contract No.: EPA-14-12-809; EPA-15080-EOT

Hamburg, S.P.; Homann, P.S. (1986). *Utilization of growth parameters of eelgrass, Zostera marina, for productivity estimation under laboratory and in situ conditions.* Mar. Biol., Vol. 93, No. 2, pp. 299-303.

Hampson, G.R.; Moul, E.T. (1977). *Salt marsh grasses and N2 fuel oil.* Oceanus 20(4):25-30.

Hampson, G.R.; Moul, E.T. (1978). *No. 2 fuel oil spill in Bourne, Massachusetts: immediate assessment of the effects on marine invertebrates and a 3-year study of growth and recovery of a salt marsh.* Presented at a Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), October 10, 1977. J. Fish. Res. Board Can., 35(5), 731-744.

Hann, R.W., Jr. (1977). *Fate of oil from the supertanker Metula.* Presented at the Oil Spill Conference, New Orleans, LA (USA), March 8, 1977. Publisher(s): American Petroleum Inst., Washington, DC (USA). Pages 465-468. Report Number: API-Publ --4284

Hann, R.W., Jr.; Rice, L.; Trujillo, M-C.; Young, H.N., Jr. (1978). *Oil spill cleanup activities.* In: The Amoco Cadiz oil spill - A preliminary scientific report. Hess, W.N., ed. NOAA/EPA Special report. p 229-275. Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA); Environmental Protection Agency, Narragansett, RI (USA)

Hannah, R. (1981). *Resource protection measures.* The IXTOC 1 Oil Spill: The Federal Scientific Response. Hooper, C.H., ed. NOAA Spec. Rep. Publisher(s): NOAA/OMPA, Boulder, CO (USA), pp. 105-118. Report Number: NOAA-SR-HMRP-1981

Hansen, K.; Vestergaard, P. (1986). *Initial establishment of vegetation in a man-made coastal area in Denmark.* Nord. J. Bot., Vol. 6, No. 4, pp. 479-495

Harrison, P.G. (1987). *Natural expansion and experimental manipulation of seagrass zostera-spp abundance and the response of infaunal invertebrates.* Estuarine Coastal Shelf Sci 24(6): 799-812.

Hartstein, A.M.; Pawlowski, L.; Alaerts, G.; Lacy, W.J. (eds.) (1986). *State-of-the-art of the fossil fuel issue in the environment.* Proceedings of the 5th International Conference on Chemistry for Protection of the Environment, Leuven (Belgium), 9-13 Sep 1985, pp. 679-689. Studies in Environmental Science 29. Elsevier Science Publishers, Amsterdam (Netherlands)

Hershner, C.; Moore, K. (1977?). *Effects of the Chesapeake Bay oil spill on salt marshes of the lower bay.* 1977 Oil Spill Conference New Orleans, LA, Mar. 8-10, 1977. American Petroleum Institute Publication 4284, pp. 529-533

Hersman, L.E.; Klein, D.A. (1979). *Restored oil shale effects on soil microbiological characteristics.* J Env Quality, Oct-Dec 79, V8, N4, P520 (5)

Heubeck, M. (1979). *A report to SOTEAG on monitoring counts of seabirds and waterfowl in 2 areas of North Shetland, Winter 1978-79.* Shetland Oil Terminal Environmental Advisory Group (UK). 57 p.

Higo, N.; Nagashima, M. (1978). *On the fish gathering effect of the artificial reefs ascertained by the diving observation 2. At the sea of the Satsuma Peninsula in Kagoshima Prefecture.* Mem. Fac. Fish. Kagoshima Univ., 27(1), 117-130

Holmes, W.N.; Cavanaugh, K.P.; Cronshaw, J. (1978). *The effects of ingested petroleum on oviposition and some aspects of reproduction in experimental colonies of mallard ducks (Anas platyrhynchos).* J. Reprod. Fertil., 54(2), 335-347

Holmes, W.N.; Cronshaw, J.; Cavanaugh, K.P. (1978). *The effects of ingested petroleum on laying in mallard ducks (Anas platyrhynchos).* In: Proceedings of the Energy/Environment '78: A Symposium on Energy Development Impacts, Los Angeles (USA), 22 Aug 1978. Lindstedt-Siva, J., ed. Society of Petroleum Industry Biologists Los Angeles (USA). Pages 301-309.

Horner, R.A. (1978). *Beaufort Sea plankton studies.* Seattle, WA, USA. In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1978. Volume 5, receptors--fish, littoral, benthos. p 85-142. Publisher(s): US Environmental Research Laboratories, Boulder, CO. Outer Continental Shelf Environmental Assessment Program

Howe, J.R. (1989). *Alaska disaster.* Defenders, V64, N3, P20(10).

Hueckel, G.J.; Buckley, R.M. (1986). *The mitigation potential of artificial reefs in Puget Sound, Washington.* Oceans '86 Conference Record: Science-Engineering-Adventure, Vol. 2. Data Management, Instrumentation and Economics, Washington, DC (USA), 23-25 Sep 1986, pp. 542-546. Oceans '86. Report Number: IEEE-86CH2363-0

242

Hutchinson, T.C.; Freedman, W. (1978). *Effects of experimental crude oil spills on subarctic boreal forest vegetation near Norman-Wells Northwest-Territories Canada.* Can J Bot 56 (19):2424-2433.

Hutchinson, T.C.; Hellebust, J.A.; Soto, C. (1981). *Effect of naphthalene and aqueous crude oil extracts on the green flagellate Chlamydomonas angulosa IV. Decreases in cellular manganese and potassium.* Can. J. Bot., Vol. 59, No. 5, pp. 742-749.

Hyland, J.L.; Hoffman, E.J.; Phelps, D.K. (1985). *Differential responses of two nearshore infaunal assemblages to experimental petroleum additions.* J. Mar. Res., Vol. 43, No. 2, pp. 365-394

Ibanez, F.; Dauvin, J.-C. (1988). *Long-term changes (1977 to 1987) in a muddy fine sand Abra alba -- Melinna palmata community from the western English Channel: Multivariate time-series analysis.* Mar. Ecol. (Prog. Ser.) Vol. 49, No. 1-2, pp. 65-81.

Jacobs, R.P.W.M. (1980). *Effects of the Amoco Cadiz oil spill on the seagrass community at Roscoff with special reference to the benthic infauna.* MarLow chronic additions of no. 2 fuel oil: Chemical behavior, biological impact and recovery in a simulated estuarine environment. Mar. Ecol. (prog. Ser.)., Vol. 9, No. 2, pp. 121-136,.

Jeffries, H.P.; Johnson, W.C. (1976). *Petroleum, temperature, and toxicants: Examples of suspected responses by plankton and benthos on the continental shelf.* NOAA Sea Grant/Univ of Rhode Island Marine Reprint 69, 1976 (15).

Jennings, A.L. (1972). *Spill damage restoration.* Natl Conf Hazardous Material Spill Houston Mar 21-23, 1972, P221 (3).

Jenssen, B.M.; Ekker, M. (1989). *Rehabilitation of oiled birds a physiological evaluation of four cleaning agents.* Mar Pollut Bull 20(10):509-512.

Jernelov, A. (1976). *The St. Peter oil spill: An ecological and socioeconomic study of effects.* EPA Intl Env Document Report 04209A-Colombia, Oct 76 (38)

Jessee, W.N.; Carter, J.W.; Carpenter, A.L.; DeMartini, E.E. (1986). *Density estimates of five warm-temperate reef fishes associated with an artificial reef, a natural reef, and a kelp forest.* Artificial reefs -- marine and freshwater applications. D'Itri, F.M., ed. Pages 383-400. Report Number: ISBN 0-87371-010-X

Johansson, S.; Larsson, U.; Boehm, P. (1980). *The Tsesis oil spill: Impact on the pelagic ecosystem.* Mar. Pollut. Bull., 11(10), 284-293

Johnson, B.T.; Romanenko, V.I. (1983). *Fuel oil 2 in a fresh water microcosm impact and recovery.* 83rd Annual Meeting of the American Society for Microbiology, New Orleans, LA, USA, Mar. 6-11, 1983. Abstr Annu Meet Am Soc Microbiol 83 (0). Q73.

Johnson, B.T.; Romanenko, V.I. (1989). *A multiple testing approach for hazard evaluation of complex mixtures in the aquatic environment the use of diesel oil as a model.* Environ. Pollut. 58 (2-3):221-236.

Johnson, G.F.; deWit, L.A. (no date). *Ecological effects of an artificial island, Rincon Island, Punta Gorda, California.* Misc. Rep. US Army Coast. Eng. Res. Cent. Contract No. DACW 72-76-C-0011

Johnson, G.F.; deWit, L.A.; Wales, B.A.; Hurme, A.K. (1978). *Ecological effects of an artificial island.* In: Proceedings of Energy/Environment '78: a symposium on energy development impacts, Los Angeles (USA), 22 Aug 1978. Lindstedt-Siva, J., ed. Society of Petroleum Industry Biologists Los Angeles (USA). p 145-162.

Johnson, L.A. (1981). *Revegetation and selected terrain disturbances along the Trans-Alaska Pipeline, 1975-1978.* Cold Regions Research and Engineering Lab., Hanover, NH (USA), 122 pp. NTIS Number: AD-A138 426/2.

Johnson, T.L.; Pastorok, R.A. (1985). *Oil spill cleanup: Options for minimizing adverse ecological impacts.* Publisher(s): American Petroleum Institute, Health and Environmental Sciences Department, 1220 L Street, NW, Washington, DC 20005. Report Number: API 4435

Jones, L.E.; Hunter, R.A. (1981). *Strategies for rehabilitation and enhancement of coastal sites for waterfowl.* 6th Biennial International Estuarine Research Conference, Gleneden Beach, OR (USA), 1-5 Nov 1981. Estuaries, Vol. 4, No. 3, p. 266. Summary only.

Jordan, W.R.; Peters, R.L.; Allen, E.B. (1988). *Ecological restoration as a strategy for conserving biological diversity.* Env Management, Jan 88, V12, N1, P55(18)

Josselyn, M.; Buchholz, J. (1982). *Summary of past wetland restoration projects in California.* Presented at Tiburon Center for Env Studies/et al Wetland Restoration Sym, Hayward, CA, Feb 82, P1 (10).

Kakimoto, H. (1979). *Artificial fish reefs in Japan Sea coastal regions.* In: Proceedings of the Seventh Japan-Soviet Joint Symposium on Aquaculture, September 1978, Tokyo and Tsuruga, Japan. Yamamoto, G., ed. p 103-109. Publisher(s): Tokai University, Tokyo (Japan); Ministry of Fisheries, Moscow (USSR); Tokai University Press, Tokyo (Japan)

Kaplan, E.; Royce, B.; Garrell, M.H.; Riedel, E.F.; Sathaye, J.; Rotarius, G.J. (1984). *Environmental assessment of enhanced oil recovery.* Miner. Envir. Vol. 6, No. 2, pp. 54-65

Kawasaki, Y.; Yamada, S.; Honda, M. (1988). *Development of technique for marine macrophyte bed creation in the coastal zone near Power Plant-10 method for eelgrass Zostera-marina l. bed creation by seedling.* Denryoku Chuo Kenkyusho Hokoku 0(U88030). I-IV, 1-21.

Kelley, K. (1988). *Seagrass replanting efforts may improve fisheries.* Natl. Fisherman, Vol. 68, No. 11, pp. 14-16.

Kentula, M.E. (1986). *Wetland rehabilitation and creation in the Pacific Northwest.* Ecol. Res. Ser., U.S. Environ. Prot. Agency, 29 pp. NTIS Number: PB86-241023/GAR. Report Number: EPA/600/D-86/183

Kerley, G.I.H.; Crellin, C.G.; Erasmus, T. (1987). *Gravimetric determination of water-repellency in rehabilitated oiled seabirds.* Mar. Pollut. Bull., Vol. 18, No. 11, pp. 609-611.

Kerley, G.I.H.; Erasmus, T. (1986). *Oil pollution of cape gannets: To clean or not to clean.* Mar. Pollut. Bull., Vol. 17, No. 11, pp. 498-500.

Kerley, G.I.H.; Erasmus, T. (1987). *Cleaning and rehabilitation of oiled jackass penguins.* S. Afr. J. Wildl. Res. S.-Afr. Tydskr. Natuurnavors., Vol. 17, No. 2, pp. 64-70.

Kerley, G.I.H.; Erasmus, T.; Mason, R.P. (1985). *Effect of moult on crude oil load in a jackass penguin Spheniscus demersus.* Mar. Pollut. Bull., Vol. 16, No. 12, pp. 474-476.

Kikuch, K.; Sato, S.; Honda, M. (1987). *Development of the techniques for marine macrophyte bed creation in the coastal zone near a power plant the influence of environmental factors on the flowering shoot formation of Zostera-marina.* Denryoku Chuo Kenkyusho Hokoku 0(U86044):1-10.

Kooyman, G.; Costa, D. (1978). *The effects of oil on temperature regulation in sea otters.* In: Environmental assessment of the Alaskan continental shelf. Quarterly reports of principal investigators for April-June 1978. p 66-69. Publisher(s): U.S. National Oceanic and Atmospheric Administration, Boulder, CO, Environmental Research Laboratories

Kooyman, G.L.; Costa, D.P. (1978). *Effects of oiling on temperature regulation in sea otters.* In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1978. Volume 7, effects. p 1-11. Publisher(s): US Environmental Research Laboratories, Boulder, CO. Outer Continental Shelf Environmental Assessment Program.

Kooyman, G.L.; Costa, D.P. (1979). *Effects of oiling on temperature regulation in sea otters.* In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1979, Volume 6, effects. p 1-26. Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA), Outer Continental Shelf Environmental Assessment Program.

Krebs, C.T.; Tanner C.E. (1981). *Restoration of oiled marshes through sediment stripping and Spartina propagation.* In: Parrotte, R.B. (ed). Proceedings of the 1981 Oil Spill Conference, Atlanta, March 2-5, pp.375-385.

LaRoe, E.T. (1979). *The biological basis for estuarine ecosystem mitigation.* Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979. Gen. Tech. Rep., U.S. Dept. Agriculture Fort Collins, CO (USA). p 90-92.

Laubier, L. (1980). *The Amoco Cadiz oil spill: An ecological impact study.* Ambio, Vol. 9, No. 6, pp. 268-276

Le Moal, Y. (1980). *Ecological effect of the Amoco Cadiz oil pollution on littoral communities living on hard and soft substrata. (2nd year). Part 2: intensive study: Yveline Le Moal.* In: Ecological effect of the Amoco Cadiz oil pollution on littoral communities living on hard and soft substrata. (2nd year). Part 1: extensive study: Claude Chasse. Part 2: intensive study: Yveline Le Moal. Chasse, C.; Le Moal, Y., Universite de Bretagne Occidentale Brest (France)., 1980.

Le Moal, Y. (1983). *Ecological survey of beaches (after the Amoco Cadiz oil spill) on the northern coast of Brittany.* Etude de la Macrofaune du Microphytobenthos de la Meiofaune des Estrans et Etude des Chenaux des Abers. (Ecological Survey of Macrofauna, Microphytobenthos and Meiofauna of the Foreshore, and Survey of the Channels of the Abers Estuaries.), pp. 1-19. Report Number: Contract CNEXO82/2604

Lee, W.Y.; Macko, S.A.; Nicol, J.A.C. (1981). *Changes in nesting behavior and lipid content of a marine amphipod (Amphithoe valida) to the toxicity of a no. 2 fuel oil.* Water Air Soil Pollut., Vol. 15, No. 2, pp. 185-196.

Leppaekoski, E.J.; Lindstroem, L.S. (1978). *Recovery of benthic macrofauna from chronic pollution in the sea area off a refinery plant, Southwest Finland.* Recovery potential of oiled marine northern environments: Symposium papers. Edited by J. C. Stevenson. Journal of the Fisheries Research Board of Canada 35(5):766-775.

Levasseur, J.; Durand, M.-A.; Jory, M.-L. (1981). *Biomorphologic and floristic aspects of the reconstitution of a phanerogamic vegetal cover, altered by the Amoco Cadiz oil spill and the following clean-up operations: Special study of the Ile-Grande Salt Marshes (Cotes du Nord).* Amoco Cadiz : Fates and Effects of the Oil Spill. Proceedings of the International Symposium. Centre Oceanologique de Bretagne, Brest (France). November 19-22, 1979, pp. 455-473. Report Number: ISBN 2-90272-09-9

Levasseur, J.E.; Jory, M.L. (1982). *Natural recovery of salt-marsh vegetation destroyed by the Amoco Cadiz oil spill: Circumstances and tendencies.* NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill Biological Studies after the Amoco Cadiz Oil Spill Charleston, SC (USA). Brest (France) 17 Sep 1981. 28 Oct 1981. Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Gundlach, E.R.; Marchand, M., eds. Pages 329-362.

Levings, C.D. (compiler). (1980). *An account of a workshop on restoration of estuarine habitats.* Workshop on Restoration of Estuarine Habitats West Vancouver, B.C. and Nanaimo, B.C. (Canada) 19 Oct 1979. Can. Manuscr. Rep. Fish. Aquat. Sci. 36 p.

Leymann, G. (1983). *Reflections on the rehabilitation of damages caused by oil pollution in the central Baltic Sea.* Wasser Boden., Vol. 35, No. 11, pp. 512-514.

Lindall, W.N., Jr.; Mager, A., Jr.; Thayer, G.W.; Ekberg, D.R. (1979). *Estuarine habitat mitigation planning in the southeast.* Presented at the Mitigation Symposium: a National Workshop on Mitigating Losses of Fish and Wildlife Habitats, Fort Collins, CO (USA), 16 Jul 1979. Gen. Tech. Rep. U.S. Dept. Agriculture Fort Collins, CO (USA). p 129-135.

Linden, O.; Elmgren, R.; Boehm, P. (1979). *The Tsesis oil spill: Its impact on the coastal ecosystem of the Baltic Sea.* Ambio 8(6), 244-253.

Linden, O.; Elmgren, R.; Westin, L.; Kineman, J. (1978?). *Scientific summary and general discussion.* In: The Tsesis oil spill. Report of the first year scientific study (October 26, 1977, to December, 1978) - a cooperative international investigation. Kineman, J.J.; Elmgren, R.; Hansson, S., eds. p 43-58. NOAA/Outer Continental Shelf Environmental Assessment Program Boulder, CO (USA)., Mar 1980.

Linkins, A.E.; Johnson, L.A.; Everett, K.R.; Atlas, R.M. (1984). *Oil spills: Damage and recovery in tundra and taiga.* Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981. Cairns, J., Jr.; Buikema, A.L. eds. Pages 135-156. Report Number: ISBN 0-250-40551-2

Little, A.E. (1983). *A resurvey of rocky shore transects in Milford Haven, January - April 1979: Comparisons with data collected from 1961-1978.* Publisher(s): Oil Pollution Research Unit, Pembroke (UK), 1983. 241 pp., published in 2 volumes. Report Number: FSC(OPRU)/6/83

Lum, A.L. (1978). *Shorebird fauna changes of a small tropical estuary following habitat alteration: Biological and political impacts of environmental restoration.* Environmental Management 2(5):423-430.

Lutz, R.E.; Meck, J.P. (1977). *Recovering for marine life damage: Legal aspects of allocating social costs and protecting public interests.* Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977. Publisher(s): American Petroleum Inst., Washington, DC (USA), pp. 11-14. Report Number: API-Publ --4284

Mackie, P.R.; Hardy, R.; Whittle, K.J. (1978). *Preliminary assessment of the presence of oil in the ecosystem at Ekofisk after the blowout, April 22-30, 1977.* Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1077. J. Fish. Res. Board Can. 35(5):544-551.

Maiero, D.J.; Castle, R.W.; Crain, O.L. (1978). *Protection, cleanup and restoration of salt marshes endangered by oil spills: A procedural manual.* United Research Services, San Mateo, CA (USA). Contract No. EPA-68-03-2160.

Mair, J.McD.; Matheson, I.; Appelbee, J.F. (1987). *Offshore macrobenthic recovery in the Murchison Field following the termination of drill-cuttings discharges.* Mar. Pollut. Bull., Vol. 18, No. 12, pp. 628-634.

Mann, K.H. (1978). *A biologist looks at oil in the sea.* Shore And Beach 46(4):27-29.

Mann, K.H.; Clark, R.B. (1977). *Session 3. Summary and overview: Long-term effects of oil spills on marine intertidal communities.* Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1977. J. Fish. Res. Board Can. 35(5):791-795.

Marcus, M.D.; Bergman, H.L.; Stoller, D.A.; Brown, S.K.; Molhot, P.A. (1980). *Bibliography of aquatic ecosystem effects: Analytical methods and treatment technologies for organic compounds in advanced fossil-fuel processing effluents.* Ecol. Res. Series. Environmental Protection Agency, Duluth, MN (USA). Office of Research and Development. 362 p.

Maynard, N.G. (1984). *Effects of petroleum residues on intertidal organisms of Bermuda.* Publisher(s): American Petroleum Institute, 1220 L. Street, NW, Washington, DC 20005. Report Number: API 4355

McGill, W.B. (1977). *Soil restoration following oil spills - A review.* J. Can. Pet. Technol., 16(2), 60-67.

McIntyre, D. (1983?). *Underground oil spill investigation and cleanup.* API/EPA/USCG Oil Spill 8th Conf, San Antonio, Feb 28-Mar 3, 1983, P393 (4).

McKell, C.M.; van Epps, G. (1980). *Vegetative rehabilitation of arid land disturbed in the development of oil shale and coal.* NTIS Report Number: PB80-189541, APR 80 (50).

McVay, M.E.; Heilman, P.E.; Greer, D.M.; Brauen, S.E.; Baker, A.S. (1980). *Tidal freshwater marsh establishment on dredge spoils in the Columbia River Estuary.* J. Environ. Qual., 9(3), 488-493.

Meade, N.F. (1981). *The Amoco Cadiz oil spill: An analysis of emergency response clean-up and environmental rehabilitation costs.* Presented at OECD Cost of Oil Spills Conf, France, Jun 16-18, 81, P130 (18).

Michaelis, F.B. (1983). *Effect of Turoa oil spill on aquatic insects in the Mangawhero River system.* N.Z. Entomol., Vol. 7, No. 4, pp. 447-455.

Mickelson, P.G.; Schamel, D.; Tracy, D.; Ionson, A. (1977). *Avian community ecology at two sites on Espenberg Peninsula in Kotzebue Sound, Alaska.* In: Environmental assessment of the Alaskan continental shelf. Volume 5. receptors--birds. U.S. National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Laboratories, Mar 1977, p. 1-74. Contract No. 03-5-022-56. Report Number: NOAA/ERL-AR-77-5

Moldan, A.; Chapman, P.; Fourie, H.O. (1979). *Some ecological effects of the Venpet-Venoil collision.* Marine Pollution B, V10, N2, P60 (4)

Moore, S.F. (1976). *Oil spills and the marine environment.* Technology Review, Feb 76, V78, N4, P61 (8).

Moore, S.F.; Chirlin, G.R.; Puccia, C.J.; Schrader, B.P. (1974). *Potential biological effects of hypothetical oil discharges in the Atlantic Coast and Gulf of Alaska.* NTIS Report COM-74-11089, Apr 1, 1974 (206).

Mozley, S.C.; Butler, M.G. (1978). *Arctic effects of crude oil on aquatic insects of tundra ponds.* Presented at the Workshop on Ecological Effects of Hydrocarbon Spills in Alaska, Woods Hole, MA (USA), 8 Apr 1978.

Newell, B.S. (1981). *Restoration of Lake Wellington -- a multi-objective experiment.* Aust. Fish., Vol. 40, No. 5, pp. 19-21, (1981).

Nichols, A.B. (1989). *Alaskan oil spill shocks the nation.* WPCF J, Jul 89, V61, N7, P1174(12).

Niedzialkowski, D.M.; Kerr, R.L. (1988). *Wetlands mitigation banking: Planning for protection of environmental values.* Proceedings of the Symposium on Coastal Water Resources Wilmington, NC (USA). Lyke, W.L.; Hoban, T.J., eds. Tech. Publ. Ser. Am. Water Resour. Assoc. Pages 789-790. Report Number: TPS-88-1

Niesen, T.M.; Lyke, E.B. (1981). *Pioneer infaunal communities in the Hayward Salt Marsh restoration (San Francisco Bay).* 6th Biennial International Estuarine Research Conference, Gleneden Beach, OR (USA), 1-5 Nov 1981. Estuaries, Vol. 4, No. 3, p. 243. Summary only.

Niewolak, S. (1978). *Microbiological aspects of restoration of cultivated soils contaminated with crude oil.* Wiad Ekol 24(2):109-118.

331

Nulty, P. (1989). *The future of big oil.* Fortune, May 8, 89, V119, N10, P46(4).

O'Brien, P.Y.; Dixon, P.S. (1976). *The effects of oils and oil components on algae a review.* Br. Phycol. J. 11(2):115-142.

O'Farrell, T.P.; Mitchell, D.L. (1985). *Habitat restoration plan for Naval Petroleum Reserve No. 1, Kern County, California.* Sponsor: Department of Energy, Washington, DC. Report No.: EGG-10282-2081. 68 pp. NTIS Number: DE86007008/XAB . Contract No.: AC08-83NV10282

Oviatt, C.; Frithsen, J.; Gearing, J.; Gearing, P. (1982). *Low chronic additions of no. 2 fuel oil: Chemical behavior, biological impact and recovery in a simulated estuarine environment.* Mar. Ecol. (prog. Ser.)., Vol. 9, No. 2, pp. 121-136,.

Owens, E.H.; Rashid, M.A. (1976). *Coastal environments and oil spill residues in Chedabucto Bay Nova Scotia Canada.* Can. J. Earth. Sci. 13(7):908-928.

Owens, E.H.; Robillard, G.A. (1981). *Spill impacts and shoreline cleanup operations on Arctic and sub-Arctic coasts.* Presented at EPA/API/USCG 1981 Oil Spill Conf, Atlanta, Mar 2-5, 81, P305 (5).

Pain, S. (1989). *Alaska has its fill of oil.* New Scientist, Aug 12, 89, V123, N1677, P34(7).

Palmer, H.V.R., Jr. (1972). *Falmouth's oiled shellfish beds being restored.* National Fisherman 53(4): C10, Aug. 1972

342

Perna, A.J.; Wayne, T.J. (1970). *Effects, recovery, reuse of oil from aqueous environments.* Conf at Univ of Rhode Island, Jul 21-23, 70 P232 (12)

Perry, M.C.; Ferrigno, F.; Settle, F.H. (1978). *Rehabilitation of birds oiled on two Mid-Atlantic estuaries.* Proceedings of the 32nd Annual Conference Southeastern Association of Fish and Wildlife Agencies, Hot Springs, VA (USA), 5 Nov 1978. 32:318-325

Petersen, J.A. (1984). *Establishment of mussel beds: Attachment behavior and distribution of recently settled mussels (Mytilus californianus).* Veliger, Vol. 27, No. 1, pp. 7-13.

Phillips, R.C. (1980). *Transplanting methods.* In: Handbook of seagrass biology: An ecosystem perspective. Phillips, R.C.; McRoy, C.P., eds. p 41-56. Publisher(s): Garland STPM New York, NY (USA)

Prince, E.D.; Maughan, O.E. (1978). *Freshwater artificial reefs: biology and economics.* Fisheries, 3(1), 5-9.

Prince, E.D.; Maughan, O.E.; Prouha, P. (1977). *How to build a freshwater artificial reef.* Sea Grant Rep. Va. Polytechnic Inst. Publisher(s): VPI, Blacksburg, VA (USA), 2nd ed. 17p. Report Number: VPI-SG-77-02

Putwain, P.D.; Gillham, D.A.; Holliday, R.J. (1982). *Restoration of heather moorland and lowland heathland, with special reference to pipelines.* Env Conservation, Autumn 82, v9, n3, p225 (11)

Race, M.S. (1985). *Critique of present wetlands mitigation policies in the United States based on an analysis of past restoration projects in San Francisco Bay.* Environ. Manage., Vol. 9, No. 1, pp. 71-82.

Race, M.S. (1986). *Wetlands restoration and mitigation policies: Reply.* Environ. Manage., Vol. 10, No. 5, pp. 571-572.

Radecki, E.A.; Matson, C.; Brenoel, M.R. (1987). *Enhanced natural degradation of a shallow hydrocarbon contaminated aquifer.* Haztech Intl (Pudvan) Conf, St. Louis, Aug 26-28, 87, P331(11).

Radvanyi, A. (1980). *Control of small mammal damage in the Alberta Canada oil Sands Reclamation and AF Forestation Program.* For Sci 26 (4):687-702.

Randall, R.M.; Randall, B.M.; Bevan, J. (1980). *Oil pollution and penguins is cleaning justified?.* Mar. Pollut. Bull. 11(8):234-237.

Rauta, C.; Zarioiu, V.; Creanga, I.; Petre, N.; Kaszoni, E.; Carstea, S.; Mihalache, G. (1987). *Preliminary research concerning the technology for bringing under agricultural use some soils polluted with petroleum residues.* An Inst Cercet Pedol Agrochim 47(0):211-220.

Redente, E.F.; Cook, C.W. (1982). *Revegetation studies on oil shale related disturbances in Colorado.* Sponsor: Department of Energy, Washington, DC. Report Number: DOE/EV/04018-6. 90 pp. NTIS Number: DE82020140 . Contract No.: AC02-76EV04018

Relini, G.; Moretti, S. (1986). *Artificial reef and Posidonia bed protection off Loano (western Ligurian Riviera).* Tech. Consult. of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association with Artificial Reefs Ancona (Italy). FAO Fish. Rep. No. 357. Report of the Technical Consultation of the General Fisheries Council for the Mediterranean on Open Sea Shellfish Culture in Association with Artificial Reefs, Ancona, Italy, 17-19 March, 1986, pp. 104-108. Report Number: ISBN 92-5-0024550-X

Renaud-Mornant, J.; Gourbault, N. (1980). *Survival of meiofauna after the Amoco Cadiz oil spill (Morlaix Channel and Roscoff Beach, Brittany, France).* Bull. Mus. Natl. Hist. Nat. (France) (4E Ser.) (A Zool. Biol. Ecol. Anim.), Vol. 2, No. 3, p. 759-772.

Rice, S.D.; Korn, S.; Karinen, J.F. (1979). *Lethal and sublethal effects on selected Alaskan marine species after acute and long-term exposure to oil and oil components.* In: Environmental assessment of the Alaskan continental shelf. Annual reports of principal investigators for the year ending March 1979, Volume 6, effects. p 27-59. Publisher(s): NOAA Environmental Research Labs, Boulder, CO (USA), Outer Continental Shelf Environmental Assessment Program,

Robers, R. (1987). *Beaufort Sea Sale 97, Alaska outer continental shelf, final environmental impact statement. Volume 1.* OCS/EIS/EA/MMS-87-0069-VOL-1. 485 pp. NTIS Number: PB88-118625/GAR. Report Number: MMS/AK/EIS-87/001

Roland, J.V.; Moore, G.E.; Bellanca, M.A. (1977). *The Chesapeake Bay oil spill - February 2, 1976: A case history.* Presented at the Oil Spill Conference, New Orleans, LA (USA), 8 Mar 1977. Publisher(s): American Petroleum Inst., Washington, DC (USA) . Report Number: API-Publ.--4284. p.523-527.

Sabourin, T.D.; Tullis, R.E. (1981). *Effect of three aromatic hydrocarbons on respiration and heart rates of the mussel, Mytilus californianus.* Bull. Environ. Contam. Toxicol., Vol. 26, No. 6, pp. 729-736

Samuels, W.B.; Ladino, A. (1984). *Calculations of seabird population recovery from potential oilspills in the Mid-Atlantic Region of the United States.* Ecological Modelling, Jan 84, V21, N1-2, P63 (22)

Samuels, W.B.; Lanfear, K.J. (1982). *Simulations of seabird damage and recovery from oilspills in the northern Gulf of Alaska.* J Env Management, Sep 82, V15, N2, P169 (14)

Sanders, H.L. (1977). *The West Falmouth spill Florida 1969.* Oceanus, 20(4), 15-24.

Schneider, K. (no date). *Sex and age segregation in Alaskan sea otter populations.* Presented at the 2nd Conf. on the Biology of Marine Mammals, San Diego, CA (USA), 12 Dec 1977.

Scoones, I. (1988). *Ecological impact assessment: The case of onshore oil in Britain.* J Env Management, Jul 88, V27, N1, P11(13).

Seaman, W., Jr.; Aska, D.Y. (1986). *The Florida reef network: Strategies to enhance user benefits.* Artificial Reefs -- Marine and Freshwater Applications. D'Itri, F.M., ed. Pages 545-561. Report Number: ISBN 0-87371-010-X

Segal, W.; Mancinelli, R.L. (1987). *Extent of regeneration of the microbial community in reclaimed spent oil shale land.* J Environ Qual 16(1):44-48.

Seip, K.L. (1984). *The Amoco Cadiz oil spill -- At a glance.* Marine Pollution Bulletin, Vol. 15, No. 6 (June), p. 218

Seneca, E.D.; Broome, S.W. (1982). *Restoration of marsh vegetation impacted by the Amoco Cadiz oil spill and subsequent cleanup operations at Ile Grande, France.* NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill Biological Studies after the Amoco Cadiz Oil Spill Charleston, SC (USA). Brest (France) 17 Sep 1981. 28 Oct 1981. Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Gundlanch, E.R.; Marchand, M., eds. Pages 363-420.

Senner, S.E. (1989). *The Exxon Valdez oil spill: First impressions and commentary.* Am Birds 43(2):218-220.

Sheehy, D.J. (1979). *Fisheries Development: Japan.* Water Spectrum., Vol. 12, No. 1, pp. 1-9.

Sheehy, D.J. (1986). *New approaches in artificial reef design and applications.* Artificial Reefs -- Marine and Freshwater Applications. D'Itri, F.M., ed. Pages 253-263. Report Number: ISBN 0-87371-010-X

Sherry, J.P. (1984). *The impact of oil and oil-dispersant mixtures on fungi in freshwater ponds.* Science of the Total Env, Apr 19, 84, V35, N2, P149 (19)

Shin, P.K.S. (1989). *Effects of a spill of Bunker oil on the marine biological communities in Hong Kong.* Environ Int 14(6):545-552.

Shtina, E.A.; Shilova, I.I.; Neganova, L.B.; El'Shina, T.A. (1986). *Effect of methods for the biological recultivation of oil-polluted lands on soil algoflora in taiga.* Ekologiya 0(2):23-30.

Simmons, C.L.; Everett, K.R.; Linkins, A.E.; Webber, P.J.; Walker, D.A. (1983). *Sensitivity of plant communities and soil flora to seawater spills, Prudhoe Bay, Alaska.* NTIS, Springfield, VA (USA) Number: AD-A136 619/4.

Smail, J. (1978). *Separating oil from sea birds: Giving witness or saving lives.* Oceans, 11(4):59-61.

Sogard, S.M. (1989). *Colonization of artificial seagrass by fishes and decapod crustaceans importance of proximity to natural eelgrass.* J Exp Mar Biol Ecol 133(1-2):15-38.

Soule, D.F.; Oguri, M.; Dawson, J.K.; Osborn, R.; McGlade, L.R.; Feldmeth, C.R.; Wicksten, M.K.; Soule, J.D.; Smith, R.W.; Dabelstein, D.; Kurtz, S.; Edmands, F. (1978?). *The significance of the Sansinena incident.* Univ. of Southern California, Allan Hancock Foundation 139, Inst. for Marine and Coastal Studies, Harbors Environmental Projects, Los Angeles, CA 90007. Energy/environment '78: A symposium on energy development impacts Los Angeles, CA Aug. 22-24, 1978. In: Energy/environment '78: A symposium on energy development impacts: Proceedings. Edited by J. Siva-Lindstedt, p. 295

Southward, A.J. (1982). *An ecologist's view of the implications of the observed physiological and biochemical effects of petroleum compounds on marine organisms and ecosystems.* The Long-Term Effects of Oil Pollution on Marine Populations, Communities and Ecosystems, London (UK), 28-29 Oct 1981. Philos. Trans. R. Soc. Lond. Ser. B., Vol. 297, No. 1087, pp. 241-255.

Southward, A.J.; Southward, E.C. (1978). *Recolonization of rocky shores in Cornwall after use of toxic dispersants to clean up the Torrey Canyon spill.* Presented at the Symposium on Recovery Potential of Oiled Marine Northern Environments, Halifax (Canada), 10 Oct 1977. J. Fish. Res. Board Can. 35(5):682-706.

Stevenson, J.C. (1978). *Recovery potential of oiled marine northern environments: Symposium papers.* Journal of the Fisheries Research Board of Canada 35(5):499-795. .

Stikney, R.R.; Dodd, J.D. (1979). *Artificial propagation of a salt marsh.* Sea Front., 25(3), 173-179.

Straube, M. (1989). *Is full compensation possible for the damages resulting from the Exxon Valdez oil spill?.* Env Law Reporter, Aug 89, V19, N8, P10338(13).

Straughan, D. (1978). *Biological studies of the Metula oil spill.* Presented at the Conference on Assessment of Ecological Impacts of Oil Spills, Keystone, CO (USA), 14 Jun 1978. American Institute of Biological Sciences (USA). p 365-377.

Subrahmanyam, C.B. (1984). *Macroinvertebrate colonization of the intertidal habitat of a dredge spoil island in North Florida.* Northeast Gulf Sci., Vol. 7, No. 1, pp. 61-76.

Swift, W.H.; Touhill, C.J.; Haney, W.A.; Nakatani, R.E.; Peterson, P.L. (1969). *Review of Santa Barbara Channel oil pollution incident.* (Water pollution control research series). Report No.: USCG-794102/003 or FWPCA-15080-EAG-07/69; W70-06320. 165p. Also available as Water Pollution Control Research Series DAST-20. NTIS Number: AD-726 156 or PB-191 712. Contract No.: FWPCA-14-12-530 or DI-14-12-530

Sylva, D.P. de (1982). *Potential for increasing artisanal fisheries production from floating artificial habitats in the Caribbean.* Proceedings of the 34th Annual Gulf and Caribbean Fisheries Institute, Mayaguez, PR (USA), Nov 1981. No. 34., pp. 156-167

Tagatz, M.E.; Tobia, M. (1978). *Effect of barite ($BaSO_4$) on development of estuarine communities.* Estuar. Coast. Mar. Sci., 7(4), 401-407.

Taylor, W.E. (1983). *Restoration of oil well drilling sites.* American Soc Agri Engineers Reclamation of Disturbed Lands Conf, Bozeman, MT, Jun 26-29, 83 (12).

Thayer, G.W.; Fonseca, M.S.; Kenworthy, W.J. (1982). *Restoration and enhancement of seagrass meadows for maintenance of nearshore productivity.* International Symposium on Utilization of Coastal Ecosystems: Planning, Pollution and Productivity, Rio Grande (Brazil), 22 Nov 1982. Fundacao Univ. Rio Grande (Brazil) Duke Univ. Mar. Lab., Beaufort, NC (USA). Atlantica, Vol. 5, No. 2, pp. 118-119. Special issue. Summary only.

Thomas, M.L.H. (1977). *Long-term biological effects of Bunker C oil in the intertidal zone.* In: Fate and effects of petroleum hydrocarbons in marine ecosystems and organisms: Proceedings of a symposium held at the Olympic Hotel, Seattle, WA (USA) on 10-12 Nov 1976. Wolfe D.A. (ed) Pergamon New York NY (USA) 1977. p. 238-246. Report Number: ISBN 0-08-021613-7

Thorhaug, A. (1979). *Mitigation of estuarine fisheries nurseries: seagrass restoration.* Presented at the Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats Fort Collins, CO (USA) 16 Jul 1979. Gen. Tech. Rep. U.S. Dept. Agriculture, Fort Collins, CO (USA). p 667-669.

Thorhaug, A. (1980). *Restoration of seagrass communities: Strategies for lessening man's impact on nearshore marine resources.* Tropical Ecology and Development. Proceedings of the 5th International Symposium of Tropical Ecology, 16-21 April 1979, Kuala Lumpur, Malaysia. Part 2. Furtado, J.I., ed. Pages 1199-1206.

Thorhaug, A. (1983). *Habitat restoration after pipeline construction in a tropical estuary: Seagrasses.* Mar. Pollut. Bull., Vol. 14, No. 11, pp. 422-425

Thorhaug, A. (1986). *Review of seagrass restoration efforts.* Ambio Vol. 15, No. 2, pp. 110-117.

Thorhaug, A.; Miller, B.; Jupp, B.; Bookers, F. (1985). *Effects of a variety of impacts on seagrass restoration in Jamaica.* Mar. Pollut. Bull., Vol. 16, No. 9, pp. 355-360.

Thorhaug, A.; Miller, B.; Rose, D. (1983). *Restoration of seagrasses in Jamaica: Preliminary summary of Jamaica's management of seagrass restoration.* Seventeenth Meeting of the Association of Island Marine Laboratories of the Caribbean Miami, FL (USA) 16 May 1983. Proc. Assoc. Isl. Mar. Lab. Caribb., Vol. 17, p. 10. . Summary only.

Thorsteinson, L.K. (1984). *North Aleutian shelf environment and possible consequences of offshore oil and gas development.* Proceedings of a Synthesis Meeting held at Anchorage, Alaska on March 9-11, 1982. North Aleutian Shelf Environment and Possible Consequences of Offshore Oil and Gas Development: Synthesis Meeting Anchorage, AK (USA) 9-11 Mar 1982. National Ocean Serv., Rockville, MD (USA). Off. of Oceanography and Mar. Serv., 178 pp. NTIS Order No.: PB84-209428. Report Number: NOAA-84061404

Tyler, J. (1981). *Materials placement procedures--surface to bottom transfer.* Artificial Reefs: Proceedings of a Conference held September 13-15, 1979, in Daytona Beach, FL. Aska, D.Y., ed. Rep. Fla. Sea Grant Program. Pages 106-109. Report Number: FSG-R-41

UK Offshore Operations Association, London, UK; DOE, London, UK; MAFF, London, UK (1983). *Environmental effects of oil based mud cuttings.* Publisher(s): UK Offshore Operators Assoc., London (UK), 124 pp.

van Gelder-Ottway, S. (1975). *Some physical and biological effects of oil films floating on water.* Presented at Inst of Petroleum/Field Studies Council Meeting on Marine Ecology and Oil Pollution, Scotland, Apr 21-23, 75, P255 (32).

Vanderhorst, J.R.; Blaylock, J.W.; Wilkinson, P.; Wilkinson, M.; Fellingham, G. (1980). *Recovery of Strait of Juan de Fuca intertidal habitat following experimental contamination with oil.* NTIS, Springfield, VA Number: PB81-112518

Vandermeulen, J.H. (1977). *The Chedabucto Bay Spill-Arrow, 1970.* Oceanus 20(4):31-39.

Vandermeulen, J.H.; Buckley, D.E.; Levy, E.M.; Long, B.; McLaren, P.; Wells, P.G. (1978). *Immediate impact of Amoco Cadiz environmental oiling: Oil behavior and burial, and biological aspects.* One day session Amoco Cadiz Brest, France Jun 7, 1978. Centre National pour l'Exploitation des Oceans. Actes de Colloques No. 6, pp. 159-173. ISSN: 0335-8259

Vervalin, C.H. (1989). *Bioremediation on the move.* Hydrocarbon Processing-International, Aug 89, V68, N8, P50(3).

Wagenet, R.J.; McKell, C.M.; Malek, A.; Fransway, D.F. (1982). *Hydrologic properties of processed oil shale.* Reclamation & Revegetation Research, Jun 82, V1, N1, P33 (18)

Wallenberg, B. (1977). *The Ekofisk accident: Its environmental and political implications.* OECD Observer 88:9-12.

Walsh, W.J. (1985). *Reef fish community dynamics on small artificial reefs: The influence of isolation, habitat structure, and biogeography.* Bull. Mar. Sci., Vol. 36, No. 2, pp. 357-376.

Ward, D.M.; Winfrey, M.R.; Beck, E.; Boehm, P. (1982). *Amoco Cadiz pollutants in anaerobic sediments: Fate and effects on anaerobic processes.* NOAA/CNEXO Joint Scientific Commission Workshops: Physical, Chemical, and Microbiological Studies after the Amoco Cadiz Oil Spill Biological Studies after the Amoco Cadiz Oil Spill Charleston, SC (USA). Brest (France) 17 Sep 1981. 28 Oct 1981. Ecological Study of the Amoco Cadiz Oil Spill: Report of the NOAA-CNEXO Joint Scientific Commission. Gundlach, E.R.; Marchand, M., eds. Pages 159-190

Watanabe, Y.; Terawaki, T. (1986). *Development of techniques for marine macrophyte bed creation in the coastal zone near a power plant. 6. Assessment of a transplanting method to prevent the eelgrass Zostera-marina L. from being washed away.* Denryoku Chuo Kenkyusho Hokoku 0(U86008). I-III, 1-16.

Whitlatch, R.B.; Zajac, R.N. (1985). *Biotic interactions among estuarine infaunal opportunistic species.* Mar. Ecol. (Prog. Ser.), Vol. 21, No. 3, pp. 299-311.

Whittle, K.J.; Mackie, P.R.; Farmer, J.; Hardy, R. (1978). *The effects of the Ekofisk blowout on hydrocarbon residues in fish and shellfish.* Presented at the Conference on Assessment of Ecological Impacts of Oil Spills, Keystone, CO (USA), 14 Jun 1978. American Institute of Biological Sciences (USA). p 541-559.

Wilcox, C.G. (1986). *Comparison of shorebird and waterfowl densities on restored and natural intertidal mudflats at Upper Newport Bay, California, USA.* Colonial Waterbirds, Vol. 9, No. 2, pp. 218-226.

Wilde, P.A.W.J. de; Kuipers, B.R. (1977). *A large indoor tidal mud-flat ecosystem.* Helgol. Wiss. Meeresunters. 30(1-4):334-342.

Williams, A.S. (1977). *Current methods of oiled bird rehabilitation.* Presented at the Oil Spill Response Workshop, Metairie, LA (USA), 15 Feb 1977. In: Proceedings of the 1977 Oil Spill Response Workshop. Fore, P.L., ed. p 125-134. Publisher(s): U.S. Fish and Wildlife Service, Biological Services Program NSTL Station, MS

Williams, A.S.; Brundage, S.C.; Anderson, E. (1978). *Saving oiled seabirds: A manual for cleaning and rehabilitating oiled waterfowl.* American Petroleum Institute Washington, DC (USA). 35 p.

Williams, T.D. (1978). *Chemical immobilization, baseline hematological parameters and oil contamination in the sea otter.* Final Report to Marine Mammal Commission, Washington, DC. Report Number: MMC-77/06. 33 p. NTIS Number: PB-283 969/4 . Contract No.: MM7AD094

Williams, T.M.; Kastelein, R.A.; Davis, R.W.; Thomas, J.A. (1988). *The effects of oil contamination and cleaning on sea otters Enhydra-Lutris I. thermoregulatory implications based on pelt studies.* Can J Zool 66(12):2776-2781.

Williams, U.P.; Kiceniuk, J.W. (1987). *Feeding reduction and recovery in cunner Tautogolabrus adspersus following exposure to crude oil.* Bull. Environ. Contam. Toxicol., Vol. 38, No. 6, pp. 1044-1048.

Wilson, T.C.; Krenn, S.J. (1986). *Construction and evaluation of an artificial reef designed to enhance nearshore rockfish production.* Oceans '86 Conference Record: Science-Engineering-Adventure, Washington, DC (USA), 23-25 Sep 1986. Vol. 2. Data Management, Instrumentation and Economics, pp. 547-551. Report Number: IEEE-86CH2363-0

Woodward, D.F.; Riley, R.G.; Henry, M.G.; Meyer, J.S.; Garland, T.R. (1985). *Leaching of retorted oil shale: Assessing the toxicity to Colorado squawfish, fathead minnows, and two food-chain organisms.* Trans. Am. Fish. Soc., Vol. 114, No. 6, pp. 887-894.

Wyers, S.C.; Frith, H.R.; Dodge, R.E.; Smith, S.R.; Knap, A.H.; Sleeter, T.D. (1986). *Behavioral effects of chemically dispersed oil and subsequent recovery in Diploria-strigosa.* Mar Ecol (Publ Stn Zool Napoli I) 7(1):23-42.

Young, C. (1988). *Instant reefs.* Fins., Vol. 21, No. 2, pp. 12-17.

Zedler, J.B. (1984). *Salt marsh restoration: a guidebook for Southern California.* California Sea Grant Report T-CP-009, 1984, (51).

Zentner, J. (1985). *Wetland restoration in coastal California: A decade of management lessons.* 8th Biennial International Estuarine Research Conference, Durham, NH (USA), 28 Jul 1985. Estuaries, Vol. 8, No. 2B, p. 30A.

Zieman, J.C.; Orth, R.A.; Phillips, R.C.; Thayer, G.; Thorhaug, A. (1984). *The effects of oil on seagrass ecosystems.* Restoration of Habitats Impacted by Oil Spills Symposium, Blacksburg, VA (USA), 9-11 Nov 1981. Restoration of Habitats Impacted by Oil Spills. Cairns, J., Jr., Buikema, A.L., eds. Pages 37-64. Report Number: ISBN 0-250-40551-2