



United States Department of the Interior



IN REPLY REFER TO:

FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503

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MAY 11 1990

Memorandum

To: Department of Interior Representative
Exxon Valdez Oil Spill Restoration Planning Work Group

From: Regional Director, Region 7
U.S. Fish and Wildlife Service

Subject: Proposed Oil Spill Restoration Pilot Project

In response to your interest in reviewing pilot projects for restoration planning this year, we are submitting a summary proposal concerning availability of forage fish in Prince William Sound. We hope you will favorably consider this project during your review. Please call Paul Gertler (786-3579) or David Irons (786-3376) if you have any questions.

Walt Stieglitz

Attachment

RESTORATION STUDIES - PILOT PROJECT

Title

Pilot Project -- Distribution and abundance of forage fish in relation to marine birds and marine mammals in northeastern Prince William Sound.

Introduction

Many species of marine birds and marine mammals feed mainly on schooling forage fish (e.g., sandlance, capelin, and herring). Populations of some marine bird and marine mammal species in Prince William Sound have decreased during the past 18 years (Dwyer et al. 1975, Klosiewski, pers. comm.). The reasons for these declines are unknown, but may be related to food availability. If the Exxon Valdez oil spill negatively affected forage fish populations we might expect an accelerated decline of some marine bird and mammal populations. Marine bird and mammal species require appropriate habitat and food to maintain stable populations. If restoration studies repair or replace habitat damaged by oil, but sufficient food does not exist, then there will be no restoration of the target species.

Objective

- I. Determine distribution and relative abundance of forage fish in relation to foraging and non-foraging marine birds and mammals.

Methods

This pilot study would be conducted in conjunction with an existing non-oil spill study being done in the northeastern portion of the Sound. Major equipment items such as boats could be shared with the ongoing study, thereby decreasing costs. The work would be concentrated in the area between Bligh Island and Glacier Island and would stress testing techniques that would be used in a fully funded study.

The objective of the study would be met using the following procedures. First, the precise area to be studied would be defined, within this area 20 to 30 random transects would be chosen. These transects would be surveyed repeatedly to determine the temporal and spatial variation of forage fish, marine birds, and marine mammals. Presence, behavior (i.e., foraging, flying, or resting), and exact location of marine birds and marine mammals would be recorded for a width of 200 meters along the transects. Presence of fish would be recorded with a chart recording

fathometer. Species of forage fish in the area would be determined by collecting birds foraging on the fish and through the use of gill nets. The degree of the temporal and spatial variability found in the pilot study would help determine the appropriate sample size and timing of surveys for a large scale study.

Budget

Salaries GS 5	\$5000
Volunteer Expenses	\$1500
Travel	\$1000
Fuel	\$4000
Equipment (Gill nets etc.)	\$3000
Supplies (i.e., Food)	\$2000
Total	\$16500

Submitted by

David Irons
Migratory Bird Mgmt.
U.S. Fish & Wildlife

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1. Title: Prince William Sound Harlequin Duck Breeding Habitat
Analysis Feasibility Study

Study I.D. Number: Conducted as part of NRDA Bird Study No. 11
Project Leader: Dr. Samuel M. Patten

Assisted by: Robert G. Hunter

Leading Agency: Alaska Department of Fish and Game

Cooperating Agency: U.S. Fish and Wildlife Service

Date of Report: November 8, 1990

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3. Executive Summary

Harlequin Ducks (Histrionicus histrionicus) are both resident in and winter migrants to Prince William Sound, Alaska, feeding in intertidal zones and breeding along nearby streams. Harlequins were subject to considerable direct mortality associated with the Exxon Valdez Oil Spill of March 24, 1989. The NRDA Bird Study No. 11 (Seaduck Damage Assessment Study) has also documented that a significant proportion of the Harlequin Duck population surviving in oiled areas of Prince William Sound is in physiologically poor condition, probably associated with consumption of oiled intertidal prey items. Affected birds exhibit minimal adipose tissue and concentrations of petroleum chemicals in liver and bile. Results of the summer 1990 investigation of resident Harlequin Ducks in the oil spill area of western Prince William Sound further indicate a reproductive failure and population decline. In contrast, a stable population and normal reproduction was observed in unoiled areas around Prince William Sound.

A Harlequin Duck Restoration Feasibility Study was conducted by ADF&G in summer 1990 in Prince William Sound. The goals of this study were to locate Harlequin nesting streams, describe breeding habitats, and obtain

productivity indices. Information gathered during the 1990 field season demonstrates the proposed restoration project is technically and logistically feasible.

140 Prince William Sound anadromous fish streams were walked by experienced observers recording observations of Harlequin Ducks in the 1990 field season. No Harlequin broods were observed in the oil spill area in 1990. Harlequin breeding concentrations were noted in several areas of northeastern Prince William Sound; Port Etches, Hinchinbrook Island; southwestern Montague Island; and northwestern Prince William Sound. Nine confirmed Harlequin nesting streams were identified in these areas.

Harlequin nesting streams were larger than the usual anadromous fish streams in PWS, with moderate gradients, and clear waters averaging .3 -.5 m depth, used by spawning chum and humpback salmon. The streams averaged 750 ft elevation at their onset, were bordered by mature spruce-hemlock forest, and were typically 30 - 50 ft wide at estuary mouths, with extensive intertidal areas providing foraging areas for nesting Harlequins before the arrival of spawning salmon. Observed Harlequin brood size outside the PWS EVOS area was 3.1 ducklings per brood, a relatively low production rate for a duck species.

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4. Objectives

- A. To locate, identify and describe Harlequin nesting streams in Prince William Sound.

- B. To identify habitats used by nesting Harlequin Ducks including stream, riparian, and adjacent forest types.
- C. To investigate Harlequin Duck breeding parameters such as distance from the coast, distance from the stream, and physical features of the nest site.
- D. To obtain limited data on Harlequin breeding productivity where possible, such as clutch size, hatching and fledging success.
- E. A postulated objective for the restoration project would be the recommended size of forested buffer strips or stream conservation easements to protect Harlequin breeding sites from the effects of impending logging in Prince William Sound.

Logging effects could significantly retard or thwart efforts to restore the population of Harlequin Ducks in Prince William Sound after the EVOS. Riparian forest zones or stream conservation easements could be protected as part of the "acquisition of equivalent resources" phase of the oil spill restoration program. Many wildlife species including Harlequin Ducks would benefit.

- F. Identify potential alternative methods and strategies for restoration of lost use, populations, or habitat.

5. Introduction

The focus of this report is a feasibility study for restoration of Harlequin Duck (Histrionicus histrionicus) populations in Prince William Sound (PWS). Harlequin Ducks are year-around residents in Prince William Sound (Isleib and Kessel, 1973), feeding in heavily impacted intertidal zones resulting from the Exxon Valdez Oil Spill (EVOS) and breeding along nearby streams (Hogan, 1980).

Preliminary estimates from boat surveys conducted in 1989 by the U.S. Fish and Wildlife Service indicate a summer population of approximately 6000 Harlequin Ducks in Prince William Sound. This number is substantially augmented by winter migrants from northern and interior montaine breeding areas. An estimated 10,000 Harlequin Ducks winter in Prince William Sound (Isleib and Kessel, 1973).

Harlequin Ducks, because of their resident status and intertidal foraging habits, have been considered substantially at risk to effects of the Exxon Valdez Oil Spill (King and Sanger, 1979).

Harlequin Ducks are dependent upon intertidal marine invertebrates (Vermeer and Bourne, 1982). Harlequins consume a wide variety of small mussels, clams, snails, chitons, limpets, and salmon eggs (Koehle, Rothe and Dirksen, 1982; Dzinbal and Jarvis, 1982). Bivalves, particularly blue mussels (Mytilus), and small clams (Macoma), are well-known for their ability to concentrate pollutants at high levels (Shaw et al, 1976). The crude oil spilled from the Exxon Valdez may cause severe damage to marine invertebrates that support Harlequin Ducks (Stekoll, Clement, and Shaw, 1980) and bioaccumulation in the food chain may result in uptake of petroleum hydrocarbons by Harlequin Ducks over a long period (Dzinbal and Jarvis, 1982; Sanger and Jones, 1982).

Bird Study No. 11 is determining levels of petroleum hydrocarbon ingestion by sea ducks, including Harlequins, and predicting resultant physiological and life-history effects (Hall and Coon, 1988). In addition to direct mortality associated with the EVOS, preliminary damage assessment results from Bird Study No. 11 suggest that a significant proportion of the Harlequin population surviving in oiled areas is in physiologically poor condition, probably associated with consumption of oiled intertidal prey items.

USFWS and ADF&G biologists attending the initial Oil Spill Restoration Planning meeting in Anchorage (April 3-4, 1990) identified the lack of knowledge of Harlequin Duck breeding habitat ecology in Prince William Sound as being a critical data gap which needs to be addressed as part of restoration efforts for this species.

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Harlequin breeding habitat in Prince William Sound may need protection as part of restoration efforts aimed at rebuilding population numbers, yet little is known about Harlequin breeding parameters other than they nest along forested streams.

Two studies have been conducted on the breeding ecology of the Harlequin Duck, one in Iceland (Bengston, 1966) and another study in Glacier National Park, Montana (Kuchel, 1977). Specific information is lacking about Harlequin Duck breeding in Alaska. Dzinbal's (1982) MS thesis on ecology of Harlequin Ducks in Prince William Sound during summer and Dzinbal and Jarvis' (1982) work on summer coastal feeding ecology provided limited data on specifics of Harlequin breeding ecology in Alaska.

Increase in knowledge about Harlequin breeding ecology received a priority rating by USFWS and ADF&G biologists attending the initial (April 1990) EVOS restoration planning meeting in Anchorage. Harlequin nesting streams in Prince William Sound may need special protection from impending logging, aquaculture, mariculture, and hydroelectric activities if this seaduck population is to recover from the 1989 Exxon Valdez Oil Spill.

6. Study Methodology

In response to this priority identification, Bird Study No. 11 proceeded with a feasibility study in the 1990 field season. This was considered an additional, although limited, objective for Bird Study No. 11. The feasibility study took the form of:

- 1) an extensive regional survey to locate where Harlequins were concentrated in spring and summer
- 2) a description of stream sites where presumably breeding Harlequins were identified

3) an identification of general parameters of Harlequin breeding habitats

4) a collection of limited data on Harlequin productivity (brood size).

Information concerning anadromous fish streams (where Harlequins nest) is available from Commercial Fisheries Division of the Department of Fish and Game. Spring and summer surveys of streams along which Harlequins nest involved minor logistical planning changes to a summer 1990 field program already in place. The breeding habitat analysis feasibility study enabled ADF&G biologists to gather initial data on Harlequin breeding ecology, allowing aspects of a larger 1991 restoration project to be assembled.

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Sampling Methods: Since breeding Harlequin Ducks feed extensively on salmon eggs when available, these ducks are usually found along anadromous fish streams.

Approximately 900 anadromous fish streams are located in Prince William Sound. An experienced observer from Commercial Fisheries Division volunteered to report Harlequin sightings while walking 140 of these streams. The streams were selected for investigation based upon three factors:

- 1) prior historical sampling for fish concentrations;
- 2) 80% of the PWS pink salmon production originates from these watercourses;
- 3) the streams are spatially distributed throughout Prince William Sound, including oiled and unoled areas.

These 140 streams were walked during the summer of 1990, and locations and information were recorded on Harlequin Duck sightings and habitats.

Additional data on Prince William Sound Harlequin distribution was requested from U.S. Fish and Wildlife Service biologists conducting aerial and boat surveys. Interviews were conducted with Commercial Fisheries personnel working on Prince William Sound stream surveys. Other agency or private biologists working in Prince William Sound and having

knowledge of Harlequin Ducks were also consulted. This data complemented information produced by boat and stream surveys associated with the Seaduck Damage Assessment Project (Bird Study No. 11) in the oil spill area of western Prince William Sound.

7. Study Results

Harlequin Ducks historically bred throughout Prince William Sound, including areas effected by the EVOS. No Harlequin broods were observed in the oil spill area in 1990. Harlequin breeding concentrations were noted in several areas of northeastern Prince William Sound; Port Etches, Hinchinbrook Island; southwestern Montague Island; and northwestern Prince William Sound (College Fiord). The greatest concentration of nesting Harlequin ducks is apparently located in northeastern Prince William Sound, unfortunately in an area soon to be logged.

Nine confirmed PWS Harlequin nesting streams were identified by USGS name and standardized ADF&G Commercial Fisheries Division Anadromous Fish Stream Index Number. These streams are as follows: (Table 1)

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Table 1

Identified Harlequin Breeding Streams, PWS			
Stream Name	Index Number	Area,	Region
Stellar Creek	11530	Sawmill Bay,	Valdez Arm
Olsen Creek	10510	Olsen Bay,	Port Gravina
Eyak River	10050	Heney Range,	Cordova
Nuchek Creek	18120	Port Etches,	Hinchinbrook I.

Constantine Creek	18150	Port Etches,	Hinchinbrook I.
Etches Creek	18060	Port Etches,	Hinchinbrook I.
MacLeod Creek	17070	MacLeod Harbor,	Montague Island
Hanning Creek	17100	Hanning Bay,	Montague Island
Coghill River	13220	College Fiord,	Port Wells

In general, Harlequin nesting streams are larger than the usual anadromous fish streams in PWS, with moderate gradients, and non-glacial waters averaging .3 - .5 m depth, used by spawning pink and chum salmon (Table 2). Substrates in these streams are large stone, rocks, and boulders, often creating turbulent flow patterns.

The streams average 750 ft elevation at their onset, and are bordered by mature spruce-hemlock forest. These streams are typically 30 - 50 ft wide at the mouth to the estuary, have extensive intertidal areas, and are relatively short, 5 - 8 km in length (Table 2). The intertidal areas are used for feeding by breeding pairs, and later, by nesting females which fly to the intertidal to feed before the arrival of spawning salmon upstream. Harlequin nests are generally located beginning at about .5 km from the stream mouths (Dzinbal, 1982). Nests are typically found within 2 to 20 m from the water (Bengston, 1966). Mean clutch size in the literature averages 5.5 eggs (Bengston, 1966). Observed brood size outside the PWS oil spill area in 1990 was 3.1 ducklings per brood, a relatively low productivity rate for a duck species.

Table 2

Characteristics of Harlequin Nesting Streams

30 - 50 ft wide at mouth to estuary

extensive intertidal areas in estuary

moderate gradient

discharge rates of 1.5 - 7.0 cu. m/sec.

.3 -.5 m deep

elevation at onset of stream approx. 750 ft.

clear, not glacial or turbid

substrate of large stones, rocks, boulders

5 - 8 km length (relatively short)

bordered by mature spruce-hemlock forest

salmon spawning stream (chum, humpback)

Harlequin nest areas begin approx. .5 km from mouth (Dzinbal, 1982)

nests found from 2 to 20 m from water (Bengston, 1966)

mean clutch size approx. 5.5 eggs (Bengston, 1966)

mean brood size summer 1990 observed outside oil spill area:

3.1 ducklings per brood

Concentrations of moulting and flightless males were noted inside the oil spill area of western Prince William Sound. Up to 70 individual ducks were observed in these concentrations. The largest of these aggregations was at Foul Bay, south of the entrance to Port Nellie Juan. An apparent characteristic of these moulting sites was their location in extensive rocky intertidal zones in secluded bays. These sites appeared highly productive, were used by a variety of avian and mammal species, and may need protection as part of further restoration efforts. This topic is addressed in the proposed ADF&G Harlequin Duck Restoration Project Description.

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Bengston, S.-A. 1966. Field studies on the Harlequin Duck in Iceland. Wildfowl Trust Ann. Rep. (1964-65) 17: 79-94.

Kuchel, C.R. 1977. Some aspects of the behavior and ecology of Harlequin Ducks breeding in Glacier National Park, Montana. M.S. Thesis, University of Montana, Missoula. 163 pp.

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1. Title: Prince William Sound Harlequin Duck Breeding Habitat Analysis Feasibility Study

Study I.D. Number: Conducted as part of NRDA Bird Study No. 11

Project Leader: Dr. Samuel M. Patten

Assisted by: Robert G. Hunter

Leading Agency: Alaska Department of Fish and Game

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Date of Report: November 8, 1990

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3. Executive Summary

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4. Objectives

- A. To locate, identify and describe Harlequin nesting streams in Prince William Sound.
- B. To identify habitats used by nesting Harlequin Ducks including stream, riparian, and adjacent forest types.
- C. To investigate Harlequin Duck breeding parameters such as distance from the coast, distance from the stream, and physical features of the nest site.
- D. To obtain limited data on Harlequin breeding productivity where possible, such as clutch size, hatching and fledging success.
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Logging effects could significantly retard or thwart efforts to restore the population of Harlequin Ducks in Prince William Sound after the EVOS. Riparian forest zones or stream conservation easements could be protected as part of the "acquisition of equivalent resources" phase of the oil spill restoration program. Many wildlife species including Harlequin Ducks would benefit.

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USFWS and ADF&G biologists attending the initial Oil Spill Restoration Planning meeting in Anchorage (April 3-4, 1990) identified the lack of knowledge of Harlequin Duck breeding habitat ecology in Prince William Sound as being a critical data gap which needs to be addressed as part of restoration efforts for this species.

Harlequin breeding habitat in Prince William Sound may need protection as part of restoration efforts aimed at rebuilding population numbers, yet little is known about Harlequin breeding parameters other than they nest along forested streams.

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6. Study Methodology

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- 1) an extensive regional survey to locate where Harlequins were concentrated in spring and summer
- 2) a description of stream sites where presumably breeding Harlequins were identified
- 3) an identification of general parameters of Harlequin breeding habitats
- 4) a collection of limited data on Harlequin productivity (brood size).

Information concerning anadromous fish streams (where Harlequins nest) is available from Commercial Fisheries Division of the Department of Fish and Game. Spring and summer surveys of streams along which Harlequins nest involved minor logistical planning changes to a summer 1990 field program already in place. The breeding habitat analysis feasibility study enabled ADF&G biologists to gather initial data on Harlequin breeding ecology, allowing aspects of a larger 1991 restoration project to be assembled.

Sampling Methods: Since breeding Harlequin Ducks feed extensively on salmon eggs when available, these ducks are usually found along anadromous fish streams.

Approximately 900 anadromous fish streams are located in Prince William Sound. An experienced observer from Commercial Fisheries Division volunteered to report Harlequin sightings while walking 140 of these streams. The streams were selected for investigation based upon three factors:

- 1) prior historical sampling for fish concentrations;
- 2) 80% of the PWS pink salmon production originates from these watercourses;
- 3) the streams are spatially distributed throughout Prince William Sound, including oiled and unoiled areas.

These 140 streams were walked during the summer of 1990, and locations and information were recorded on Harlequin Duck sightings and habitats.

Additional data on Prince William Sound Harlequin distribution was requested from U.S. Fish and Wildlife Service biologists conducting aerial and boat surveys. Interviews were conducted with Commercial Fisheries personnel working on Prince William Sound stream surveys. Other agency or private biologists working in Prince William Sound and having knowledge of Harlequin Ducks were also consulted. This data complemented information produced by boat and stream surveys associated with the Seaduck Damage Assessment Project (Bird Study No. 11) in the oil spill area of western Prince William Sound.

7. Study Results

Harlequin Ducks historically bred throughout Prince William Sound, including areas effected by the EVOS. No Harlequin broods were observed in the oil spill area in 1990. Harlequin breeding concentrations were noted in several areas of northeastern Prince William Sound; Port Etches, Hinchinbrook Island; southwestern Montague Island; and northwestern Prince William Sound (College Fiord). The greatest concentration of nesting Harlequin ducks is apparently located in northeastern Prince William Sound, unfortunately in an area soon to be logged.

Nine confirmed PWS Harlequin nesting streams were identified by USGS name and standardized ADF&G Commercial Fisheries Division Anadromous Fish Stream Index Number. These streams are as follows: (Table 1)

Table 1

Identified Harlequin Breeding Streams, PWS			
Stream Name	Index Number	Area,	Region
Stellar Creek	11530	Sawmill Bay,	Valdez Arm
Olsen Creek	10510	Olsen Bay,	Port Gravina
Eyak River	10050	Heney Range,	Cordova
Nuchek Creek	18120	Port Etches,	Hinchinbrook I.
Constantine Creek	18150	Port Etches,	Hinchinbrook I.
Etches Creek	18060	Port Etches,	Hinchinbrook I.
MacLeod Creek	17070	MacLeod Harbor,	Montague Island
Hanning Creek	17100	Hanning Bay,	Montague Island
Coghill River	13220	College Fiord,	Port Wells

In general, Harlequin nesting streams are larger than the usual anadromous fish streams in PWS, with moderate gradients, and non-glacial waters averaging .3 - .5 m depth, used by spawning pink and chum salmon (Table 2). Substrates in these streams are large stone, rocks, and boulders, often creating turbulent flow patterns. The streams average 750 ft elevation at their onset, and are bordered by mature spruce-hemlock forest. These streams are typically 30 - 50 ft wide at the mouth to the estuary, have extensive intertidal areas, and are relatively short, 5 - 8 km in length (Table 2). The intertidal areas are used for feeding by breeding pairs, and later, by nesting females which fly to the intertidal to feed before the arrival of spawning salmon upstream. Harlequin nests are generally located beginning at about .5 km from the stream mouths (Dzinbal, 1982). Nests are typically found within 2 to 20 m from the water (Bengston, 1966). Mean clutch size in the literature averages 5.5 eggs (Bengston, 1966). Observed brood size outside the PWS oil spill area in 1990 was 3.1 ducklings per brood, a relatively low productivity rate for a duck species.

Table 2
Characteristics of Harlequin Nesting Streams

30 - 50 ft wide at mouth to estuary
extensive intertidal areas in estuary
moderate gradient
discharge rates of 1.5 - 7.0 cu. m/sec.
.3 -.5 m deep
elevation at onset of stream approx. 750 ft.
clear, not glacial or turbid
substrate of large stones, rocks, boulders
5 - 8 km length (relatively short)
bordered by mature spruce-hemlock forest
salmon spawning stream (chum, humpback)
Harlequin nest areas begin approx. .5 km from mouth (Dzinbal, 1982)
nests found from 2 to 20 m from water (Bengston, 1966)
mean clutch size approx. 5.5 eggs (Bengston, 1966)
mean brood size summer 1990 observed outside oil spill area:
3.1 ducklings per brood

Concentrations of moulting and flightless males were noted inside the oil spill area of western Prince William Sound. Up to 70 individual ducks were observed in these concentrations. The largest of these aggregations was at Foul Bay, south of the entrance to Port Nellie Juan. An apparent characteristic of these moulting sites was their location in extensive rocky intertidal zones in secluded bays. These sites appeared highly productive, were used by a variety of avian and mammal species, and may need protection as part of further restoration efforts. This topic is addressed in the proposed ADF&G Harlequin Duck Restoration Project Description.

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