Confidential

DRAFT NOT YET REVIEWED by RPNG

Fish/Shellfish Summary

Known Damage:

Salmon -

Pink salmon:

- egg and alevin in spawning gravel (>50% increase in mortality in oiled streams).
- stock work still inconclusive - decreased returns for hatchery (AFK) - survival rate less than 1/2 that for Ester Is. hatchery (usually similar).
- reduced growth of juveniles in oiled areas.
- increased HC body burden in '89; not in '90 samples.
- increased MFO induction in fish from oiled areas.
- significant fin erosion in '90 samples (chum?)

Herring

- morphologic & cytogenetic effects shown from eggs exposed to oil, but raised in lab (effects in '89 and '90; more drastic in '89).
- egg mortality surveys - survival decreased in oiled area ('89 and '90, less drastic in '90).
-

Dolly Varden

- heavy concentration HC in bile (highest of any fish)
- >30% increase in mortality in oiled areas.

Cutthroat Trout

- >30% increase in mortality in oiled areas.
- significant difference in growth.

Rockfish

- first finfish to show mortality due to oil.
- increased HC in bile (showed up in other bottom fish also - flatfish, halibut, pollock).

Nearshore fish

- (field info available in 2 weeks)
- increased levels of blood parasites in fish from oiled areas (153/ml vs 0.3/ml in control, 5/ml in lab exposed fish).
- increased rate of respiration in fish from oiled areas.
- increased MFO levels in oiled areas (DEC study, not NRDA).

Clam use

- highest level of HC in any organism (subsistence use shut down in Windy Bay).

Subsistence/Recreational uses

Probable Damage:

Ground fish

- some sublethal effects (data not yet available).

Clams

Shrimp

- increase in % spot shrimp with dead eggs in oiled areas (in '89; '90 data not in).

1991 Potential Projects:

Public Information (sport fish)

Habitat Rehabilitation

Identify multi-beneficial acquisition/protection

Access (sport fish)

Restoration survey (prioritization)

Continued exposure/sublethal effects monitoring

1990 Recommendations:

Salmon/herring escapement

Salmon/herring tagging

Port sampling

Otolith marking

Herring spawning area catalogue

Meeting Notes - October 26, 1990

B. Ross reviewed the factors to be considered in evaluating projects and feasibilty studies.

- Wash. Policy Group (WPG) will make ultimate decisions regarding projects. (MT, Peer Reviewers will look at package)
- Will proposals from the general public also be considered? Any such proposals that are submitted as comments to the FR notice will need to be addressed.
- B. Spies expressed concern that basic information on exposure/ contamination effects necessary for the NRDA case may be lost due to positics.
- RPWG will propose all projects that make sense scientifically and meet the factors; if one does not qualify under restoration, then RPWG will recommend to MT that they are proposed/continued as NRDA studies.
- NRDA projects will be harder to justify this year.
- C. Meacham expressed concern about stepping into this process before clean-up is complete, damages are not fully assessed yet; this expedited process for determining restoration projects is inappropriate.

Proposed Projects

1. ADFG (FRED) proposal (10/25 memo, Allee to Ross) - Jeff Hartman, Tom Kron:

- Six restoration project ideas (four had detailed proposals) and eleven feasibility studies (six had detailed proposals) were included in the memo and discussed at some length.
- Feasibility studies #3,4,5,and 6 on the list have problems with NRDA link to the particular species.
- Coordination between Divisions is important.
- one study must assess which tools should be used.
- Is it more appropriate to do direct restoration than to enhance another system (direct vs. replacement)? - In short term (before settlement) the more directly related to an injury, the more likely a project will be reimbursable. A project that enhances a site beyond its original condition

must show that this is conpensating for something you can't correct somewhere else.(M. Fox).
- Sometimes in order to pursue things that make the most sense you may need to move to a different system.
- If we move too fast with certain projects, might lose in terms of cost effectiveness; i.e., must look at all damaged streams before pick one is "best" to restore. (Peterson: this type of study may be a good "feasibility" study)
- Restoration effort taken in the end must enhance something in the long term; need to address the "rate of recovery issue"; But there is a risk in waiting, esp. if ongoing impacts are apparent. (Peterson).
- One legal case: Although the regs "favor lost use value over restoration", the court said that the statute does favor restoration, but it must be a reasonable relationship between resotration and what has been lost. (Fox)
- Can possibly use "local" groups to help with projects (i.e., stream rehabilitation).
- FRED package seems to be a series of tools, nothing specific in terms of what we're trying to address.
- This meeting should be a first step bringing ideas together and combining projects where appropriate.
- reference was made to the third paragraph of the 9/25/90 memo (Schmidt, Barrett to Senner) concerning using standard enhancement practices to accelerate the restoration process.

2. ADFG (Commercial) - outline submitted:

S.Sharr presented ideas for salmon restoration (see handwritten outline labeled salmon restoration studies). These ideas included escapement enumeration (aerial and ground surveys), stock identification (coded wire tags, otolith marking, adult tagging) and run reconstruction. The following comments were made in general about these ideas by Sharr:

- Referencing outline:

  Stock Identification - The goal of the coded wire tag program is to assess contribution of stocks to commercial fishery; it will identify time and area distributions to eventually alter management. Cost for this type of program could run into the hundreds of thousands of dollars. The recovery portion of the project would need additional funds, approximately $500,000. The otolith marking study will add greater precision. It could be done as a feasibility study; it could run approx. $500,000, and additional funds would be needed for the recovery portion.

  Run Reconstruction - historic data summaries would include information on escapement runtime, adult tagging (time and area densities), existing CWT data. It would maximize the likelihood of predicting exploitation of stocks in commercial harvest.

- The factors for consideration are addressed in the following ways: addresses known damage, technical feasibility established (most are extensions of ongoing programs), all

should be implemented rapidly, net environmental benefit includes nearshore and upland portion of ecosystem, duration of projects should include several generations of pink salmon, the geographic scope is PWS.
- historic data exists for oil impacted streams.
- It was suggested that some could fall under monitoring to determine recovery; however Sharr disagreed stating that these types of projects were needed to improve management precision. Without management precision, any enhancement may be futile effort.
- Monitoring is the tool needed to assess any enhancement, it is necessary to test whether direct restoration is effective. Besides monitoring for natural recovery, it is necessary to determine if restoration work is being effective.
- Another method of restoration is to implement conservation management strategies, especially if it will take awhile to address uncertainties.
- Otolith tagging could be proposed as a feasibility study, but coded wire tagging is necessary to truth. This would avoid gaps in the data base (Peterson).
- Since the oil spill, there is now a need for better management. (for example, when the quality of salmon declined, fishermen were directed to non-contaminated areas,this force a management situation which would not have occurred without the Spill.
- These types of management projects make sense legally, especially since they are also needed to monitor the restoration effort.(Fox)

3. NOAA Projects - three proposals submitted (A. Wertheimer):
- all represented work that needs to be continued can be catagorized under NRDA, specifically, if 1990 NRDA data (yet to be analyzed) shows continued exposure in oiled areas.
- A question was raised regarding seperating out the effects of oil on salmon relative to the effects on abundance of prey (less fish feeding on prey). In response, A. Wertheimer stated that the herpacticoid trophic link is well established.
- B. Spies expressed the concern that projects that are critical to establishing damages need to be highlighted by the group; important arguments need to be plugged into any decisions relative to the continuation of such projects. Economics should also be factored in.
- Project costs should decrease if projects are combined with other agencies.

4. E. Biggs (ADFG/Commercial) discussed restoration relative to the herring fishery. She was in agreement with previous participants that the biggest tool to rehabilitate a resource is management and maintaining and improving accuracy results in good management. The following were suggestions for improving management:
- Maintain spawn deposition studies - increase in sample size provides increased accuracy.
- Continue 1990 egg loss study for two more years - this is

a direct multiplier in model (increasing biomass estimation increases accuracy forcast).
- Improve forecast model - more time needed to study the biometrics.
- Stock seperation studies needed to properly identify the unit that is being forecasted and measured (this could be a problem with herring). A tagging program would look at immigration/emmigration.

Most of the above programs are in place; writing and rewriting proposals impedes PI progress. Precision is needed to manage the salmon/herring fishery in finer detail since the oil spill; need to know what the damage is and how to predict. For example, the harvest rate for the weakest stock has already been chosen for salmon, harvest quota is based on forcasting. There is not much latitude in herring; market is set ahead, industry driven.

The following are ideas for direct restoration:
- transplant kelp to boost productivity (egg survival) of an area - hard to evaluate effectiveness, cost effectiveness.
- transplanting of stocks.

Restoration can also be accomplished through protection of the ecosystem:
- development of marine sanctuaries.
- establish limits on sedimentation effects.
- prevent upland damage.
- eliminate in-water log storage.

Monitoring for bird and mammal work can be piggy-backed with herring survey work.

5. ADFG (Sport fish) - Kelly Hepler discussed this proposal (10/3 memo, Roth to Meachem):
- high incidental take of Dolly Varden and Cutthroat trout; need greater resolution in PWS, need expansion of program.
- can piggyback on some of ADFG/Comm. projects, i.e., weir location, port sampling, etc.
- passage problems can be identified and proposed to address this year; preference over enhancement (question as to whether sportfishing wants enhancement).
- JSA doing study for J. Hartman - possibility for funding.
- Need to push sportfishing toward lesser impacted areas to allow recovery of affected stocks - could be done through alternative access, information brochures.
- Public information could be done in short-term, before all data is known. (makes sense legally, since it is connected to restoration)
- Specific impacts in Valdez & Cordova due to increased population during Spill clean-up; increased impact to roads and sanitation. (could have been Dingall-Johnson $ in past, higher priority now)
- no management program existed before Spill for bottomfish (rockfish) in PWS. Basic needs for more information include

port sampling (catch information, cohort analysis) - NRDA studies designed for sublethal effects, not population effects. Some restoration ideas include artificial reef development to enhance sport fishing (may not actually increase population, maybe just redistribution) - also may be bringing fish back to impacted area (i.e., Bligh reef) - more feasibility studies may be needed.
- charters going to non-oiled areas may be impacting these areas; also increasing impact from gillnet and longline.
-a proposal for shellfish (clam) and spotted shrimp was discussed (9/25 memo, Donaldson to Senner). Use of clams (subsistence) was damaged, even if population is surviving.

Summary:

C. Meacham summarized the day's discussion with the following chart:

Known Damage:
- salmon
- herring
- Dolly Vardan
- rockfish
- cutthroat trout
- subsistence/recreational uses
- near-shore fish
- clam use

Known Exposure/Probable Damage:
- groundfish
- clams
- shrimp

1990 Recommendations (from Tech. Wkshp. 4/90) - still applicable:
- salmon/herring escapement
- salmon/herring tagging
- port sampling
- otolith marking
- herring spawning area catalogue

Potential Restoration Ideas for 1991:
- public information (sport fish)
- habitat rehabilitation
- explore and identify multi-beneficial acquisition/protection
- access (sport fish)
- restoration survey
- continued exposure/sublethal effects monitoring

Closing remarks:

- salmon/herring are key elements to ecosystem in PWS (nutrient enrichment)

- more monitoring for natural recovery is needed.
- the above list should not be prioritized at this time, too prliminary.
- state proposals must be to legislature by Nov. 15.
- RPWG will send (fax) a format to all participants.

10-26-90
SIMPSON BLDG,
ANCHORAGE

FISH/SHELLFISH RESTORATION MEETING

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Oct. 26

Fish + Shellfish

Intro - (Brian)

Restration ⇒

direct

indirect (replacement)

acquisition

⇒ link to damage

⇒ endpt = pre-spill conditions

do we assume we know full extent of damages to propose prj's.

⇒ this is not an overall rest'n project

multi-year projects need commitment; but should be reviewed (+ reassessed) at end of each year — + monitoring

are they actual rest'n projects, feas. proj's?

both should be considered; note "factors" are listed for both

⇒ don't have to address the whole problem if we don't know the whole scope of problem

Overview of Damages → Chuck

- concern about stepping into this process before clean-up is complete
- don't really know damages - info not in yet
- unhappy @ expedited process - not appropriate

Damage

clear damage { pink sal
heavy
DV Trout
Rockfish

concerns { clams
groundfish

San Juan —

Pink Salmon — extent of damage to date restricted to egg + alevin stage in spawning gravel
→ may be sig > 50% ↑ mortality in eggs/alevins in oiled streams

stock assmt / stock id. } results are not conclusive:

stock id @ code-wire tagging (differential hatch vs wild) } hatchery stocks have been affected as well as wild
i.e. hatch in SW → lower survival
→ to assess return
" damages at pop'n level

all pinks face private

1990 → SW facility ~~AFK~~ (@ San Juan)
1990 (survival rates less than 1/2) fry prod level 150-200 mill
returns 5-10 mill
similar fact. N Esteros (valley) →

locally prevalent

Possibly due to Δ in cult. tech's imposed due to oil — deep horn 5-6"
fry confined longer in vicinity of hatch
* posibly prev. dispersion of fry in 200 l. waters

∴ failed to grow normally

release date was a little later - but actually held much longer due to nature of boom

eggs layed in 1988 ↓ true for all stocks pws across board in pws ↓ wild stock returns were (better than forcast) ok - not record levels

not argument for no-damage [linear rel'n.] ↓ assmt to date on

[next year's return will be measure of oil spill yr] ↓ but already have indicat. in gravel

Alex →

① UAF-PWSJ

* diff dispersion pattern → concl. evid of contam. of P.S. in marine env behav. & movmt out of Prt S.J. was different in spill year (cannot conclude it was mun → metabolic load on juv's

* definitive → reduced growth of fish in oil vs non-oil thru juvenile stage

in previous yrs, juv's left rapidly & congregated in corridor (where zoopl. ↑)

* ADFG - codewire tag → fish recov. from Eston (non-oil) were larger than those rec. in oil areas

indicat - opposite effect of fish released in SJ area

NMFS ↑ HC, body burden, MFO in oiled area
reduced size in oiled loc
prey abundance (copep./zoopl.) → no diff -
if diff oil areas ↑

? any info on
- Size of returning stocks
diffic. to do bec. of no historic baseline
but sampled for histopath
commercial harv → 700-800 stocks (mixed) - prey sampled historical

do not have stock spec. info for pinks

effects of oil → growth red → selecting
away if smaller if fish (predat.)

can get 90% of mortality pop. in 1st 30 days

any extrap. to chum?
- no HC data
samples being looked at
- feeding hab - more orient. toward
near shore feed. - more risk for
contam. (contam in sed, in nearshore)
- caught few chum in samples - prob
due to site sel. — but
those caught have no indic of growth effects
greater likelihood to see effects in chum like pink
in 91 →

chum sockeye { pop'n size
escapmt enumerat.

→ is it premat. to talk this yr if other spp
besides pink?

pop of chum in west PWS are small

few of oil stems had pop ins of chums

diffic to come up @ enough sample

but there were chum → suppect that they have undergone same effects as pink

Body burden levels in Oil Yr 1 not in yet?

1990 samples → body burd. is no longer there

↓ expos. contam.

no underst. of mech.

body burd in 89 was due to expos to oil in fish to

biomarker results not back yet

degree of contam ↓ from Oy1 - Oy2

→ significant fin erosion (1990) — will send more samples down

even if expos. had occured, MFO might not show →

system might have been too young

- may not see body burd or eng. indict.

imp? → if mech. occured to adults thru transitity oil H_2O → impacts to greater suite of spp.

chem analysis pattern juv. salmon → ingest. is route of contamin.?

are WSF fract. was low

*Pot Study

sockeye sal. overescp. study init. this Spring →

expect that depress. of sockeye prod

don't have data yet

both spp. have strong homing instinct

were tagged before exposure to oil

caught/exam. thru fish weir

? 16% survival in control 25% survival

Kelly

D.V. — 1989 (11,000 tags)

Cutthroat — (2,000 tags)

⊗ equal survival btwn oil & nonoil tagged, recov. in 1990

spend summer feeding near spawning areas (& contam.)

conclude → sig. diff in survival for both

- mortal. > 30% greater for both (oil vs nonoil)
- sig. diff in growth for CT trout, not D.V.

on tagged fish only

Spr 1989 - Spr. 1990

- D.V. picked up heavy conc. of HC in bile
- specimens sent for MFO; histopath.

hope study will continue to 90-91

? biol. info on track?

looked to other obvious indicat. →

obvious tag loss, fishing mortal., migrat., literat. on other studys (consistent @ other work)

F/shel. #34 D.V. had

- highest level of HC in bile
- prel.

~~possibility~~ CT. can look at pred. at nat rec →

since weirs are in place - can get pop'n.

1990 - tagged 38,000 DV.

#

pop'n size:

CT (north end of range) → ~34-50% of pop'n PWS in oil areas? (sample areas)

→ Stock surplus model

[knowns: Eshemy - ongoing decr.

green lks. → stock non-exist.

* restn idec → need to get more info on pop'n

to ultimately D mgmt

Rockfish

Kelly → 1st finfish to show mortality from oil
Concl → die from oil contam.

control vs. oil:
HC contam in fish
→ yellow-eyed R. – ↑ HC in bile (oil vs control)
(surprising since crude oil does not sink)
trawl surveys →
other bottom fish picked up HC in bile

OBJ of study: ① pathway
② subleth. effects

info not yet avail:
(Bligh Reef → Kenai)
adult fish (tissue)
eggs (females) – aHFO, histopath, HC
prey spp (HC)
juv. rockfish → stress check on otolith
sed. samples for HC

Dave Context.
other spp.
flatfish, sole, halibut, pollack

↑ HC metab.
pollack → ↑ levels AK peninsula SW Kodiak
study now to det. if ↑ levels are due to oil
some subletlal effect – premat to discuss

halib. → not much in 1989 (↑ HC metab. in bile)
1990 not assessed yet

blk cod → no elev. levels of HC metabolites

hunner crab (collect. 1990) → no analys yet

subleth. effs

Will Barber

lab → injury & gill from experim. approach (tank - oil/non-oil rocks)

field → # in biomass

gill damage (3 weeks till data)

~2 weeks till data from field

lab study → respirat. work
blood parasites → may have had a high # in 1st place

→ Fremds. fish: 153/ml
exced. ↑ hi levels of bld paras.
↑ respirat
∴ conclude that paras. level is elevat

→ control fish:
.3 bld paras./ml.
↓ resp.

blood paras. 5/ml in clean fish put in with oil rocks

Kahn? article:
gill parasite → higher levels in oil vs non-oiled beaches

→ possibly recruitmt failure; but no data yet

Daily News article ↑ MFO 1990 levels in near shore fish (DEC study) Scolpins Sticklebacks?

Debbie Fairgrieve

Tim Baker Herring 89-90 3 locat. Naked Montague } oil -non oil

eggs exposed to oil - (short time exposure)
but raised in lab (after fertilig.) ∴ abnormalities would ↑ were if eggs left in env.

morphol. } 2
cytogenet. } effects in 89, 90
↳ more drastic in 89

egg mortality (tracked over 2-3 days)
survival ↑ in control areas
surviv. ↓ in oil area ⇒ greater amt of mortal @ larger amt of oil
Same in 1990 - but not as dramatic (~5-10% diff.)

Surprising that effects are coming on 1990 in larvae

1989 { control : 39% mortality — stat. sig.
oil : 65-75%

1990 { control : 18% mortal. — stat. sig.
oil : 32-37%

Paper at Symp.: oil effects on herring larvae ⇒ curvat. of spine
~500T. crude oil in Finland
effects for 3 yrs.
⇒ reprod.
attrit. of eggs ↑ in oiled fish - lasted for 3 yrs

[oil in env. could not be measured in H_2O - col.]

D. Irons seabirds

- no damage assmt projects on dist'n/abund on forage fish (no data before oil spill)

(Rest'n Feas. Study 1990 forage fish)
Eatwakes forage close to shore more
looked at 3 areas ⇒ (where birds were tagged)
transects [compare near shore 0-500m — offshore 1500m]

pop. declining over yrs 72- { terns murrelets murres scoters

⇒ Shld bioacoust equip be used to assess fish popns. (Can differences actually be det. or is natl variat. a probl.)

seasonal diff
tidal diff

Glaciers
Tat. narrows
N side of Valdez arm

[how can restore pop'ns. if birds, if prey spp are ↓]

are there any studies prey
→ aerial est. of abundance
(maybe more approp.)
(swim bladder)
need target strength ment to
convert to biomass
(expensive)

Chuck M. Shellfish → (good grant. of data on mussels)
clams
shrimp

Shrimp 1989 sample of Spott. shrimp stat sig?
↑ % of shrimp @ dead eggs in oiled vs non-oil
1990 " → results not in
abundance of shrimp Spott. → comm. harvest Quota
? ~ 250-400,000 lbs.
rocky, near shore rel. deep

Clams min + outside PWS
little info avail
1989 data ~~$~~HC info → clams cannot metab. HC
∴ highest conc. HC
(highest conc → outside PWS; (Windy B. subsist fish. was shut

Mussels → being used (in many studies) as indic. spp. for oil
coastal hab. studies

Dave Cont.

Dung. Crabs

dropped in 1990 – due to not enough crabs collected in '89

F/SF #22 – outside dung. crab PWS. Some, not enough, crabs data still out.

89' → King Crab ? Tanner

⇒ if any ideas about Sport fisheries → bring them out.

Brian ⇒ review factors

? will proposals from public be solicited in FR notice →
Brian → if, thru comments, we get them, we'll have to address them.

Monitoring ⇒
aspects can be proposed under rest'n

Spies – concern that ongoing basic info on expos./contam. effects not be lost due to politics

Whose making decisions?
Wash. Policy Group will
RPWG will propose all projects that make sense scientif.; if factors are adhered (if not rest'n projects – then continue to push under NRDA)

Mark K. ⇒ if rest'n projects are being proposed; meanwhile propos. monitoring to det. if damages are still being seen – to det. rest'n

→ difficult to recover costs in suit & til actual recovery → only to estimate

restn projects must be directed toward specific area (esp. to justify acquis.) → must study where impacts potentially exist

damage assmt. projects will be harder to justify this year

Peer Reviewers + Mgmt team will look at Pkg.

Proposed Projects →

① Jeff Hartman (econom.) / Tom Kron
- Coordinat. btwn Div. is import.
- one study must assess which tools should be used

Brian → → is it more appropr., at this time, to do direct restn than to enhance another system. (Direct vs. Replacement)

Martha → in short term (before $) → more directly rel. to injury, more likely to get $ reimb. enhancement of a site beyond cond → must show compensating for something you can't correct someplace else

Tom K. → want to pursue things that make the most sense → ie: may need to move to a diff. sys.

Jeri → ? ie: more appropr. → project that dev. proposals, & implementing some when come

Mark Brod → if we move too fast, might lose in terms of cost effectiveness. [must look at all dam. storms, before pick one]

Peterson might be a nice Feasib Study → look system wide for "best" projects

need blend { projects which can be done in impacted area
new ideas → where do we go from here?

Peterson ⇒ - restn effort taken in end must enhance something in long term
rate of recovery issue
- risk in waiting, esp if ongoing impacts

Murphree ⇒ case regs ⇒ "favor lost use value over restn"
Court said No ⇒ statute does favor restrat; but must be a reasonable rel'n. btwn restn & what's lost.

Glen W. Black Cod / Dung Crab } ⇒ not linked to Damage yet, might be difficult to justify — even tho. can look at indirect (replacmt) ⇒ too preliminary

See list of Lost Service Spp. # ~~9~~ ⇒

Brian ⇒ possibility to use "local" groups (e: RPT) to help @ projects (e: stream rehab.)

Will B ⇒ FRED pkg. seems to be a series of tools ⇒ nothing specific in terms of what we're trying to address.

Tom K ⇒ this meeting shld be a 1st step ⇒ bring ideas together; combine projects where appropriate

1:30 PM

S Shaw

(2)

- important for the total of PWS
- nutrient/energy transport from offshore

historic data exists for oil impacted streams
- programs are ready to roll (most are ongoing)
- could be incorporated @ Sport fish [i.e. Dolly, CT streams are same]
  ? should be considered in evaluation

Brian some could fall under category of monitoring to det.

Shaw ⇒ disagree; recovery all projects needed to improve mgmt precision

might be more cost-effective to actually go out to enhance known prob stream.

Shaw ⇒ w/o ~~be~~ mgmt, enhancing ~~will~~ may be futile effort

⇒ monitoring is tool needed to assess any enhance
* need to test whether direct restn. is effective

Brian ⇒ besides nat. recovery monitoring, also need to det. if restn work is being effective

another argument ⇒

one method better resolut. mgmt; another way is to institute conservat. mgmt. strategy (esp. if it's going to take awhile to address uncertain

run failure in 1989

Kodiak - fishery was closed, escapmt levels were

will overescapmt be assessed?

for sockeye - not major spp. of concern

pink + chum

Peterson → otolith + scales should follow along coded-wire tag - that info is needed to avoid gap in data base

(coded wire tag truths otolith marking program.

↳ (has a long way to go)

Brian → is some proposable as feas.

Shaun → yes - otolith tagging (w/ CWT. to truth)

Peterson - if program is one that has been wanted along time - -be careful not to make it appear agency self-serving

Brian → not purely an oil-spill prob → But there is now a need for better Mgmt.

Marlar → good sense; esp. cost effectiveness need this type of ~~basic~~ project to monitor this rest'n.

Chuck → state had, pre-oil spill, a good mgmt prog. with oil spill - its not possible for program to now assess the fishery

quality of salmon declined - because fishermen were directed (managing for high quality) not oil contamin, but darkness of fish because they were spawners

forced a mgmt situat. which we would not have been in.

NOAA Projects — flex. W-

responsib. to track if resources are

(3A) need '90 data to det. if further damage; to det. whether to proceed

Peterson how do you separate out the effects of oil on salm. / + effects on abund. & prey (less fish feeding on prey)

Pete (herpatcoid trophic link is well established)

Brian Spies → concern, needs to be a bin for projects that are critical to keep going for the case (ie: effects ≠ exposure)

imp. arguments need to get plugged in - economics should come into play.

→ project costs will go down if projects are combined @ other agencies

Evelyn → agree @ Sam

→ biggest tool (mgmt) to rehabilit. resource maintain & improve accuracy →

I, improve Mgmt ① maintain spawn deposit. (count eggs under H₂O)

↑ sample size → ↑ accuracy

② continue egg loss study

→ 1990 study for 2 more yrs

direct multiplier in model ↑ biomass est. ↑ accuracy forcast

③ improve forcast model

biometric exercise (more time)

④ stock separation study -
probably herring — properly id. unit that we're forcasting
& measuring
tagging program to look at crossing/crossing.
⇒ programs are in-place

PIs should put forth leg. proposals ⇒
RIWG or mgmt team should decide
if it is Rest'n a NRDA
writing/rewriting proposals impedes PI progress

will ⇒ mixed stock fishery exists for salmon/herring
shld be managing in finer detail
(Exxon has called it to the forefront)
Why did do you want to do it now,
if not before
need precision to know ~~to~~ what damage is — ~~to~~ how
to predict
(already chosen harvest rate for ~~herring~~
true salmon ⇒ weakest stock)
not much latitude the way the mgmt plan is set
(harvest quota is set based on forcasting)
herring ⇒ market is set ahead of time;
industry (processors) driven for herring

II Direct Rest'n (less cost effect. in general)
- boost prod. of area by transpl. type of kelp
to another area (? cost effect;
hard to evaluate)
- transplanting; moving stocks around

III Protect. of Ecosystem of area
- marine sanctuaries
- sedim. effects (put limits)
↑ bio load - effects plankton -
- ~~protect~~ prevent upland damage
- log storage <bark>
↳ invertebrates

(meet @ timber rep's)

USFS is not doing logging in Chugach around PWS.

→ monitoring should be piggy-backed with ongoing surveying

Rec. → define "mgmt gain" in terms of cost-effectiveness

---

(4) Sport Fish
- high incid take in CT & DV
- greater resolut. in PWS

→ piggyback on Shari's studies
- weir locat. <pop. size, egg struct.>
- migrat. info

Over sust. yield due to oil spill & what's happened due to the spill

→ in short run, why not do what you can directly
↳ not clear cut

Prob - sportfishing docs not want entanclmt.
(some physical things can be done; ie: maintain fish passage)

$/B -

① fishermen prefer to catch natural stock over enhanc stock

↳ no evid. that there is a lower demand for enhancmt

→ need refined mgmt.

⇒ need to push people toward lesser impacted areas

Kent ⇒

- enhancmts / habitat
- mgmt concerns:

some anglers may be displaced

resp. to provide another oppty.

alt.

- access
- informat. brochures

Brian → public info - can be done in short term, before all data is known

can this be consid. under restr

Martha has no comment at this time

makes sense tho, that its consv. to restr

Kent ⇒ access - 2 impacts in Valdez / Cordova

↑ cleanup workers - ↑ impact to roads & sanitat.

(Flemming Spit, Cordova)

(Alison Pt - Valdez)

? Dingle Johnson $

Rockfish no program exists on bottomfish in PWS

(until Oilspill)

→ need for more info (due to spill)

((studies were designed for substantial effects, not pop (lethal effects))

- port sampling - - catch info
- cohort analyses
- (palagic fish) - det if year class is missing

- attracting /s. enhancing
redist'n → ↓ sportfishing process
healing process - directed toward public

for bottom fish - art.f. reef enhances food resources (but are food resources limiting)

rockfish - old ~~fish~~ farming → chuck transplant good fecund.? adults to area where pop'n was been ~~reduced~~ reduced

combination ↓ takes along time to re-estab.

Prop → not necessarily ↑ # fish (may be just redistn.)

* ie: Bligh Reef - rockfish pop ↓ dramatically (if bring fish in + damage is still occurs, pot ie: fish pass back in Bay - sales, impact still there)

→ greatest impact (larvae) was never measured

Charters going to non-oiled areas - impacting these areas.

↑ impact from gillnet + longline

- kill? census (surveys) of catch.

Kelly & dep. 1990 results - shld current assmt project be rolled over to restn.

Chuck → good possibility

Known Damage	Known Exposure / Probable Damage	(out of green book) 1990 Recommdat
Salmon	Groundfish - Pollack	1) Salmon/herring escapement
Herring	Clams	2) Salmon/herring tagging
D. V.	Shrimp	3) Port Sampling
Rockfish - Transplant		4) Otolith marking
Cutthroat		5) Herring spawning area catalogue
Sub./Rec. Uses		1991 List:
Near-shore fish		- Public Info. (S.F.)
Clam use		- Habitat Rehabilitat.
		- Explore Acquisit/Protect (I Do multi-benefit)
		- Access (Sport Fish)
		- Restorat. Survey
		- Continued expos./subleth effect monitorg

don't red flag people whose livelihood from ~~subsist~~ commercial uses salmon/herring ⇒ key elements to ecosyst. in PWS. (nutrient enrichmt)

⇒ some more monitoring for rat recovery is needed

⇒ do we want to prioritize this now? Too preliminary

State proposals must be to legis. by NOV 15 ⇒ for new admin.

pollack

(5) Clam proposal → data not in yet

looked at growth, survival, HC in tissue

known → very hi levels of HC in tissue

have damaged use (recreat, consumpt.) even if organism is surviving

?

10-26-90
@ Simpson Bldg

Fish / Shellfish Meeting

Patrol - nc

Impacts - Chuck M.: For record, state is participating under duress - premature, and not all info avail. yet.

- Pink Salmon - Sam Shaw - Alevin/eggs in oiled streams, over 50% increased mort.
  Stock work - not completely conclusive yet but CWT's show much decreased return for SW PWS hatchery (AFK facility) (Sawmill Bay), as well as for wild fish.
  (↑ 1½ survival of Esther Bay hatchery - had been parallel in past years)
  - Alex Wertheimer - conclusive evidence of contam of juveniles in early marine stage, too. Doesn't think can exclude direct - oil effect on Sawmill Bay hatchery fish. Rand dispersion of these fish was diff't from previous years. Also, apparently reduced growth, as well.
  (Esther hatch. fish in non-oiled areas larger than those recovered in oiled areas.)
  - NMFS data incl MFO induction in oiled areas.
  - Prey abundance (zoopl. + harpacticoids) - no signif diff apparent.

Sawmill HC body burden in 89, not in 91, 92 decrease in exposure. But biomarker results (not back yet) may still show a level of ongoing exposure.

(Other salmon spp have been tagged - not yet returned from sea -)

10-26-90 Fish/Shellfish 2

Tom Kron — Sockeye overescapement study in 90 — expected depression in production, may need to do restoration there, too.

Kelly Hepler — Dolly Varden/Cutthroat trout — 89 studied
89 - 11,000 DV TAGS, CT ~ 2000 TAGS
3 oiled + 2 ref. systems. Tagged most fish.
SURVIVAL: ~FS 25% oiled vs 16% oiled (90 - 35,000 DV tagged)
Signif. diff in survival (>30% extra mort. in oiled systems). Also, signif diff. in growth for CT, but not dollys.
Looked for MFO induction, histopath, + bioenerg.

Dave Cantillon — DV showed highest levels of HC in bile of any fish studied.
CT - 30-50% of pop'n's in systems being studied (end of distr, rel'ly small pop in PWS.
DV - larger pops

Kron - For both - discrete pops, so, like salmon, may have endangered specific stocks. Overall PWS #'s not most appropriate measure

Kelly H — Rockfish - 1st finfish to show mort. in 89 due to oil. So - looked @ HC burdens, oil vs non.
Yelloweye RF had signif'ly higher bile HC concent's. (Other bottom fish, too)
'90 - redesigned study to look @ pathology + sublethal effects. Collected prey, eggs, juveniles for sublethal indicators.
No results yet.

Other Groundfish — flatfish, pollock: widespread indications →

(from as far as SW of Kodiak for pollock) of exposure (HC bile). Some sublethal indicators being looked at - a few mo. before data will be avail.

Intertidal Fish - Wil Barber - Field + lab studies on intertidal fish. ~~Field ...~~ Field biomass #'s + gill infl. to be avail in ~2 weeks. Lab study: blood parasites/respiration: High blood parasites in oiled vs unoiled area. (153/ml FIELD vs ~~0.3~~ 5/ml LAB EXPOSED & vs 0.3/ml CONTROL)

- Respiration tracks w/ this. (Higher w/ oil exposure - consistent w/ lit. according to Spies.)
- Looks ~~like there~~ may be a recruitment (year class) failure, too - ~2 wks from data here, too.

DEC: - Also, caged ~~...~~ pholids showed increased C-P450 oiled vs unoiled.

Herring - Tim Baker - 89+90 - 3 locations (2 ~~...~~ oiled, 1 un-oiled) Eggs exposed to oil then raised in lab. Morphology + cytogenetics - saw effects in both years, greater in 1989. Also egg mort. surveys showed decreased survival in oiled areas. (May have basic dose-response here, too.) → Both yrs, too, but in 90 = ~5-10% diff. They were surprised to see abnormalities + morts continue into 90.

Spies - 65-75% ~~mort~~ LARVAL vs 35% controls
32-37% ABNORMALITIES vs 18% control.

→

Chuck M -
Paper presented @ Herring symposium on oil effects on herring -
Evaglynn was there - 570 Ton spill in England -
effects carried for 3 yrs (oil was gone from water column) (Effects ended in 4th yr) (except livers remained enlarged (+) ~~(+)~~ gonad weight remained lower after 3 yrs, too (+)

Dave Thoms - Forage Fish study - A Feas. Study on seabirds + mammals, no other NRDA study on Forage fish but Herring - (incl capelin, sand lance, walleye pollack).
No data before spill, either.
Studying black-legged Kittiwake throughout PWS, + connection between their preferential nearshore foraging + the D/A of forage fish; using hydroacoustics.
0-500 m (nearshore) transects + 1000-1500m (offshore) transects.

-Break-

Shellfish - Chuck M. -
Shrimp + Clam NRDA projects -
Shrimp '89 - increased % shrimp w/ dead eggs in older vs non.
'90 - data not yet avail - (nearshore, but relly deep: ~ 50-150'). → (% of dead eggs/♀ low, though statistically signif, he thinks)

Clams - w/in + outside PWS. Little info in yet.
HC data, clams show highest levels of any organisms tested. Highest in Windy Bay. (Subsistence fishery shut down, here) →

Dave C. - Dungeness crab studies '89+90 - in + out PWS - '90 out only (Fish/Sh #2)

Went over Factors

- SIGNIFICANT concerns about lack of criteria/knowledge about how projects will be approved, w/r/t overall NRDA.

Difficult to get enough crabs to work with. Data collected so far not all avail. - no + results yet...)

Some King & Tanner collected in '89, Do. Data not avail.

Jeff Hartmen — New Handout (10-25-90, alla & Ross)

Know - read 3rd ¶ from 9.25.90 memo, Schmidt/Barrett to Sennes.

FRED Restoration ideas package: (Restn. 6 projects + 11 feas. studies

See Handout.

(Idea to have study to address individual impacted streams/habitats to ID most appropriate restn techniques, + then do it in a few areas)

-Lunch-

Handout - Sam Sharis —

For Fish, as exploited/managed species already, most cost-effective + bio'ly successful means of rehab. is thru good management. Addl mgmt precision in existing programs is needed to allow better stock-specific ability to manage for rehab. Also, several salmon + trout measures can be integrated. Need for real-time info for better mgmt.

See Handout

Acknowledges that these can easily be considered in either NRDA or Restn programs - not clear from here.

Sharp - went thru criteria for his list. Damage there; + tech'l feas. established (but run reconstr modeling may be less used - however PRs think useful + well enough est'd); Impt to carry forward these ideas rapidly, since can pot'ly do more damage (than incr. harvest) on depressed stocks w/o improving mgmt ASAP. [He addressed how these studies reflect all criteria on "Factors" list.]

Rough costs: ground surveys ~ $2-300K (less needed for restn)
expand aerial " ~ $30-50K
CWT } $100's K each
Otolith marking }
CWT Recovery ~ $1/2 MM

Can be implemented immediately upon avail'ty of funds. Also, sportfish ideas to come easily integrated w/ these, w/ little addl cost (eg, port sampling to incl. DV-CT.)

Peterson argument that marking, such as otolith marking, should not be delayed because of need/opportunity to cross-validate techniques.

3 NOAA Proposals

Alex W -

Evelyn — Herring - Agrees w/ Sam - best tool for herring is mgmt - need to improve accuracy / forecast ability →

10-26-90 Fish / Shellfish

I ① Improve accuracy by ↑ # transects / samplers.
② Continue (2 yrs) existing egg loss studies.
③ Improve forecast model (biometric species)
④ Stock separation study - (Flax. Study - tagging to look @ emigration / immigration)
Acknowledged that this too is grey area between NRDA + Restoration + monitoring. It is all of them.

II Direct restn
- increase egg survival by transplanting algae that allow better survival. (But hard to ensure / measure effectiveness)

III Prevent further ecosystem damage
- marine sanctuaries
- prevent ↑ sed'n rates (avoiding coastal logging - esp by transfer / storage facilities)

IV - Monitoring for bird + mammal work can be piggy-backed w/ herring work.

Kelly H. - Sportfish - Handout (same as Oct 3 Rock to Meacham letter)
For DV + CT - only studying 3 sites now. Want to expand program.
From tags, found "significant" incidence of incidental take by comm. fisheries.
Propose to piggy-back on same pings proposed by Sharr: weirs on certain streams post sampling, etc.

→

Kelly H, cont.

Passage problems can be I Dd + proposed to address this year. Preferred over enhancement.

(*) [USA doing study for Jeff Hartman (re: willingness to pay $) – check it out]

other idea – want to push sport fish pressure to unaffected, unexploited stocks to allow recovery of affected stocks (otherwise, ind-value lost too ...)

Access – to new fishing opportunities
– incl public info about alt. opportunities.
– 2 impacts: in Valdez/Cordova, ↑ pressure on local sport fisheries. Access + sanitary/roadside devel improvements
@: Fleming spit, Cordova } Could have been Engell –
Alison Pt, Valdez } Johnson ↓ in part – higher priority now.

Rockfish – no PWS bottomfish mgmt program existed pre-spill. Basic needs: port sampling, (for species comp + #'s, + possibly cohort anal)
– Artificial reef to enhance sport fish opportunities (if not # of fish) + "psychological" healing by getting people involved in building it.
– Transplanting fecund rockfish to areas of impact (such as Bligh Reef) may help. Maybe more Feas. Study possibilities & short-cuts than recruit.

– Break –

Chuck M – port overview of know + possible damages + list of rec'd approaches on board – [see LCS notes]

4:40 pm END

Confidential

Fish/Shellfish Summary

Known Damage:

Salmon -

Pink salmon:

- egg and alevin in spawning gravel (>50% increase in mortality in oiled streams).
- stock work still inconclusive - decreased returns for hatchery (AFK) - survival rate less than 1/2 that for Ester Is. hatchery (usually similar).
- reduced growth of juveniles in oiled areas.
- increased HC body burden in '89; not in '90 samples.
- increased MFO induction in fish from oiled areas.
- significant fin erosion in '90 samples (chum?)

Herring

- morphologic & cytogenetic effects shown from eggs exposed to oil, but raised in lab (effects in '89 and '90; more drastic in '89).
- egg mortality surveys - survival decreased in oiled area ('89 and '90, less drastic in '90).
-

Dolly Varden

- heavy concentration HC in bile (highest of any fish)
- >30% increase in mortality in oiled areas.

Cutthroat Trout

- >30% increase in mortality in oiled areas.
- significant difference in growth.

Rockfish

- first finfish to show mortality due to oil.
- increased HC in bile (showed up in other bottom fish also - flatfish, halibut, pollock).

Nearshore fish

- (field info available in 2 weeks)
- increased levels of blood parasites in fish from oiled areas (153/ml vs 0.3/ml in control, 5/ml in lab exposed fish).
- increased rate of respiration in fish from oiled areas.
- increased MFO levels in oiled areas (DEC study, not NRDA).

Clam use

- highest level of HC in any organism (subsistence use shut down in Windy Bay).

Subsistence/Recreational uses

Probable Damage:

Ground fish

- some sublethal effects (data not yet available).

Clams

Shrimp

- increase in % spot shrimp with dead eggs in oiled areas (in '89; '90 data not in).

1991 Potential Projects:

Public Information (sport fish)

Habitat Rehabilitation

Identify multi-beneficial acquisition/protection

Access (sport fish)

Restoration survey (prioritization)

Continued exposure/sublethal effects monitoring

1990 Recommendations:

Salmon/herring escapement

Salmon/herring tagging

Port sampling

Otolith marking

Herring spawning area catalogue

(1)

MEMORANDUM **STATE OF ALASKA**
Department of Fish and Game

TO: Brian Ross
U.S. EPA
Restoration Planning Team Leader
Oil Spill Restoration
Planning Office
Anchorage

DATE: October 25, 1990

FILE NO:

THRU:

TELEPHONE NO: 465-4160

SUBJECT: Restoration Meeting
Submission from FRED
Division

FROM: Brian J. Allee Ph.D.
Director
Division of FRED

Thank you for inviting staff from the Fisheries Rehabilitation Enhancement and Development Division to the Fish/Shellfish Restoration Work Session. Tom Kron, Regional Program Manager, and Jeff Hartman, Economist, will be attending. To the extent possible, we have responded to your cover letter and provided some restoration concepts as well as feasibility study concepts for you review.

FRED Division has a broad range of Fish stocking and fisheries rehabilitation tools and other fisheries analytical tools that could be applied to restoration. If you need to utilize these tools in the process of restoring fisheries we would be happy to assist you.

Included in this letter is (1) a list of proposed restoration projects and a Brief Project Proposal for selected projects and (2) a list of proposed feasibility studies and brief Project Proposals for selected studies. A few of the feasibility studies also occur in the list of restoration projects, since portions of the work would immediately serve to restore affected fishery resources.

I would like to emphasize that the restoration ideas that we have listed are strictly suggestions to give you some concept of the type of projects that FRED Division would be capable of participating in. Any number of projects identified in this submission could be intertwined with projects proposed by other agencies, and we are willing and interested in becoming cooperators with other agencies.

We are equipped to respond quickly to application of fishery enhancement and rehabilitation technologies should there be a compelling need to do so. The FRED Division's statutes under State of Alaska Title 16 allow us to apply a wide variety of enhancement and rehabilitation activities on virtually on all species of fin fish and shellfish in Alaska waters. No other state agency has this charge. With a number of State owned enhancement facilities in place, the additional costs of projects related to salmonid restoration will be very small compared to starting a new stock rehabilitation program from scratch.

FRED Division also oversees the regulatory process for transport of live fish and eggs, in state waters. Again, no other state agency has this authority, and we would be willing to discuss an expedited process for the restoration activities (that may require re-seeding or stocking of fish and shellfish), within Title 16 constraints. The state's fishery enhancement program includes a

multi-discipline rehabilitation staff consisting of genetics, fish health and pathology, limnology, esturine ecology, engineering and design, fish culture, fish tagging, planning and economics. We have the experience of building the largest ocean ranching program in North America and know how to apply these technologies as quickly or as methodically as you require.

If we may be of further assistance, or if more detail is needed in these projects please contact me at 465-4160, Tom Kron at 267-2158 or Jeff Hartman at 465-4160.

Attachments

cc: Bob Burkett
Jim Cochran
Nick Dudiak
Jeff Hartman
Johnny Holland
Jeff Koenings
Tom Kron
Jerry Madden
Larry Peltz
Keith Pratt
Lonnie White
Jim Hasbrouck

DRAFT
LIST OF FRED DIVISION
PROPOSED RESTORATION PROJECTS

October 25, 1990

The following is a list of proposed projects for restoration of damages from the Exxon Valdez oil spill. It is being submitted to Brian Ross, U.S. EPA Restoration Planning Team Leader, Oil Spill Restoration Planning Office, by Director Brian J. Allee of the Division of Fisheries Rehabilitation, Enhancement and Development (FRED).

This preliminary submission will undergo further revision in the future and is intended to be a working document for formulation of more detailed plans. Project order on this list has not been based on predetermined priorities.

The projects that are listed with an asterisk (*) have more detailed project proposals attached.

1.* Sockeye Rehabilitation through fertilization of lake systems in Prince William Sound and Cook Inlet.

Principal Project Coordinator: Dr. Jeff Koenings (FRED Division, Soldotna)

2.* Increasing juvenile salmonid and trout growth using inorganic nutrient additions to rivers.

Principal Project Coordinators: Dr. Jeff Koenings (FRED Division, Soldotna)

3.* Improving environmental yield of salmon and harvests by Evaluation and Modeling of Wild Pink Salmon Stock Population Size in Prince William Sound, Including Potential Interactions with Enhanced Stocks (Note: Same as Feasibiltiy study #3).

Principal Project Coordinators: Larry Peltz (FRED Division, Cordova), Dr. Jim Hasbrouck, (FRED Division Biometrician, Anchorage), Dr. Doug Eggers (Comm Fish Division, Juneau), Hal Geiger (Comm Fish Division, Juneau).

4. Rebuilding of Pink Salmon Populations in Streams and Esturine Areas Impacted by the Exxon Valdez Oil Spill

Principal Project Coordinators: Larry Peltz (FRED Division, Cordova), Nick Dudiak (FRED Division, Cordova), Lonnie White (FRED Division, Kodiak)

5. Improving sustainable yield of coho and sockeye with Eyak Lake Spawning Channel for coho and sockeye salmon

Principal Project Coordinator: Larry Peltz (FRED Division, Cordova)

6.* Marine Fin Fish and Shellfish Development Center Serving Cook Inlet, PWS, Kodiak and Ak. Peninsula.

not much done in AK.

Principal Project Coordinators: Tom Kron, Keith Pratt, (FRED Division, Anchorage, Dr. Don Kramer, (University of Alaska, Seagrant, Anchorage)

DRAFT
LIST OF FRED DIVISION
PROPOSED RESTORATION FEASIBILITY STUDIES

October 25, 1990

The following is a list of proposed feasibility studies for restoration of damages from the Exxon Valdez oil spill. It was requested by Brian D. Ross with the Oil Spill Impact, Assessment and Restoration Planning Office and it is submitted by Dr. Brian J. Allee, Director of the Division of Fisheries Rehabilitation, Enhancement and Development (FRED).

This preliminary submission will undergo further revision in the future and is intended to be a working document for formulation of more detailed plans. Project order on this list has not been based on predetermined priorities.

Studies are listed in 2 groups. The **NRDA GROUP of Feasibility Studies** consist of projects for fish species that have preliminary study information on damages available or are suspected to show signs of exposure to oil. The **Feasibility studies aimed at Replacement of Services Lost from Damages** refer to projects for which there is no current evidence of damage to the target fish species (known by FRED Division), but the study is aimed at replacing services lost to fishermen from the oil spill.

The studies that are listed with an asterisk (*) have more detailed project proposals attached.

NRDA GROUP of Feasibility Studies

1.* Feasibility of Enriching Near-shore Environments with Either Organic or Inorganic Fertilizer to Optimize Survival of Rearing Salmonids

Principal Investigator: Dr. Jeff Koenings (FRED Division, Soldotna) and University of Alaska-Southeast

2.* Feasibility of Enriching Stream Environments with Organic Fertilizer to Optimize Survival of Rearing Salmonids

Principal Investigator: Dr. Jeff Koenings (FRED Division, Soldotna)

3.* Evaluation and Modeling of Wild Pink Salmon Stock Population Size in Prince William Sound, Including Potential Interactions with Enhanced Stocks

Principal Investigators: Larry Peltz (FRED Division, Cordova), Dr. Jim Hasbrouck (FRED Division Biometrician, Anchorage), Hal Geiger, (Division of Comm Fish, Juneau), Dr. Doug Eggers (Division of Comm Fish, Juneau)

4. Rebuilding of Pink Salmon Populations in Streams and Esturine areas Impacted by the Exxon Valdez Oil Spill

Principal Investigator: Larry Peltz (FRED Division, Cordova), Nick Dudiak (FRED Division, Homer)

5.* Dolly Varden Rehabilitation Feasibility Study Stream rehab w/ stocking

Principal Investigator: Larry Peltz (FRED Division, Cordova), Dave Parks (FRED Division, Clear Hatchery), Staff (Sportfish Division, Anchorage)

6.* Cutthroat Trout Restoration Feasibility Study

Principal Investigator: Larry Peltz (FRED Division, Cordova), Staff (Sportfish Division, Anchorage)

7. Black Cod (Sablefish) Larval Collection Techniques

Principal Investigator: Keith Pratt (FRED Division, Anchorage)

8. Black Cod Culture Techniques

Principal Investigator: Nick Dudiak (FRED Division, Homer)

9.* Rehabilitation/Restoration of Rockfish: Feasibility Study

Principal Investigator: Keith Pratt (FRED Division, Homer)

10. Herring Early Life Stage Rehabilitation

Principal Investigator: Nick Dudiak (FRED Division, Homer)

11. Clam and Mussel Collection, Culture, and Seeding Techniques

Principal Investigator: Jim Cochran (FRED Division, Juneau)

Feasibility Studies aimed at Replacement of Services Lost from Damages

1. Evaluation of the Enhancement Potential for Pink and Chum Salmon Populations on Montague Island

   Principal Investigator: Larry Peltz (FRED Division, Cordova)

2.* King Crab Culture Techniques and Feeding Trials

   Principal Investigators: Lonnie White (FRED Division, Kodiak) and Dr. Tom Shirley (University of Alaska-Southeast)

3.* King Crab Rehabilitation: Gulf of Alaska Site Selection

   Principal Investigators: Lonnie White (FRED Division, Kodiak) and Dr. Tom Shirley (University of Alaska-Southeast)

4. King Crab Evaluation of Rehabilitation Success

   Principal Investigators: Lonnie White (FRED Division, Kodiak) and Dr. Tom Shirley (University of Alaska-Southeast)

5. Tanner and Dungeness Crab Rehabilitation Techniques

   Principal Investigator: Jim Cochran (FRED Division, Juneau), Nick Dudiak (FRED Division, Homer)

6. Halibut Egg-Collection Techniques

   Principal Investigator: Keith Pratt (FRED Division, Anchorage)

7. Halibut Culture Techniques

   Principal Investigator: Keith Pratt (FRED Division, Anchorage)

8. Shellfish and Finfish Artificial Habitat Investigation. This feasibility study will explore the application of artificial reef design, site selection, and evaluation for several species of finfish and shellfish.

   Principal Investigator: Keith Pratt (FRED Division, Anchorage)

9. Replacement of Aquatic Plants ← ancillary benefits for subtidal fish; compensa aspects + direct rest'n.

   Principal Investigator: Jim Cochran (FRED Division, Juneau)

10. Scallop Enhancement Techniques

    Principal Investigator: Jim Cochran (FRED Division, Juneau)

* probs with NRDA link to some lost ~~services~~ spp. listed above

FRED Restoration Project #1

Sockeye Rehabilitation through fertilization of lake systems in Prince William Sound and Cook Inlet.

Principal Project Coordinators: Dr. Jeff Koenings (FRED Division, Soldotna), Nick Dudiak (FRED Division, Homer)

Injury Documentation;link to NRDA

NRDA Studies are underway to determine if fishery closures following the Exxon Valdez Oil Spill resulted in higher than desired escapement of sockeye salmon into spawning areas. High densities of fish in certain sensitive spawning streams may lead to reduced survival of eggs or fry, and a net loss in outmigration. If these studies reveal reduced population sizes of important stocks of sockeye, restoration may be desired. If studies do not confirm that reductions of sockeye salmon have occurred in the area's studied this study may still be a least cost approach for replacing lost services related to environmental damage that have affected salmon fishermen.

Methods

Restoration in this case would be aimed at replacing lost sockeye production by rehabilitating systems that are nutrient limited, and capable of sustaining greater numbers of spawners. The controlled additions of nitrogen and phosphorous to the surface of sockeye (O. nerka) nursery lakes has substantially enhanced the survival of rearing juveniles, in Alaska. Sixteen lakes throughout the State have received nutrient additions to increase the production of sockeye and coho smolts. The increased numbers of smolts have in-turn increased numbers of adults either for spawning or harvest by the common property fishery.

Several potential sites exist in Prince William Sound and in Cook Inlet where these methods could be applied. Since the technical feasibility of this approach is known this project could begin in 1991, and should be carried out for 3 or more years.

Net environmental benefits expected

Models for estimating the change in the size of each stock of salmon must be applied to specific systems and projects. Typical a typical fertilization project on a single lake system may increase harvest from 10,000 to 100,000 salmon.

Cost of implementation

Costs of nutrient modification projects depend on many variables. Some may include additional stocking. Costs of investigations, and applications for each lake vary between $15,000 and $50,000 annually.

FRED Restoration Project #2

Increasing juvenile salmonid and trout growth using inorganic nutrient additions to rivers.

Principal Project Coordinators: Dr. Jeff Koenings (FRED Division, Soldotna)

Injury Documentation;link to NRDA

While FRED Division is not aware of the existence of oil exposure data on rainbow trout, and other stream rearing trout anglers may have avoided traditional recreational fishing sites for this species through the fear of contamination or through expectation of poorer recreational experience.

Similarly, oil exposure data on coho salmon (O. kisutch) is not available, however, coho are highly amenable to rehabiltiation, and may serve as an excellent species of salmon to rehabilitate for the purpose of replacing lost services related to environmental damage that have affected commercial and sport salmon fishermen.

Methods

Restoration in this case would be aimed at replacing lost trout and salmon production or by improving fishing opportunities through improving of other nearby trout fishing opportunities.

Improved in-river production of forage increases the survival of rearing trout, such as (O. mykiss) and salmon (O. kisutch). The purpose of nutrient additions is to stimulate the natural food chain to increase forage production and thereby enhance fish production. As the size of most fish populations in freshwater are controlled by lack of adequate rearing, increased rearing capacity will lead to an increase in the stocks of stream rearing fishes.

Several potential sites exist in Prince William Sound and in Cook Inlet where these methods could be applied. Since the technical feasibility of this approach is known this project could begin in 1991, and should be carried out for 3 or more years.

Net environmental benefits expected

Literature on improvements in rearing success of salmon and trout are available but not sufficient to project the change in the size of each stock of salmon that would occur from a specific stream system or projects.

Cost of implementation

Costs of nutrient modification projects depend on many variables. Some may include additional stocking. Costs of investigations, and applications for each stream system will be determined by the project coordinator.

FRED Restoration Project #6

Marine Fin Fish and Shellfish Development Center for Cook Inlet, Prince William Sound and Kodiak/Alaska Peninsula.

Principal Project Coordinator: Tom Kron, Keith Pratt, Don Kramer

Injury Documentation;link to NRDA

NRDA study results suggest that several species of marine fin fish and shell fish may have been damaged by the Exxon Valdez oil spill. Some of the finfish species mentioned include rockfish, herring, sablefish, (possibly halibut, pollack, sole, pacific cod). Some of the shellfish species mentioned include spot shrimp, clams, and mussels. As studies progress, other shellfish may show signs of damage to populations from oil contamination.

With so many marine fish species showing signs of exposure or sensitivity oil, it is likely that managers may be forced to respond with conservative management techniques where population sizes are expected to be reduced. Slow growth to sexual maturity in the natural environment may exacerbate these management efforts aimed at increasing populations by reducing or ceasing common property harvests.

There is also a considerable risk that some of these species may not respond to conventional management actions for decades (such as with Red King Crab in the Bering Sea). Many of the species mentioned, however, are highly amenable to culture of one or more lifestages, and there is a large potential for rehabilitating stocks damaged by this event or future events. However, a large marine laboratory sufficient in size to aggressively develop cultural techniques for early life stages does not presently exist in the areas of Alaska affected by the oil spill.

Methods

FRED Division proposes the construction of a Marine Fishes Cultural Development Center to serve South Central Alaska, Kodiak, and Prince William Sound. This facility would house university, state and federal studies for rehabilitation of marine fin fish and shellfish in Alaska waters.

Suggested Site: Seldovia

Net environmental benefits expected

Creation of the methods for culturing and rehabilitating important marine species would significantly reduce the risk of lost fishing income and fishing opportunities associated with losses or dramatic population crashes of stocks of marine fish, and shellfish through catastrophic environmental events, or long term damage from the Exxon Valdez Oil Spill. Application of rehabilitation techniques to specific stocks of fin fish and shellfish, will provide population size and growth information that would be difficult for managers to obtain in conventional surveys.

Cost of implementation

Rough costs for the repair and modification of an existing lab site in Seldovia for conducting small scale work is approximately $500,000. A large scale lab, and cultural center could cost several million dollars.

Brief Proposal #1 for Restoration Feasibility Studies

Feasibility of Enriching Near-shore Environments with Either Organic or Inorganic Fertilizer to Optimize Survival of Rearing Salmonids

Principal Investigator: Dr. Jeff Koenings (FRED Division, Soldotna) and University of Alaska-Southeast.

Injury Documentation:link to NRDA

Pink salmon populations in oil impacted areas of coastal Alaska demonstrate signs of physical exposure to oil, and populations of some small stocks may have been damaged. As such, these natural stocks may respond to rehabilitation. Local esturine rearing conditions may prove to be a limiting factor to pink salmon stock rebuilding efforts through management or intensive rehabilitation, in that food abundance can be ecologically constrained. These constraints in food production may handicap efforts of managers to increase stocks of pink salmon or other near - shore rearing salmonids through allowing for larger escapement.

Estuaries typically receive energy inputs from terrestrial detritus and from phytoplankton which supports production of zooplankton. A lack of terrestrial decomposition in Alaska may limit the amount of detritus exported from watersheds into the near-shore environment. Enrichment of estuaries with a combination of inorganic and organic fertilizers may stimulate the seasonal production of zooplankton (as has been shown for freshwater zooplankton), the principal forage item for juvenile pink and chum salmon.

This study could also be a low cost approach for replacing services lost to fishermen related to environmental damage that have affected other areas of the salmon fishery.

Methods

Restoration in this case would be aimed at replacing lost pink salmon production or production of specific stocks known to rear in the near-shore areas receiving treatment.

This study would compare the effects of both controlled additions of nitrogen and phosphorous inorganic fertilizers, with organic fertilizers to designated nearshore areas.
Tagging studies would be initiated to evaluate the comparative success of the two options.

Several potential areas in Prince William Sound and in Cook Inlet would be investigated to conduct the trials.

Likelihood of project ultimately being proposed as a full scale restoration measure

Probability of successful study.

Ecological importance of target resource.

Ability to evaluate success and document ecological value of project

Cost of feasibility study.

Costs, are yet to be computed.

Brief Proposal #2 for Restoration Feasibility Studies

Feasibility of Enriching Stream Environments with Organic Fertilizer to Optimize Survival of Rearing Salmonids

Principal Investigator: Dr. Jeff Koenings (FRED Division, Soldotna) and University of Alaska-Southeast).

Injury Documentation;link to NRDA

While FRED Division is not aware of the existence of oil exposure data on rainbow trout, and other stream rearing trout anglers may have avoided traditional recreational fishing sites for this species through the fear of contamination or through expectation of poorer recreational experience.

Similarly, oil exposure data on coho salmon (O. kisutch) is not available, however, coho are highly amenable to rehabilitation, and may serve as an excellent species of salmon to rehabilitate for the purpose of replacing lost services related to environmental damage that have affected commercial and sport salmon fishermen.

Fish forage production in nutrient-poor coastal streams is heavily dependent on the amount of detritus entering the system especially under a heavy streamside canopy.

Methods

Restoration in this case would be aimed at replacing lost trout and salmon production or by improving fishing opportunities through improving of other nearby trout fishing opportunities.

The addition of organic fertilizers seeks to stimulate the detrital food chain in order to produce more food items for stream rearing trout (e.g., O. mykiss) and salmon (O. kisutch). An increase in the growth and survival of stream rearing fish will lead to an increase in the survival to adult fish, and increase common property harvests.

Several potential sites exist in Prince William Sound and in Cook Inlet where these methods could be applied.

Likelihood of project ultimately being proposed as a full scale restoration measure

Probability of successful study.

Ecological importance of target resource.

Ability to evaluate success and document ecological value of project

Cost of feasibility study.

Costs, are yet to be computed.

Brief Proposals #3 for Restoration Feasibility Studies

Evaluation and Modeling of Wild Pink salmon Stock Population Size and fishery interactions with enhanced fish in Prince William Sound.

Principal Investigators: Larry Peltz, FRED Division; Dr. Jim Hasbrouck, FRED Division; Karen Crandall, FRED Division; Hal Geiger, Division of Comm Fisheries.

Injury Documentation;link to NRDA

Pink salmon populations in oil impacted areas of coastal Alaska demonstrate signs of physical exposure to oil, and populations of some small stocks may have been damaged. As such, these natural stocks may respond to rehabilitation. Managers propose to restore these stocks population numbers by allowing for increased escapement to respective streams of origin. In the process of reducing exploitation to small stocks of salmon that have been stressed, exploitation may be reduced on larger and unimpacted populations. This could create biological and economic feedbacks. Biological feedbacks could occur, in that stronger stocks may overescape, causing decreased production. Economic feedbacks could occur, in that the harvest of some hatchery stocks may be reduced or restricted to terminal areas with reduced quality and decreased value.

The ability to separate all discrete stock components is important for management of the Pink Salmon fishery and for evaluating the consequences of specific restoration alternatives in Prince William Sound, as well as Lower Cook Inlet and Kodiak.

Methods

Existing studies in the NRDA process intend to gain a better understanding pink salmon fishery interactions. Some of the new studies proposed below could be combined with the tasks that would be continuing under the existing pink salmon damage assessment studies.

The spacial and temporal distribution of enhanced, and wild stocks in oil impacted areas will be determined through coded wire tagging. In addition, otolith marking and scale pattern analysis will be tested as potential alternatives to coded-wire tagging.

1. Coded-wire tagging is assumed to continue at the same locations and levels of tag application as in NRDA study #3. Additional wild stock sites may be added if deemed necessary.

2. Otolith marking will be attempted at one or more hatcheries. Catch contributions will be compared to results obtained from coded-wire tagging. The presence of naturally occurring otolith marks will be investigated at wild stock sites.

3. The use of scale pattern analysis to differentiate wild and hatchery stocks of fish will be investigated. Investigations will concentrate on the same hatcheries and wild stock systems as the coded wire tagging and otolith marking.

4. Modeling of the probable harvest outcomes of various management actions aimed at increasing population size of stocks that are considered to be biologically weak and impacted by the oil spill. The analysts will develop a time series of projected harvests of stocks originating from major production systems of natural and enhanced fish in the Sound. These efforts could be part of, or in addition to the run reconstruction modeling associated with

existing NRDA studies.

Likelihood of project ultimately being proposed as a full scale restoration measure

Application of management actions and rehabilitation actions aimed at restoring damaged pink salmon populations are likely to occur since this is an extremely important fishery in Prince William Sound. Improved tools for evaluating the success of those programs are likely to be useful.

Probability of successful study.

Application of CWT's and associated recovery programs to enhanced and selected wild stocks will, on its own, provide new knowledge of stock composition of harvests. Thus, probability of success is close to 100 %. New quantitative marking tools are promising, and may provide reliable and affordable stock separation techniques. A breakthrough in this area is deemed likely, because of the success with this identification technique in the enhancement of sockeye salmon.

Ecological importance of target resource.

Pink salmon are high in the food chain, and an important resource in the Sound. Hundreds of individual pink salmon stocks exist in Prince William Sound, Lower Cook Inlet and Kodiak. Some stocks, impacted by the spill may be small in population number and dramatically altered or lost without rehabilitation.

Ability to evaluate success and document ecological value of project

Excellent

Cost of feasibility study.

Additional Spinoffs:

This study may aid in the evaluation of alternative forms of restoration of weak stocks through rehabilitation and/or enhancement.

Brief Proposals #9 for Restoration Feasibility Studies

Rehabilitation/Restoration of Rockfish Feasibility Study

Injury Documentation;link to NRDA

Tissue analysis of resident populations of rockfish in reef zones affected by the oil spill demonstrate exposure to hydrocarbons. Populations of rockfish may have been reduced. Recruitment may be dramatically reduced in populations of sexually mature fish and several age classes could experience low fecundity, and low numbers of larval forms. It may take several years before recruitment of rockfish are improved.

Methods

Culture techniques for rockfish are not developed in North America, however, appropriate food organisms, and culture practices that have been applied to marine fishes with very small larval lifestages are expected to be applicable to rockfish. This study would begin with a literature search for rock fish culture experiences from Japan. Techniques for collecting fertilized females from live bearing species would be tested at selected sites impacted by the oil spill.

Trial incubation of fertilized eggs would be tested at a selected State Hatchery in PWS or Kodiak.

Likelihood of project ultimately being proposed as a full scale restoration measure

Probability of successful study.

Ecological importance of target resource.

Ability to evaluate success and document ecological value of project

Cost of feasibility study.

Investigators:

Keith Pratt, FRED Division; .

Brief Proposals #2 for Restoration Feasibility Studies

Red King Crab Rehabilitation Feasibility

I. DESCRIPTION

1. Title: **Red King Crab Rehabilitation Feasibility Study**
2. Goal: Test feasibility of culturing red king crab embryos to their first benthic stage, evaluate settlement of the young crabs in two "seeded" and one control bay, report and make recommendations based on findings.
3. Location: Kodiak
4. Team: Lonnie White, FB III, Leader. Cooperative effort with Commercial Fisheries Division staff.
5. Schedule: Start March 1991; Three-year study.
6. Background: Red king crab populations were at a very low level prior to the Exxon Valdez oil spill. If impacted, some stocks would be at increased risk, and recovery could extend for many years: 50? Culture of crabs could be a tool to accelerate recovery of stocks. Culture of red king crab has been accomplished by the Japanese.

II. JUSTIFICATION

1. Need: Red king crab are a high-value product. Restoring populations to higher numbers would restore earnings to the fishing fleet.
2. Benefits: This feasibility study would provide information needed to evaluate this culture approach with red king crab in Alaska.
3. Criteria

   A. Relationship to NRDA studies and injured natural resources.
   B. Identified public concern: Item E. Mariculture in the fish and shellfish matrix would encompass this approach.
   C. Ability to implement the study in the near future: Study plan has been developed and is ready to implement as soon as funds are available.
   D. Reasonable likelihood of success: Team leader Lonnie White has a proven track record in mariculture and fisheries project accomplishment. Staff are available. Japanese success improves probability of success. It is highly likely that a feasibility study will be completed and needed information produced and reported.
   E. Cost relative to funds available: Yearly cost of $111,330 for each of three years.

III. OBJECTIVES

1. Method: This project will test the feasibility of culturing red king crab from embryos to the first benthic stage. Research will involve culturing of young crabs and evaluation of the success of their settlement in two bays.

A. Culture and Research
B. Evaluation of Settlement
C. Recommendations and Design for Expansion

The project involves cooperative work with the Commercial Fisheries Division.

2. Evaluation: Final evaluation will be based on successful settlement of crabs in the two seeded bays, as compared to the control bay. Enumeration of crabs stocked and crabs settled are an important part of the study. Of the budget, 35% or $39,000 is for the evaluation task.

IV. APPROACH

1. Method: This is a three-year project. The first year will focus on establishing the crab culture facilities and trial runs with proposed methods. The second year is when major production numbers will be collected. The third year will be a replicate of year two.
2. Evaluation: Enumeration of crab stocked and crab settled are key data.

V. BUDGET ESTIMATE

1. By Task: Culture: $72,330; Evaluation: $39,000. Total: $111,330/year.
2. Future Costs: Year Two: $111,330. Year Three: $111,330.

VI. ABSTRACT

To restore red king crab through culture. Test feasibility of culturing red king crab embryos to the first benthic stage, evaluate the settlement of young crabs in two seeded bays and one control bay, and report with recommendations.

Brief Proposals #5 for Restoration Feasibility Studies

Dolly Varden Restoration Feasibility Study

Injury Documentation;link to NRDA

Populations of Dolly Varden in streams and shorelines have demonstrated signs of exposure to oil. Certain populations in impacted areas may have been reduced by this exposure. Some of the affected Dolly Varden stocks are popular as recreational, subsistence or personal use fishery

Methods

Rehabilitation techniques for Dolly Varden are known and in practice in interior areas of Alaska. Techniques for culture are likely to be transferrable to Prince William Sound. The site selection work for PWS stocks that are culturally optimum for restoration has not been undertaken.

Site selection for potential stocks for restoration would occur with test lots being incubated and reared at Clear Hatchery or another state facility.

Likelihood of project ultimately being proposed as a full scale restoration measure

Probability of successful study.

Excellent, because of proven success with Dolly Varden enhancement in Alaska interior.

Ecological importance of target resource.

Ability to evaluate success and document ecological value of project

Cost of feasibility study.

Costs, between $20,000 and $50,000 annually depending on number of stocks to be rehabilitated.

Investigators:

Larry Peltz, FRED Division; David Parks, FRED Division Clear Hatchery, other investigator, Division of Sportfish.

Brief Proposals #6 for Restoration Feasibility Studies

Cutthroat Trout Restoration Feasibility Study

Injury Documentation;link to NRDA

Populations of Cutthroat Trout in streams and shorelines have demonstrated signs of exposure to oil. Certain populations in impacted areas may have been reduced by this exposure. Some of the affected Cutthroat stocks are popular as recreational, subsistence or personal use fisheries.

Methods

Rehabilitation techniques for Cutthroat are known and have been applied in several western states. While not in practice in Alaska, culture techniques and stock selection methods that have been applied to rainbow trout and dolly varden could be duplicated. Techniques for culture are likely to be transferrable to Prince William Sound. The site selection work for PWS stocks that are culturally optimum for restoration has not been undertaken.

Site selection for potential stocks for restoration would occur with test lots being incubated and reared at Clear Hatchery or another state facility.
Likelihood of project ultimately being proposed as a full scale restoration measure

Probability of successful study.

Excellent because of proven success with cutthroat enhancement in the Western U.S.

Ecological importance of target resource.

Ability to evaluate success and document ecological value of project

Cost of feasibility study.

Costs between $20,000 and $50,000 annually depending on number of stocks to be rehabilitated.

Investigators:

Larry Peltz (FRED Division, Cordova), David Parks (FRED Division Clear Hatchery), Staff (Sportfish Division, Anchorage).

MEMORANDUM STATE OF ALASKA

TO: Stan Senner Date: September 25, 1990

FROM: Dana Schmidt and Bruce Barrett
Commercial Fisheries Division
Kodiak

SUBJECT: Restoration Program

We offer the following comments in response to your restoration matrix and request for 1991 restoration feasibility/research studies.

We can anticipate a reduced salmon harvest in the Kodiak Management Area (KMA) if the overescapement that occurred from the EXXON Valdez spill in 1989 causes negative impacts. The KMA salmon stocks are managed on escapement goals with harvest opportunity permitted only when there are fish surplus to escapement requirements. Thus we inherently have a restoration mechanism built into our salmon fisheries management plan with the restoration accomplished at the expense of lost harvest opportunity to ensure escapement.

Meeting escapement goals by decreasing fishing time would restore fish available for non-marine wildlife to the same levels as non-impacted systems. Marine species which feed on salmon would be affected but should be recovered in a single generation by meeting escapement goals of returning fish. The above mechanism would not be true only if impacts were of such a magnitude that escapement goals were not met. In that case, multiple years may be necessary to restore runs to pre-spill levels. Standard enhancement practices such as those used by the FRED Division could accelerate the restoration process and mitigate potential future damages to commercial, subsistence, and sport fisheries and wildlife dependent upon salmon.

Within the Kodiak Management Area there are several important salmon producing systems which could be better managed for commercial, subsistence, and sport interests with more precise monitoring of escapements. These include the Karluk, Ayakulik, and Buskin Rivers. Currently the annual salmon escapements into these systems are counted though rigid aluminum weirs which are operated by seasonal employees. These weirs regularly do not withstand flood events and carcass buildups associated with massive pink salmon escapements. Since the salmon runs to these systems are regulated on escapement counts, management precision is compromised each time a weir washout occurs which can often be several times a year. The installation and operation of floating weirs on these systems would likely permit ADF&G to obtain complete escapement counts through flood events and pink salmon carcass buildup periods. In turn this would permit more precise fisheries management for ensuring that escapement requirements are met

and resource users are afforded an ample opportunity to harvest surplus fish. If restoration research funds were made available this year, a floating weir design could be tested on the Karluk, Ayakulik, and Buskin Rivers as early as 1991.

cc: L. Nicholson
C. Meachum

MEMORANDUM

STATE OF ALASKA
Department of Fish and Game

TO: Stan Senner
Restoration Program Manager
Division of OSIAR
Anchorage

DATE: September 28, 1990

FILE NO:

THRU:

TELEPHONE NO: 465-4160

SUBJECT: Restoration Feasibility Studies

FROM: Brian J. Allee
Director
Division of FRED

Thank you for the opportunity to submit restoration feasibility studies to the Oil Spill Restoration Planning Office. Fisheries enhancement techniques represent an economically viable approach to restoring damaged resources from this event. They also are an efficient tool for restoring services lost from resources that may be difficult to restore to their former population levels. There are also significant spinoffs in improving our knowledge for fishery management and population dynamics information that can be gained from enhancement.

To the extent possible, I am making FRED Division technical staff available to you for the purpose of providing assistance on application of fishery enhancement, rehabilitation, and development techniques to restoration. The contact names for the proposed feasibility projects are attached. Due to the short response time, we have elaborated on only one of the projects in the attached Brief Restoration Feasibility Proposal. Some of the feasibility studies on the list will be developed further by the end of the first week of October.

Formal economic information exists for many of the species so that it may be possible to provide further insights into the costs and benefits of specific enhancement alternatives as they are compared with other restoration options.

Please feel free to contact me if you need further details or have any questions.

Attachments

cc: Brian Allee
Bob Burkett
Jim Cochran
Nick Dudiak
Jeff Hartman
Johnny Holland
Jeff Koenings
Tom Kron
Jerry Madden
Larry Peltz
Keith Pratt
Lonnie White

DRAFT

AGGREGATE LIST OF FRED DIVISION PROPOSED RESTORATION FEASIBILITY STUDIES

September 27, 1990

The following is a list of proposed feasibility studies for restoration of damages from the Exxon Valdez oil spill. It is being submitted to Stan Senner, ADF&G representative with the Oil Spill Impact, Assessment and Restoration Planning Office by Director Brian J. Allee of the Division of Fisheries Rehabilitation, Enhancement and Development (FRED).

This preliminary submission will undergo further revision in the future and is intended to be a working document for formulation of more detailed plans. Additional brief project proposals are being prepared by FRED Division staff and will be available through the identified project leader. Project order on this list has not been based on predetermined priorities.

1. Feasibility of Enriching Nearshore Environments with Either Organic or Inorganic Fertilizer to Optimize Survival of Rearing Salmonids

   Principal Investigator: Jeff Koenings (FRED Division, Soldotna) and University of Alaska-Southeast

2. Feasibility of Enriching Stream Environments with Either Organic or Inorganic Fertilizer to Optimize Survival of Rearing Salmonids

   Principal Investigator: Jeff Koenings (FRED Division, Soldotna)

3. Evaluation and Modeling of Wild Pink Salmon Stock Population Size in Prince William Sound, Including Potential Interactions with Enhanced Stocks

   Principal Investigators: Larry Peltz (FRED Division, Cordova) and FRED Division Biometrician

4. King Crab Culture Techniques and Feeding Trials

   Principal Investigators: Lonnie White (FRED Division, Kodiak) and Tom Shirley (University of Alaska-Southeast)

5. King Crab Rehabilitation: Gulf of Alaska Site Selection

   Principal Investigators: Lonnie White (FRED Division, Kodiak) and Tom Shirley (University of Alaska-Southeast)

6. King Crab Evaluation of Rehabilitation Success

   Principal Investigators: Lonnie White (FRED Division, Kodiak) and Tom Shirley (University of Alaska-Southeast)

7. Tanner and Dungeness Crab Rehabilitation Techniques

   Principal Investigator: Jim Cochran (FRED Division, Juneau)

8. Halibut Egg-Collection Techniques

   Principal Investigator: Keith Pratt (FRED Division, Anchorage)

9. Halibut Culture Techniques

   Principal Investigator: Keith Pratt (FRED Division, Anchorage)

10. Shellfish and Finfish Artificial Habitat Investigation. This feasibility study will explore the application of artificial reef design, site selection, and evaluation for several species of finfish and shellfish.

    Principal Investigator: Keith Pratt (FRED Division, Anchorage)

11. Replacement of Aquatic Plants

    Principal Investigator: Jim Cochran (FRED Division, Juneau)

12. Scallop Enhancement Techniques

    Principal Investigator: Jim Cochran (FRED Division, Juneau)

13. Black Cod Larval Collection Techniques

    Principal Investigator: Keith Pratt (FRED Division, Anchorage)

14. Black Cod Culture Techniques

    Principal Investigator: Nick Dudiak (FRED Division, Homer)

15. Herring Early Life Stage Rehabilitation

    Principal Investigator: Nick Dudiak (FRED Division, Homer)

16. Clam and Mussel Collection, Culture, and Seeding Techniques

    Principal Investigator: Jim Cochran (FRED Division, Juneau)

17. Dolly Varden Rehabilitation Techniques

    Principal Investigator: Larry Peltz (FRED Division, Cordova)

18. Cutthroat Trout Rehabilitation Techniques

    Principal Investigator: Larry Peltz (FRED Division, Cordova)

19. Evaluation of the Enhancement Potential for Pink and Chum Salmon Populations on Montague Island

    Principal Investigator: Larry Peltz (FRED Division, Cordova)

20. Rebuilding of Pink Salmon Populations in Streams Impacted by the Exxon Valdez Oil Spill

    Principal Investigator: Larry Peltz (FRED Division, Cordova)

Brief Restoration Feasibility Proposal

I. DESCRIPTION

1. Title: **Red King Crab Rehabilitation Feasibility Study**
2. Goal: Test feasibility of culturing red king crab embryos to their first benthic stage, evaluate settlement of the young crabs in two "seeded" and one control bay, report and make recommendations based on findings.
3. Location: Kodiak
4. Team: Lonnie White, FB III, Leader. Cooperative effort with Commercial Fisheries Division staff.
5. Schedule: Start March 1991; Three-year study.
6. Background: Red king crab populations were at a very low level prior to the Exxon Valdez oil spill. If impacted, some stocks would be at increased risk, and recovery could extend for many years: 50? Culture of crabs could be a tool to accelerate recovery of stocks. Culture of red king crab has been accomplished by the Japanese.

II. JUSTIFICATION

1. Need: Red king crab are a high-value product. Restoring populations to higher numbers would allow fisheries to occur.
2. Benefits: This feasibility study would provide information needed to evaluate this culture approach with red king crab in Alaska.
3. Criteria

   A. Relationship to NRDA studies and injured natural resources.
   B. Identified public concern: Item E. Mariculture in the fish and shellfish matrix would encompass this approach.
   C. Ability to implement the study in the near future: Study plan has been developed and is ready to implement as soon as funds are available.
   D. Reasonable likelihood of success: Team leader Lonnie White has a proven track record in mariculture and fisheries project accomplishment. Staff are available. Japanese success improves probability of success. It is highly likely that a feasibility study will be completed and needed information produced and reported.
   E. Cost relative to funds available: Yearly cost of $111,330 for each of three years.

III. OBJECTIVES

1. Method: This project will test the feasibility of culturing red king crab from embryos to the first benthic stage. Research will involve culturing of young crabs and evaluation of the success of their settlement in two bays.

A. Culture and Research
B. Evaluation of Settlement
C. Recommendations and Design for Expansion

The project involves cooperative work with the Commercial Fisheries Division.

2. Evaluation: Final evaluation will be based on successful settlement of crabs in the two seeded bays, as compared to the control bay. Enumeration of crabs stocked and crabs settled are an important part of the study. Of the budget, 35% or $39,000 is for the evaluation task.

IV. APPROACH

1. Method: This is a three-year project. The first year will focus on establishing the crab culture facilities and trial runs with proposed methods. The second year is when major production numbers will be collected. The third year will be a replicate of year two.
2. Evaluation: Enumeration of crab stocked and crab settled are key data.

V. BUDGET ESTIMATE

1. By Task: Culture: $72,330; Evaluation: $39,000. Total: $111,330/year.
2. Future Costs: Year Two: $111,330. Year Three: $111,330.

VI. ABSTRACT

To restore red king crab through culture. Test feasibility of culturing red king crab embryos to the first benthic stage, evaluate the settlement of young crabs in two seeded bays and one control bay, and report with recommendations.

S. Shaw

(2)

Salmon Restoration Studies

I. Escapement Enumeration

A. Aerial Survey Program

~all streams now

1. More surveys of current index sites
2. Added index sites in oiled areas

B. Ground Survey Program

1. Continuation + expansion of at current sites
2. Added index sites in oiled areas

C. Weirs of oiled systems

D. Stream life studies (est. residence time)

II Stock Identification

A. Coded wire Tagging studies

goal - to assess contrib of stocks to commercial time + area dist'n to alter mgmt

1. Tagging

hundreds of 1,000's of $

a. Hatcheries - all species

b. Wild stocks - pinks + sockeye

~500,000

2. Recovery (additional $ needed)

a. Port Sampling

b. Brood Stock Sampling

c. Wild Stock escapement Sampling (Weirs)

B. Otolith marking studies

feasibility

~500,000

1. Tagging - (Hatcheries)

emphas of stock contrib @ greater precision

2. Recovery (additional $ needed)

a. Port Sampling

b. Hatchery Brood stock

c. Selected wild stocks

C. Adult Tagging

at key areas along migratory corridors

III Run Reconstruction — synthesis

A. Historic data summarization

B. Computer modeling & analysis

- escap. runtime (time & area sensitive)
- adult tagging
- existing coded wire tag
- max likelihood
- predict exploitation of stocks in commercial harvest

criteria ⇒ known damage -
growth rate
abnormalities in Ly

→ tech feas ⇒ all are already on line
(aerial survey - goes back 30 yrs.)
ground survey ⇒ ~20 yrs
coded wire tag rec. ⇒ largest on W coast

run reconst. modeling ⇒ peer reviewers (expert witness)

→ all enhance
⇒ should be implemented rapidly

⇒ net env. benefit (to nearshore, upland portion of ecosys)

⇒ dural. of project ⇒ thru several cycles of prod. cycle!
at least 1-2 generations [chinook etc]

→ geog. scope ⇒ PWS

→ cost
ground survey - <200,000
aerial survey - 30-50,000

(3) A

NOAA'S NATURAL RECOVERY MONITORING PROGRAM FOLLOWING THE EXXON VALDEZ OIL SPILL

RECOVERY OF EPIBENTHIC PREY POPULATIONS OF JUVENILE SALMON IN OILED BAYS IN PRINCE WILLIAM SOUND

P.I.: Alex Wertheimer, NMFS, Auke Bay Laboratory

This project would monitor populations of epibenthic crustaceans on heavily oiled and lightly oiled beaches within oiled embayments in Prince William Sound. Epibenthic crustaceans, especially harpacticoid copepods, produced in the intertidal and upper sub-tidal regions of beaches are an important prey item for juvenile pink and chum salmon, as well as other species of fish. Because these organisms live in or near sediments, the contamination of beach sediments by the Exxon Valdez oil spill may directly impact the epibenthic community. Perturbation of harpacticoid copepod populations have been documented in other oil spills; the direction of the perturbation can be either negative or positive. Damage to prey populations of salmon and other fishes has been a concern identified by both the peer reviewers and public commentaries to the NRDA process. NRDA research has been directed at determining if there were acute effects relative to the degree of sediment contamination to harpacticoid copepod taxa that are important prey resources for juvenile salmon. In Oil Year 1, comparisons of the abundance of these animals showed no significant difference between oiled and control sites, with a trend of higher abundance at oiled sites. In Oil Year 2, research was directed at lightly and heavily contaminated beaches within oiled embayments. If analysis of the 1990 data indicate that there are differences in the abundance of these fish prey relative to the degree of oil contamination, then it is important to determine if such perturbation continues following extensive clean-up activity in oiled areas, such as mechanical removal and bioremediation.

This project falls under Restoration Approach V identified in the Matrix of Potential Restoration Approaches: "Conduct long-term research/ monitoring programs on populations and ecology". It is directly related to the outcome of NRDA research, and would be implemented only if a perturbation to the harpacticoid copepod prey suite has been indicated. The feasibility for this type of monitoring is well-established; the project can be readily implemented for the 1991 field season. Proposed timeframe is for one year, with re-evaluation of the need for continuance prior to oil year 4. The benefit of the project will be to track restoration of an important trophic component of near-shore ecosystems, which will provide managers information for determining the efficacy of on-going restoration efforts.

need '90 data

Estimated Costs: Sample collection: 70 K
Sample Processing: 90 K
Management/analysis/reporting: 30 K
TOTAL: 190 K

1st ⇒ detect an effect

Article ⇒ may expect an ↑ in some spp due to oil

(3) B

NOAA'S NATURAL RECOVERY MONITORING PROGRAM FOLLOWING THE EXXON VALDEZ OIL SPILL

EXPOSURE OF JUVENILE SALMON TO HYDROCARBON CONTAMINATION IN PRINCE WILLIAM SOUND

P.I.: Alex Wertheimer, NMFS, Auke Bay Laboratory

This project would monitor the exposure of juvenile pink and chum salmon to hydrocarbons in oiled and non-oiled areas of Prince William Sound. The potential impact of the oil spill on juvenile salmon was one of the greatest concerns expressed by both the scientific community and the public commentaries to the NRDA process. NRDA research has identified MFO-induction and hydrocarbon body-burdens in juvenile pink salmon in Prince William Sound in oil year 1. Preliminary analysis indicates that the source of contamination is ingestion rather than or in addition to exposure to water soluble fraction. Contamination of juvenile pink salmon decreased in oil year 2 to the point that hydrocarbon body-burdens were no longer detectable. Analysis of enzyme induction indicating exposure to oil has not yet been completed for 1990 samples of juvenile pink salmon or 1989 and 1990 samples of juvenile chum salmon. The MFO analyses are a more sensitive measure of contamination than actual hydrocarbon body-burden. If these analyses indicate that exposure to hydrocarbons continues in areas polluted by the oil spill, then it is important to determine if such exposure continues following extensive clean-up activity in oiled areas, such as mechanical removal and bioremediation.

This project falls under Restoration Approach V identified in the Matrix of Potential Restoration Approaches: "Conduct long-term research/ monitoring programs on populations and ecology". It is directly related to the outcome of NRDA research, and would be implemented only if contamination of juvenile salmon in 1990 is identified by tests for MFO induction. The feasibility for determining exposure is well-established; the project can be readily implemented for the 1991 field season. Proposed timeframe is for one year, with re-evaluation of the need for continuance prior to oil year 4. The benefits of the project will be to provide managers information for determining the efficacy of on-going restoration efforts to the point at which direct contamination of the most valuable fishery resource in Prince William Sound is no longer detectable.

Estimated Costs: Sample collection: 60 K
MFO Analysis: 25 K
Management/analysis/reporting: 15 K
TOTAL: 100 K

(3) c

NOAA'S NATURAL RECOVERY MONITORING PROGRAM for SELECT MARINE FISHES

Information collected by NOAA NRDA programs has documented the exposure of several marine fish species to hydrocarbon contamination. Analysis of bile samples from Dolly Varden char, pollock, several species of flatfish and possibly other species has shown elevated levels of hydrocarbon metabolites, even a year after the spill.

NOAA proposes to continue monitoring the presence of fluorescent aromatic compounds (FACs) in the bile of affected fish species until an estimate of the timeframe of the recovery to baseline conditions can be determined.

Liver samples from select species will be collected and analyzed for aryl hydrocarbon hydroxylase (AHH) activity and immunochemically quantitated IA1 type cytochrome P-450, both of which are known to be increased after exposure to a variety of chemical contaminates.

Samples also will be taken and analyzed to measure histopathological changes, reproductive disorders and levels of DNA adducts.

The geographic extent of this sampling and the species that will be targeted will be determined from information currently being analyzed under NOAA NRDA studies.

(4)

MEMORANDUM STATE OF ALASKA

TO: Charles P. Meacham
Fishery Program Manager
OSIAR
Anchorage

DATE: October 3, 1990

FROM: Kent Roth Kent
Fishery Biologist
Sport Fish Division
Anchorage

SUBJECT: Restoration Ideas

Sport Fish/Osiar staff have prepared the following preliminary list of restoration feasibility/research studies for consideration:

1) Access - Public Lands
   a) Determination and mapping of land ownership in PWS
      1) site specific recommendations for land acquisitions for access or fisheries protection/development would be made after review of the land ownership status
   b) Development of access for sport anglers
      1) Expansion of Cordova road system boat launches, trails, parking and camping areas
      2) Road to Whittier and expansion of Whittier area roads, boat launches, trails, parking and camping areas
      3) Expansion of Valdez road system boat launches, trails, parking and camping areas
   c) Development of recreational and educational brochures and manuals for PWS

2) Rockfish in PWS
   a) Species distribution and relative abundance
      1) Expand data base to prepare for future spills and to compensate for uncertainty of Exxon Valdez spill
   b) Historical and present sport and commercial exploitation (harvest by species)
   c) Monitor future exploitation
      1) Commercial catch monitoring
      2) Sport catch monitoring
         a) Port sampling - cohort analysis
         b) Sport charter logbook program
   d) Production, maintenance, and evaluation of artificial reefs

3) Cutthroat trout/Dolly Varden char data base
   a) Update ADF&G anadromous stream catalog to include sites with populations of anadromous trout and/or char
   b) Stock status and evaluation of cutthroat trout in streams and lakes along the Cordova road system

c) Evaluation of the commercial exploitation of anadromous trout and char
d) Determination of natural mortality rates of trout and char

4) Area fisheries maintenance, development, and/or enhancement
a) construction of fish passes to PWS lakes and upper stream reaches
b) maintenance of existing fish pass structures

cc: Krasnowski
Whitmore
Hepler
Mills
Hoffmann
Hansen
McBride
Delaney
Rutz

K (5)

Stan Senner from C Meacham

To: Stan Senner
Restoration Program Manager
OSIAR Division

From: Wayne Donaldson Wayne
Shellfish Biologist
Commercial Fisheries
Cordova

September 25, 1990

Project ideas for restoration studies.

1) Two species of intertidal clams were affected by spilled oil and cleanup activities. The littleneck clam (Protothaca staminea) and butter clam (Saxidomus giganteus) are native to the spill area and are utilized by subsistence, personal use and sport fishermen. Various marine mammals, such as sea otters also utilize clams. Recovery of the intertidal clam resource can be enhanced by stocking intertidal areas with seed from indigenous clams. This study would obtain adult clams from the spill area and send them to a hatchery for spawning. The resultant seed would be stocked into the spill area to enhance the natural recovery process.

2) There is insufficient knowledge about the habitat requirements of juvenile spot shrimp (Pandalus platyceros) in Prince William Sound. The literature suggests that juvenile spot shrimp rear in shallow water. Most of the impact associated with the spill has occurred in shallow water areas. Identification of the habitat(s) of juvenile spot shrimp will help enhance the shrimp stock. Both state and federal resource agencies will be able to assess impacts of current cleanup activities. Habitat characteristics will greatly aid the evaluation of future clean up operations and future development in shallow water areas of the Sound.

3) Continuation of resource abundance surveys for spot shrimp will improve the management of this species for commercial, subsistence, personal use and sport fishing uses. A very limited data base of annual abundance should be continued to provide resource managers information on juvenile, male and female stock segments upon which to base future harvest rates.

cc: Meacham
Hilsinger
Ackley
Trowbridge

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Science Center
National Marine Mammal Laboratory
7600 Sand Point Way N.E., Bin C15700
Seattle, Washington 98115-0070

(206) 526-4045 FTS: 392-4045

October 2, 1990 F/AKC3:trl

MEMORANDUM FOR: RPWG -- John Strand

FROM: F/AKC3- Tom Loughlin

SUBJECT: Restoration Feasibility Studies

Please find attached the matrices that you sent containing possible restoration projects. My interests are with those pertaining to marine mammals and I have checked the matrices in those projects that I thought were possible and of high priority. I noted in some cases those instances where the proposed study is inappropriate or not possible to achieve.

I have an interest in the long-term monitoring of status and trends of affected marine mammals in Prince William SOund and adjoining waters and support your efforts in that direction. The Long-Trem Ecological Research Site is appropriate for this area and I encourage the establishment of such a site.

Thank you for the opportunity to comment and please let me know if I can be of further assistance.

attach.

Restoration Feasibility Study Number 1: Reestablishment of *Fucus* in Rocky Intertidal Ecosystems

Species of the marine alga *Fucus* are critical structural components of the intertidal ecosystem on rocky shores in the oil spill area. Qualitative evidence indicates that *Fucus* was damaged by both the spilled oil and cleanup efforts. If the natural recovery of *Fucus* can be enhanced through the dispersal of spores or transplants, it will benefit the associated flora and fauna on intertidal rocky shores. This study will involve field tests to develop and demonstrate the feasibility of a *Fucus* restoration project and will document the natural recovery of *Fucus* under various conditions. The U.S. Environmental Protection Agency is the lead agency.

Restoration Feasibility Study Number 2: Reestablishment of Critical Fauna in Rocky Intertidal Ecosystems

Certain faunal species are key components of intertidal rocky ecosystems. Examples include grazers, such as limpets (e.g., *Diodora*), and predators, such as starfish (e.g., *Leptasterias*). Recolonization rates for these organisms, and for the alga *Fucus*, may limit the natural rates of recovery for entire communities. This feasibility study will compare the rates of recovery in communities with and without such species as limpets, and will evaluate techniques for enhancing recolonization rates. The U.S. Forest Service is the lead agency.

Restoration Feasibility Study Number 3: Identification of Potential Sites for Stabilization and Restoration with Beach Wildrye

Beach wildrye (*Elymus mollis*) was affected by both spilled oil and cleanup activities, and is extremely important in the prevention of erosion in the coastal environment. Erosion can lead to the destabilization and degradation of cultural and recreational sites and wildlife habitats. There are well established techniques for restoring rye grasses on coastal dune systems. This study will identify sites at which damage has occurred and restoration activities appear to be feasible. The Alaska Department of Natural Resources is the lead agency.

Restoration Feasibility Study Number 4: Identification of Upland Habitats Used by Wildlife Affected by the Oil Spill

A variety of marine birds, waterfowl and other bird and mammalian species were killed by the spill or injured by contamination of their prey and habitats. Many of these species are dependent on

aquatic or intertidal habitats for such activities as feeding and resting, but they also use upland habitats in forests, along streams or above the tree line. Through the public scoping process and technical consultations, many people have suggested that protection of upland habitats from further degradation may be an important way to help wildlife recover from the effects of the oil spill. This study will explore the linkages between wildlife affected by the oil spill and upland habitats, focusing in 1990 on marbled murrelets (*Brachyramphus marmoratus*) and harlequin ducks (*Histrionicus histrionicus*). The U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game are the lead agencies.

Restoration Feasibility Study Number 5:
Land Status, Uses, and Management Plans in Relation to Natural Resources and Services

Through the scoping process, members of the public have suggested a wide variety of projects to acquire the equivalent of injured resources. Examples are the acquisition of timber or development rights, conservation easements, recreational and cultural sites, inholdings within state and federal areas and buffer strips along streams and coasts. Habitat protection may also be the best means of providing for the long-term restoration of wildlife populations. To begin identifying and evaluating potential restoration projects of this type, this study will summarize existing information about the current status, uses and management plans of both public and private lands. The Alaska Department of Natural Resources is the lead agency.

DATE: September 25, 1990

MEMORANDUM FOR: John Strand

FROM: Alex Wertheimer

SUBJECT: Restoration Feasibility Studies For 1991

I appreciated seeing the list of feasibility studies and the matrix of potential restoration approaches. I have no recommendations for specific restoration feasibility studies, but I had some thoughts on the restoration matrix in relation to salmon which I'll pass on to you.

When the matrix was first created, the magnitude of the pink salmon return to Prince William Sound in 1990 was an unknown. The matrix and prioritization of restoration approaches/feasibility studies must now be viewed in that context. The record returns to the Sound do not by any means preclude actual and documentable damage to the resource. Overall return rates are well within the documented marine survival range for pink salmon. Impacts from the spill could have occurred which reduced the aggregate production to some degree, and particular wild stocks to a considerable extent. The degree of damage may have even been compensated to some extent by other effects of the spill, such as removal of avian predators. The large catch and escapement is, however, clear evidence that there was no catastrophic impact on the total productivity of the Sound for salmon in the marine environment. Aggregate losses, if any, are transient because escapements are, in general, adequate or better. Long-term effects will be localized to particular stream systems or littoral areas that were directly and severely impacted by the spill.

If the preceding logic is valid, the restoration alternatives should be considered in the context of localized impacts rather than general production systems. All of the approaches directed at increased productivity have potential application to restore damaged production systems. For example, Protecting Upland Habitat (l) is certainly a viable method to restore productivity to a damaged system, where additional stress on the system could prevent recovery. Applying the idea throughout Prince William Sound is appealing to those of us concerned with long-term productivity of the fish-producing habitat, but that is a concern that existed prior to the oil spill. Without large-scale, long-term losses to mitigate, it seems difficult to justify as a general approach. Alternatives n and q are examples of attempts to use the restoration process to justify action on management problems that were neither caused not exacerbated by the spill. Again, catastrophic loss of the resource may have justified action on such general issues. Without catastrophic damage, this type of approach would be inappropriate.

Alternative j is at first read simply a bad idea. I may be misinterpreting the intent of the alternative, but I understand it

to mean that depleted natural stocks would be "restored" by transplants from other abundant stocks. This would be counter to the ADFG Genetics Policy. I interpret the alternative in this way because there is a separate alternative referencing preservation of wild gene pools and local populations(h). This latter alternative, if it included transplants from the local population back into the impacted watershed (the "honest thief" technique), would be an excellent approach to "jump start" depleted stocks.

Alternative v is an interesting one. Where does damage assessment end and restoration begin in monitoring populations and conducting long-term ecological research? For many species, including pink salmon, the current damage assessment projects are in a real sense the start point for such research. Which process is responsible? Let me know when you figure it out!

271--246

To Stan Senner
From C Meacham
9-28-90

TO: Stan Senner
Restoration Program Manager
OSIAR Division

DATE: September 28, 1990

TELEPHONE: 465-4210

FROM: David Ackley
Marine Fisheries Biometrician
Division of Commercial Fisheries

SUBJECT: Restoration Suggestions

Stan, below are some suggestions for potential restoration projects. Please contact me if you have any questions.

Distribution and abundance of littleneck clams (Protothaca staminea) and butter clams (Saxidomus giganteus) within Prince William Sound (PWS)

A current NRDA impact assessment project has collected data on clams at specific sites within Prince William Sound and is in the process of investigating the potential effects of the oil spill on clam growth. Although necessary for restoration considerations, little is currently known about the distribution and density of clams within PWS. This study would inventory clam populations across various habitat types within PWS, expand the impact assessment results to clam populations thoughout PWS, and identify suitable habitats for clam population enhancements through restorative transplants. The Alaska Department of Fish and Game is the lead agency.

Transplant of clams from healthy habitats to areas affected by the oil spill or cleaning efforts.

Clam populations within PWS were damaged by the oil spill, by beach cleanup efforts, and by removals due to oil spill impact assessment studies. This study will transplant adult clams into the spill area from unaffected locations to restore populations to healthy levels throughout PWS. A transplant experiment was successfully conducted as part of an NRDA impact assessment study. The Alaska Department of Fish and Game is the lead agency.

Seeding of areas in PWS affected by the oil spill by juvenile clams grown under controlled conditions.

Assuming a demonstrable impact on clam populations within the path of the oil spill, it is possible that affected populations may be restored through a seeding project. Under this study, clams would be taken from healthy areas and spawned under controlled laboratory conditions. Clams grown to the juvenile stage under controlled conditions would be introduced into substrate which had been heavily impacted by oil or by cleaning efforts. The advantages of spawning and rearing clams to a juvenile stage in a controlled environment are twofold. First, adult clams can be induced to spawn several times during a growing season, and second, survival of the larval stage is greatly enhanced under protected conditions. The Alaska Department of Fish and Game is the lead agency.

Investigation of juvenile spot shrimp (Pandalus platyceros) abundance and habitat.

An NRDA impact assessment study has sampled adult spot shrimp habitat in order to determine the possible impacts of the PWS oil spill on the adult spot shrimp population. Although adult spot shrimp inhabit deep waters, it is believed that juvenile shrimp inhabit shallower waters likely to have been impacted by the spill. Little is known about the abundance, nursery areas or vertical distribution of juvenile (under 30 mm) spot shrimp. This study would sample potential nursery areas and depth strata for juvenile shrimp and provide information about areas which should be protected or enhanced to rehabilitate shrimp stocks which are already at low levels due in part to commercial exploitation. The Alaska Department of Fish and Game is the lead agency.

Investigation of reef habitat distribution within PWS and estimation of associated species.

Reef structures comprise an important habitat to many species, including rockfish, and provide a protective area for the juvenile stages of several species. Because this habitat is necessary to many species, it is important to determine whether habitat availability is a limiting factor in species diversity and abundance. This study would determine the extent of reef habitat within PWS, catalog the species present at a representative sample of reef sites, and determine areas of PWS deficient in reef structures. The Alaska Department of Fish and Game is the lead agency.

Colonization of artificial reefs by various species within PWS.

Reef structures comprise an important habitat to many species, including rockfish, and provide a protective area for the juvenile stages of several species. An increase in the availability of this habitat type may lead to a subsequent increase in associated species and further enhance commercial and sport fishing opportunities within PWS. This study would introduce artificial reef structures into selected areas within PWS and monitor colonization rate, species diversity and effectiveness of material use and placement. The Alaska Department of Fish and Game is the lead agency.

cc: Gordon Kruse
Chuck Meacham
John Hilsinger

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Oil Spill Damage
Assessment and Restoration
P.O. Box 210029
Auke Bay, Alaska 99821

DATE: October 24, 1990

MEMORANDUM FOR: Distribution

FROM: Brian Ross
John Strand

SUBJECT: Agenda for Restoration Work Session-Fish and Shellfish, October 26, 1990

AGENDA

TIME	ACTIVITY	RESPONSIBILITY
0830-0900	Introductions and opening remarks, purpose and scope of meeting, deliverables	Ross/Group
0900-1000	Brief overview of injury/exposure to fish/shellfish resources	Meacham/ Barber/ Others
1000-1015	Break	
1015-1030	Review of 1990 restoration-feasibil- project-"Distribution of Forage Fish in Relation to Marine Mammals and Birds"	Irons
1030-1100	Review of factors to be considered in proposing restoration-feasibility and restoration projects	Strand
1100-1200	Presentation/discussion of candidate 1991 restoration-feasibility projects[1] USFWS ADF&G NOAA	Ross
1200-1300	Lunch	
1300-1500	Presentation/discussion of candidate 1991 restoration projects[1] USFWS ADF&G NOAA	Strand

1500-1600	Summary and assignments to write or modify submitted project descriptions	Ross/ Strand
1600	Adjourn	

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(1) Participants are encouraged to bring to the meeting 20 copies of a 1-page abstract of proposed restoration-feasibility or restoration projects they intend to discuss.
abstract of