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Oct 15, 1991

Stanley Senner
Oil Spill Restoration Office
437 "E" Street, Suite 301
Anchorage, Alaska

Dear Stan,

I had Brian Sharp prepare a litigation product and a "condensed" litigation product on black oystercatchers. I have included the condensed version with this fax, hoping that it will be of some use to you in restoration

Sincerely yours,

Robert B. Spies

INJURY TO BLACK OYSTERCATCHERS
Condensed Version October 1991

This version is a summary and condensation of the "Injury to Black Oystercatchers: Synthesis Review Draft June 1991." It presents only the conclusions arrived at in that document. For supporting data, references, and full documentation of conclusions reached, the reader is referred to the June 1991 version.

I. Distribution and abundance of the species before the spill.

The black oystercatcher breeds from the Aleutians eastward and southward along the Pacific coast of North America to central western Baja California. In Alaska, it is found during the breeding season throughout the spill area, from Prince William Sound (PWS) to the Alaska Peninsula (AP). Oystercatchers also winter in most of the Gulf of Alaska.

Data on pre-spill abundance: The breeding population of black oystercatchers from PWS to the AP is estimated as approximately 5600 pairs or 11200 birds. Non-breeding birds are estimated at approximately 5300 birds. A total of approximately 16,500 oystercatchers inhabit the 15,500 to 16,000 km extended spill area along the Alaska coast from PWS to the AP.

II. Exposure of the species to oil.

II.A. Number of individuals of the species that were potentially exposed to the spilled oil.

Approximately 446 or 1274 pairs of oystercatchers were exposed to heavy, moderate, and light oiling, or heavy, moderate, light, and very light oiling, respectively. Eight percent of the black oystercatcher breeding population in the Gulf of Alaska, therefore, was probably exposed to heavy, moderate, and light oil, and 23% was exposed to heavy, moderate, light and very light oil.

An additional number of non-breeding oystercatchers were exposed. If 8-23% of a total of 16,500 oystercatchers were exposed, approximately 1300-3800 total oystercatchers were exposed to oil.

II.B. Habits of the species that would expose them to oil.

Black oystercatchers are an integral component of the intertidal ecosystem, foraging predominantly on mussels, but also on other intertidal invertebrates. Mussels are known to concentrate hydrocarbons. Limpets are fed to chicks, which are flightless until 35 days old. Oystercatchers are susceptible to oil contamination by: a) direct contact with oil; b) ingestion of hydrocarbons from consuming prey that is contaminated, or from preening; c) transferring oil during incubation to eggs (minute amounts of oil are known to reduce the viability of embryos); d) direct oiling of flightless chicks; e) feeding oiled prey to chicks, with an expected reduction of growth rates or increased chick mortality; f) disturbance to nesting pairs by oiled shoreline cleanup crews, resulting in lack of breeding, abandonment of nests, or a reduction in parental attentiveness, any of which would cause a reduction in productivity; and g) mortality of prey populations, leading to a decrease in foraging efficiency and a lowered ability of adults to obtain food for themselves or their chicks. Several of these effects were observed in 1989-91.

II.C. Evidence of external oiling.

Due to the all-black plumage of oystercatchers, observations of oiling in the field are unlikely. There were observations of external oiling of the feet of a few adults, and of downy chicks which encountered oil on or between rocks on oiled shorelines. Birds were not observed to preen more frequently in oiled areas.

II.D. Chemical analyses indicating oil in tissues or eggs.

Eggshell and eggs collected in 1989 were not analyzed for hydrocarbons. Eggs observed in nests in the field in 1989 did not appear to be oiled. Clutch sizes and hatching rates were not reduced in oiled areas, which was unexpected.

II.E. Biochemical alterations indicating exposure (e.g., P-450 induction).

No biochemical analyses were performed on black oystercatchers in the Exxon Valdez oil spill (EVOS)-affected area.

II. F. Evaluation of information on geographic distribution of the oil.

Maps of the extent of shoreline oiling prepared by Alaska Department of Natural Resources (ADNR) based on surveys by the ADEC show shoreline oiling on shorelines of Prince William Sound, Kenai Peninsula, Kodiak-Afognak Islands, the Alaska Peninsula, and numerous small offshore

islands. However, a significant amount of shoreline noted as oiled by observers who were in the field in spring and summer do not appear on the oiled shoreline maps prepared by ADNR. ADEC data therefore appear to underestimate the amount of shoreline oiled.

For the Kodiak-AP sector, USFWS summaries appear to present a more complete picture of the shorelines oiled in summer of 1989. Combined ADEC and USFWS data indicate that 579, 288, and 3146 km of shoreline were oiled in Prince William Sound, the Kenai Peninsula, and Kodiak-Alaska Peninsula Sectors, respectively, for a grand total of 4013 km. oiled in 1989 (all oiling categories).

Survey data from ADEC and other observers/researchers indicate that there was still pervasive oiling in the intertidal habitat in the EVOS-affected area in 1990. In Prince William Sound, the linear extent of oiling decreased 4.6% from fall, 1989 to spring-summer, 1990. The extent of oiled shorelines increased by 208% on the Kenai Peninsula and on the Kodiak-AP by 189% between 1989 and 1990.

III. Effects of the oil.

III.A. Sublethal effects of oil on body condition, growth, or reproduction.

No data were collected on body condition and growth in 1989 or 1990. Differences in chick growth rates were observed on oiled areas in 1991.

Feeding rates (ingestions/minute) were 2 1/2 times lower in oiled than in non-oiled habitat for both pairs with eggs and pairs with chicks. Time individual oystercatchers spent feeding was correspondingly longer on oiled areas. Mortality of mussels and other intertidal invertebrates was higher on oiled areas.

Quantitative data on the extent of shoreline oiling were gathered on oystercatcher feeding areas along transects from high tide line to low tide line. Chick mortality rates were directly and significantly ($r = 0.99$) correlated with the amount of oil in feeding territories, with daily mortality rates of 0%/day on non-oiled territories, 3%/day on moderately oiled territories (with an average oil cover of 14%), and 6%/day on heavily oiled territories (average oil cover 42%). Similarly, oystercatcher brood size in mid-July was reduced by 45% on heavily oiled territories, by 36% on moderately oiled territories, and by 0% on non-oiled territories.

Heavily oiled and moderately oiled as used here are approximately equivalent to ADEC's medium and light categories. Thus, heavy, medium, and light oiling of

shorelines, sensu ADEC, were sufficient to have an effect on black oystercatcher chicks in 1989.

The mechanism for the above injury to chicks was either direct oiling of flightless chicks or feeding of hydrocarbon-contaminated prey to chicks.

Oil was still pervasive in oystercatcher habitat in PWS in 1990, and mean brood size of black oystercatchers on oiled areas was 0.5 on heavily oiled territories and 1.0 on lightly to moderately oiled territories, suggesting that the poor reproductive success of black oystercatchers found in 1989 continued in 1990.

III.A.1. Shoreline Cleanup and Bioremediation:

Exxon reported that 1760 km of shoreline were cleaned in the EVOS-affected area, and that the cleanup effort involved more than 11,000 workers, about 3,500 of whom were working directly on the beach, 84 aircraft, and more than 1,400 boats. Pressurized steam-cleaning of rocks was used on about 140 km of coastline. Effects of disturbance from cleanup were not measured separately from direct oil effects.

A strong negative correlation was found between bioremediation and nest success among oystercatcher nests examined in 1990. In 1989 and 1990 about 119 km and 320 km of shoreline were treated by bioremediation.

III.B. Sublethal effects of oil on habitat.

In the EVOS-affected area there was considerable mortality of mussels and other intertidal invertebrates. Studies suggest that it may take 5 years for a mussel bed to become re-established.

Aromatic hydrocarbon levels in mussels collected in Prince William Sound, in Chignik Bay, and along the Kenai Peninsula were significantly higher in 1989 than before the spill.

III.C. Body counts.

In the EVOS-affected area from PWS to AP, 9 black oystercatchers were recovered and taken to the morgue.

III.D The results of population surveys: pre-spill vs post-spill; oiled vs non-oiled habitats.

Oystercatcher numbers were significantly lower than expected on oiled versus non-oiled shorelines on boat transects in Prince William Sound. Reductions in numbers of other shorebird species were also observed in oiled areas.

condition of adult oystercatchers or chicks. Preliminary data indicate reduced growth rates of chicks in oiled areas in 1991. Lighter chicks have a higher mortality rate after fledging.

III.G. Economic considerations involved in estimating lost value.

Every 5 years, the U.S. Fish and Wildlife Service conducts a survey of hunting, fishing, and wildlife-oriented recreation. The number of people involved in bird-watching and other forms of non-consumptive wildlife-oriented recreation increased from 49 million in 1975 to 93 million in 1980 to 110 million in 1985. The black oystercatcher is a particular favorite of birdwatchers.

Along the Kenai Peninsula, there was a 27% reduction in oystercatchers between 1986 and 1989.

III.E. Independent estimate of total oil kill.

Correcting the known number of retrieved birds (9), by an estimated recovery rate of 7.5%, approximately 120 adult black oystercatchers probably died of direct impact of the oil spill.

III.F. A temporally and geographically integrated assessment of injury.

The direct kill of adult black oystercatchers by the Exxon Valdez spill was relatively small, of the order of approximately 120 birds.

Oystercatchers are relatively long-lived, have a high survival rate of 94%, and have been known to reproduce at the age of 34 years. The lost production from the deaths of adults carried through successive breeding seasons is estimated at 1290 chicks.

Reductions in reproductive output from oystercatchers inhabiting oiled shorelines in the EVOS-affected area were documented in both 1989 and 1990. Based on estimates of numbers of oystercatchers exposed on lightly, medium, and heavily oiled shorelines, an estimated 635 chicks were not produced on shorelines in Prince William Sound, Kenai Peninsula, and Kodiak-Alaska Peninsula in 1989. Approximately 6 percent of the potential chick production along the entire Gulf of Alaska shoreline was probably lost in 1989.

The loss of chicks calculated above is conservative in not ascribing losses to shorelines that were "very lightly" oiled, though some occurred.

In 1990, losses of chicks were still occurring on oiled shorelines. Due to oiling and bioremediation, approximately 300 chicks were not produced in 1990.

Calculations of chick losses do not include future loss of production from the birds that were not produced in 1989 and 1990 and that cannot therefore enter into the breeding population themselves.

The above assessment of injury also does not include any estimate of injury to black oystercatchers in 1991 due to uptake of hydrocarbons in their food. Due to the concentration of aromatic hydrocarbons in blue mussels, the principal food of black oystercatchers, it is probable that uptake of contaminated mussels is having an effect on the

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

June 11, 19993

Dr. John Armstrong
U.S. Environmental Protection Agency
Office of Coastal Waters
Water Division, WD-139
1200 Sixth Avenue
Seattle, WA 98101

Dear John:

Enclosed please find two, and possibly three of the four reports that you requested. I have located a copy of the fourth report on restoration of oystercatchers but this will not arrive until next week. I believe this is the work your agency supported. As to the enclosed draft report on distribution and abundance of forage fish in Prince William Sound, I am still trying to locate David Irons, Principal Investigator for the U.S. Fish and Wildlife Service on this project, to determine if a final version was ever produced. Because he is in the field, I will not be able to make contact until late the Week of June 14th. If a final report exists, either David or I will forward a copy to you at that time.

Yours very truly,

John A. Strand, Ph.D.
Restoration Manager

Enclosures

cc: Byron Morris
RPWG

APPLIED
marine
SCIENCES

May 18, 1992

To: Brad Andres
From: Bob Spies, Chief Scientist, *Exxon Valdez* government studies
Re: Peer reviewer comments on the black oyster catcher restoration project report

Enclosed are comments on your report on the 1991 black oyster catcher restoration work. I apologize for the delay in getting these comments to you, but I have been kept quite busy on several other aspects of the EVOS this spring. George Hunt seems generally satisfied with the restoration report. Both George and Mike Fry raise the apparently "contradictory" nature of some aspects of the results, e.g., chick weight is less but final reproductive success is greater on Green Island than on Montague Island. George also questions the use of individual chicks as replicates in your analyses. Mike Fry had only a few other substantive comments to make on the report. Our third reviewer, Brian Sharp was the PI for 1989 and had more detailed comments. He noted that since the sampling in 1989 did not start until June hatching success may not have been correctly estimated in 1989. Brian had comments on the apparent contradiction as to whether it is food quantity or quality that is affecting chick growth. Brian then goes on to comment that data on hydrocarbons in mussels is slow to come available. This is now quickly changing and I would urge you to contact Jeff Short at the NOAA Auk Bay Laboraotry [(907)789-6065] for an up-to-date picture of the available mussel data. Brian also enquires whether there were data on times spent foraging in diffferent habitats as were proposed previously as a study objective for 1991. Brian has a few other comments that you may wish to consider.

I do not know what your contractural arrangements are with the US Fish & Wildlfe Service, but if you are required to revise the report for final acceptance, I hope these review comments are useful to you.

In general the reviewers seem quite pleased with the quality of the restoration report and find I find the work has significant implications for restoration of this species.

Please do not hesitate to contact me if there are any questions about the reviews or if there is anything further that I can provide you.

cc: C. Gorbics
B. Sharp
D. Gibbons
P. Bergman
S. Senner
A. Swiderski

2155 Las Positas Court, Suite S Livermore, CA 94550 510.373.7142 FAX 510.373.7834

BIRD STUDY 12--BLACK OYSTERCATCHER

The 1991 work added new information useful to the assessment of impacts on this species (items 1 and 2 below). Two areas of investigation for which further information is desirable are discussed in items 3 and 4.

1) The 1991 study found i) that numbers of nesting oystercatchers increased in 1991 on Green Island (by 50%) and ii) that egg volumes in 1989 were reduced (from measurements taken in 1989 but not fully utilized). These results and analysis suggest impacts on early reproductive stages in 1989 that were not appreciated or detected earlier. Oystercatchers begin egg-laying in mid to late May, and appear to have bimodal peaks of egg-laying, in late May and mid-June. It now appears that some early nesting failures in 1989 were probably not detected because field work was not initiated until early June. The finding by Sharp et al. of no difference in hatching success in 1989 may have been incorrect, since hatching success in 1989 on Green Island may have been overestimated. The current P.I. might want to add this to his discussion of "Oiling Effects" and hatching success on page 8, bottom.

2) Growth rates (weights) of chicks, measured in 1991 for the first time, were significantly lower ($p<0.013$) on oiled vs non-oiled sites (sites need to be specified). Assessing first year survival was beyond the scope of this study, but numerous studies of other species have found that first year survival is lower for chicks of lower fledging weight. However, Groves (Auk, 1984) found that heavier chicks survived better to age of first flight, but survival thereafter was not related to weight. Since fledging rates were not reduced in 1991, it appears that the lowered growth rates were not affecting fledging success.

The discussion of growth rates (page 9) states that biomass delivered to chicks was reduced on oiled sites, i.e., a consideration of *quantity*. In the next sentence, however, the statement appears: "Thus, it appears that depressed growth rates are being driven by the *quality* of the prey delivered..."(italics mine). This statement appears to be a non-sequitur. The corroborating evidence adduced (of mussel mortality in 1989) was primarily a quantity consideration. This quality and/or quantity question needs to be clarified.

It is worth noting in comparison that growth rates of pigeon guillemots were also significantly lower in post-oilspill years 1989 and 1990 (no data collected in 1991).

3) No data on hydrocarbons were presented to corroborate the above-mentioned statement on *quality* of prey delivered to chicks. Mussel samples for hydrocarbon analysis were

collected in both 1989 and 1990 on Green and/or Montague Islands, and in other locations throughout Prince William Sound. It is disappointing that data on hydrocarbon contaminant levels in prey consumed by adults or delivered to chicks are so slow in becoming available, even three years after the oil spill. These still need to be incorporated into the assessment of damages to intertidal foraging species (Black Oystercatcher, Harlequin Duck, etc.).

4) The 1989 NRDA work provided some initial information on foraging by oystercatchers. It was my understanding that expanding on this area of investigation was one of the objectives of the present study. I was therefore disappointed that no data were presented (were they not collected?) on habitat use by foraging oystercatchers, to quantify the proportion of foraging times in non-oiled areas in relation to their availability. The question of what foraging habitat is selected by oystercatchers or whether they avoid oiled areas remains in need of further clarification.

The rest of this review addresses a few specific details.

p.2:

"Objective 2": statement should read: "data indicated that chick survival <u>was</u> lower on oiled sites in 1989" or something to that effect.

"Study subject": oystercatchers are found on types of shorelines other than rocky. And I would classify oystercatchers as generally common. For example, they were found on 25% of all boat surveys (Klosiewksi and Hotchkiss, 1989 report on Bird Study 2), even though the boat surveys failed to detect 69% (Sharp, unpub. data) of birds present.

p.3. "Study Area": One should use caution when dealing with ADEC shoreline and oiling classifications. First, the ESI (Environmental Sensitivity Index) shoreline types are somewhat inadequate in that there isn't a separate type for cobble, an important habitat in Prince William Sound. (Both large and small cobble are merged with sand/gravel.) Second, oiled shoreline data are flawed. I am sending the P.I. information on discrepancies between ADEC oiled shoreline survey data and other observations which I have compiled.

p.4. The predator surveys appear to be too cursory to detect numbers of predators present, especially secretive, terrestrial species.

p. 7. "Results. Habitat Features."

The shorelines of Green and Montague Islands also consisted in large part of cobble. Small cobble was used extensively by oystercatchers.

Paragr. 3: With certain exceptions, I believe mussels are more abundant on rocky shorelines. Even though oystercatchers might prefer gravel substrates for nesting, a component of most territories was a foraging area of either rocky shores, or an area of small cobble. In a few instances, foraging areas supporting mussels were found on sandy or silty substrates.

I don't remember there being small islets <25m on Green/Montague for the oystercatchers to choose as nesting substrate. Channel Island was evidently a preferred site, either because of its isolation from predators, the tern colony, or both. Channel Island was in part oiled in 1989 (the southwest shoreline--verified with Mary Cody), and it is not safe to include all of Channel Island with unoiled shorelines for the sake of comparing reproductive parameters.

p.8.

I noted that hatching success was significantly lower on the islet nest sites, even though they provided some protection from terrestrial predators. No explanation of this or higher brood mortality on Knight Island is offered. Predator count methodology seemed inadequate to provide meaningful data on predation probabilities. There has been little progress on the predator question since the 1989 study hypothesized predation to explain differences in hatching success. I had hoped there may be some data from damage assessment studies on otters and mink by Alaska Fish and Game that would cast some light on the predation question, but I have seen nothing useful to date, though I have not as yet reviewed the 1991 terrestrial mammal reports. However, even if predator population levels were better known, without extensive observations on prey taken, or time-lapse photography of a number of nests, it would not be possible to clarify the predation question, since predation events are rare and unobserved.

"Oiling Effects." I presume the two statements pertaining to higher hatching success and productivity on impacted sites on Knight Island are reversed and need to be corrected.

Insofar as hatching success on Montague in 1989 is concerned, I suspected that observer interference may have been part of the reason for some of the nest losses and the lower hatching success rate in 1989.

p.9.

Paragraph 3 implies that the data charted in Figure 6 were derived from 1990, but Figure 6 on Page 19 indicates 1991.

Field data on food delivery rates and biomass in 1991 need to be tabulated and presented.

p.10. I suggest use of the term "recovery" be avoided--it connotes a return to normal and is often used in association

with the word "complete." From the 1991 data presented, it would obviously not include chick growth rates or biomass delivered. Quality considerations (hydrocarbon contaminant levels) in food have not yet been examined. Survival of both first year and adult birds in contaminated areas was beyond the scope of the study and has not been investigated. If the term is used, it needs to be more narrowly defined to exclude the above components.

Table 3. Comparison between shoreline oiling data collected by ADEC, Sharp et al. (1989), and Cody (1990) for oystercatcher habitat on Green Island, 1989-1990.

Pair	Sharp et al June-July 1989	ADEC Apr-Aug 1989	ADEC Fall 1989	ADEC Spring 1990	Cody 1990 Summer 1990
1	10	None	Medium	V light	
2	13	None	V light	V light	
3	35	Med	None	Heavy	24
4	13	None	No visit	V light	
5	28	None	No visit	V light	50
6	40	Heavy	Heavy	Light	20
7	42	Heavy	Heavy	Heavy	20
8	48	None	No visit	Very Light	
9	47	Heavy	Heavy	Heavy	15
10	20	None	No visit	V light	10
11	0	None	None	V light	0
12	10	None	None	None	13
13	9	None	V light	Light	
14	no data	None	No visit	None	
15	14	None	No visit	None	
16	0	None	No visit	None	
17	20	Heavy	Medium	V light	

Sources: ADEC data: maps furnished by ADNR.
Sharp et al. (1989), Cody (1990): mean percent oil cover on meter-square quadrats on transects between high and low tidelines.

Table 5. Comparisons of ADEC and USFWS oiled shoreline surveys, Becharof NWR.

	USFWS 5/89	USFWS Summer/90	ADEC Fall/89	ADEC Spring/90
Heavy	1.6	1.1		
Medium	30.7	1.5		
Light	49.2	1.5		
V.Light	96.7	33.7		
Total	178.2	37.8	12.7	no data

Table 6. Comparisons of ADEC and USFWS oiled shoreline survey data for Kodiak-Alaska Peninsula.

	USWFWS Apr-Jul 89	ADEC Fall/89	ADEC Spring/90
Heavy	27.4	7.7	0.56
Medium	93.3	14.9	4.9
Light	397.5	24.5	6.5
Very Light	2628.1	75.8	91.9
Totals	3146.3	122.9	103.86

Source (USFWS data): Kodiak NWR.
Note: on Kodiak NWR shorelines, heavy + medium = 29.0 km, an light + very light = 300.9 km., more than ADEC total for ent Kodiak-AP.

Restoration Project 1991-96 Anchers, Black Oystercatchers

This project examined habitat needs of Black Oystercatchers and the potential affect of the EVOS on their breeding success. Overall, the project appears to be well conceived and well executed. The results are, however, somewhat difficult to interpret. Some aspects of reproductive biology in 1991 had improved since 1989 in oiled areas whereas others had not. Several variables have now been identified as potentially important: predation, disturbance, reduction of the food supply and contamination of food. In addition, the type of shoreline (smooth rock vs. gravel) is important in affecting vulnerability to predation. It would be useful if 1992 studies could be designed to control for as many of these variables as possible so that we can quantify changes in disturbance, food supply and contamination of foods and then determine the extent to which these changes affect reproduction.

Two of the objectives seem unrealistic and only marginally related to the EVOS. The second part of objective one - determining a habitat data base capable of being related to remote sensing is desirable, but not necessary for recovery efforts. Additionally nest site selection and the qualities of habitat sites that affect reproductive success probably occurs at scales too small for remote sensing. Likewise objective four, second part, refers to the elucidation of the role that oystercatchers play in structuring the intertidal invertebrate community. This is a very worthwhile project, but it does not relate very directly to the restoration of either the oystercatcher populations or the PWS intertidal community.

I question the author's practice of assuming that individual chicks in a brood can be considered as independent samples. Sibling rivalry notwithstanding, the chicks of a brood share genes in common, have the same parents and share the same territory. It is not clear that intra-brood variability in growth is likely to be as great as interbrood variability. This area needs additional analysis.

Some minor points:

Page 5, line 40. What do you mean by limpet compositions?

Page 9, line 26. Why would you expect bill growth to vary in any but the most extreme cases?

Page 10, top. Do you think oiled limpets are recognized as being limpets? If not, why are they taken at all?

Page 10, middle. Do you think recovery has been as rapid as your data suggest? Has there been sufficient local generation of young to support this level of recruitment? Maybe there were many birds temporarily displaced, or immigration occurred.

Page 10, bottom. It is of interest to know the prey size preference of oystercatchers, but how do you relate this to recovery from oiling? Can you show that certain size classes of limpets or other prey were differentially harmed by oiling? Were some prey species differentially affected?

FROM : PHONE NO. : P

Study: Feeding Ecology and Reproductive Success of BLOY in PWS
Brad Andres

Summary:

Significant effects of oil exposure to oystercatchers were demonstrated between oiled and unoiled areas of Green and Montague Islands. Birds laid smaller eggs in oiled areas, and weight gained by chicks was lower in oiled areas, even though increased food was delivered to them. An impaired food quality is hypothesized as the primary factor causing impaired growth of chicks. In spite of oil effects, however, Green Island oystercatchers were the most successful breeders in the study.

Recovery of oystercatchers is probably occurring on Green Island. The numbers of birds has increased 50% in 2 years, while on control areas of Montague I. the number stayed constant.

The text on pg 9 conflict with the conclusions and summary, in that it states that less prey biomass was being delivered to chicks in oiled areas. I assume that this should read MORE prey biomass was being delivered.

Fecal samples of BLOY adults and chicks should be collected in oiled and control areas to examine for hydrocarbon content.
Data collection and analysis:

1) Design: will results be significant? At what level?
yes, statistics are given that indicate very highly significant results. The study design, quantification of prey, growth, and reproductive parameters all indicate an excellent study.

2) Can study results be extrapolated?
In very general ways, this study could be extrapolated to other species consuming oiled prey.

3) Are there significant conclusions?
yes

Injury Identification:

4) Does study make an assessment of adverse impacts?
If so, what?
yes, decreased quality of food in oiled areas. The data is circumstantial, because no direct samples of tissues of BLOY were analyzed for oil, but the indirect data are convincing.

7) If no adverse impact is shown, could impact be shown by redesign or further study?
NA

Conclusion

5) Conflicting data that weakens evidence that oil spill was a factor? The reproductive success on Green I. was high, in spite of the fact that eggs were smaller, and chicks grew more slowly. The Knight I. data indicate that this area is quite different from the other two sites, and perhaps cannot be directly compared. The high Herring Bay productivity is not explained.

6) If causation not shown, could it be demonstrated by further study or redesign?
Yes, much additional information could be gotten in chicks were sacrificed for contaminant analysis, but the public would probably not like it. Feces analysis could suffice to prove much, including ingestion of oil, and possible excretion of undigested items because of oil in gut.

EIS
D

Richard MacIntosh
909 Mission Rd.
Kodiak, Alaska 99615
19 April, 1991

COPY

Ms. Kathy Kulitz
U.S. Fish and Wildlife Service
1011 E. Tudor Rd.
Anchorage, AK 99503

Dear Kathy,

I talked to you on the phone a while back about marbled murrelets in the Kodiak area and told you I would send what little information I have on breeding and possible breeding of birds reported as marbled murrelets in this area. Unfortunately, I don't know the "d.b.h." of spruce trees in the areas mentioned below, but all have (or had) spruce that would surely qualify as "old growth". Some of the records of birds passing overhead could conceivably refer to Kittlitz's murrelet, but given the ratio of the two species in Kodiak waters, it is highly unlikely. Here goes:

Downy young/"juveniles" found on forest floor

* 8/17/76 - "one juvenile found in woods - fully fledged Unit 121" from a report by U.S. Forest Service technician Wilma Zelhoefer who was doing bird survey work in connection with the Forest Service's Perenosa timber sale on Afognak Is. Unit 121 was a USFS timber cutting unit (Afognak map B-2, T. 22S, R. 19W, Section 3) on the east side of Discoverer Bay (see enclosed map).

* 8/11/86 - A large but still downy young found on the forest floor in the suburban Island Lake area near the town of Kodiak was brought to the Kodiak National Wildlife Refuge where it was photographed.

Adults found on the forest floor

* Sometime during the period 31 June to 12 July, 1976 - in timber cutting Unit 33 (Afognak map B-2, T. 21S, R. 19W, Section 34) on the east side of Discoverer Bay, Afognak Island, Wilma Zelhoefer (see above) found a dead adult in "Slough Creek" (see enclosed map).

* Sometime during the period late July to early August, 1976 -An adult was found under large spruce about 300 yds inland from Mill Bay, which is 2.5 mi NE of the City of Kodiak (found at 57 49.4'N, 152 21.2'W). The bird was found in or near a trailer park in which few canopy trees had been removed. I did see this bird.

* 5/25/77 - An adult brought to the Alaska Department of Fish and Game office was found on the forest floor about 500 yds from the southeast shore of Monashka Bay, about two mi north of the city of Kodiak. The bird had been found by a dog in this heavily wooded, low density residential area.

Birds flying over spruce and calling in morning or evening

* Sometime during the period 30 June - 2 July, 1978 - I camped on Afognak Island along the Afognak River where it meets salt water (58 04.8'N, 152 48.6'W). In the evening, I saw and heard murrelets flying upstream in loose groups of up to five birds, but most passed by ones or twos. They flew about 100-150 feet above the river in an area where fairly large trees lined the banks (ie: they were not too far above the treetops).

* 2-3 August, 1978 - from a report submitted to the U.S. Forest Service by Belle Heffner Mickelson on the birds of the Perenosa timber sale area on Afognak Island: "awoke each morning in Danger [Kazakof] Bay to the sound of marbled murrelets calling and flying rapidly overhead, keer, keer, keer. They seemed to fly back in the trees then out in the bay several hundred yards and back again. They flew like bomber pilots in small groups of 2-3 or 5-6. There were at least 30 birds"

* 6/23/85 - I saw and heard many flying overhead in the early morning from the beach at Pineapple Cove on Spruce Island (57 57.1'N, 152 28.2'W). Most of Spruce Island is covered with "old growth" spruce.

* they are seen and heard annually at several USFWS North American Breeding Bird Survey stops (Chiniak, Route 131) over large spruce between Cape Chiniak and Kalsin Bay. This is the same general area where a presumed marbled murrelet egg was found in August 1990 and given to the Kodiak National Wildlife Refuge.

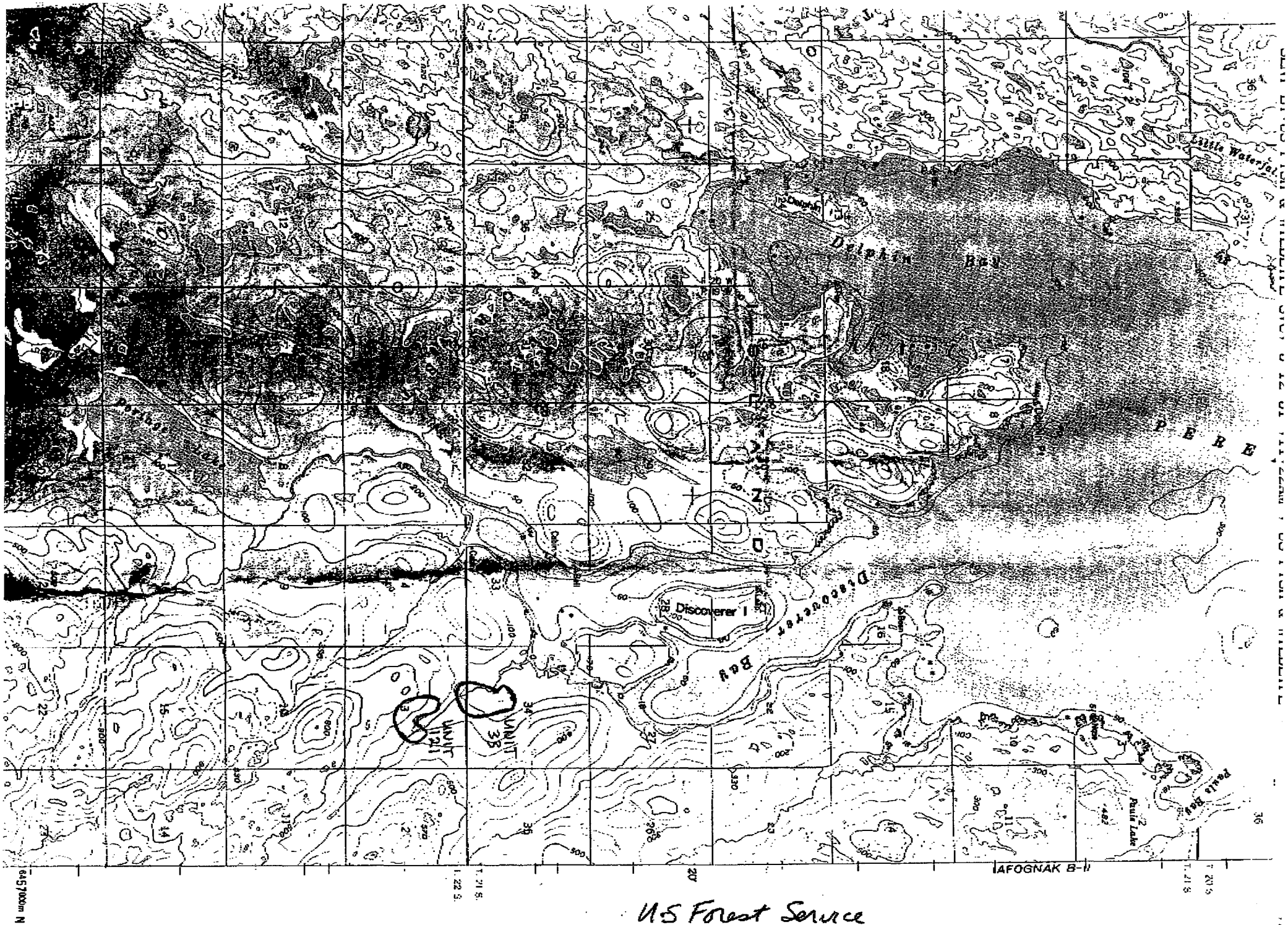
After I talked to you on the phone, I went back to the USFWS gray and ultra-gray OCSEAP literature from the late 70's and early 80's and found many, many suggestions of nesting murrelets. Perhaps the greatest mother-lode was the 1978 series of Cruise Reports (Cruises 1 through 9) of the R/V Commando, which worked on the east side of Kodiak and Afognak Islands. Some of these observations made their way into subsequent OCSEAP publications.

When you look at the sum total of evidence, it looks like marbled murrelets are common nesters throughout the forested portions of the archipelago. Unfortunately, there are fewer and fewer forested portions with each passing year. It certainly would be nice to see some Exxon money used to purchase forest land on Afognak. The chunk of land between the Kodiak Refuge's Ban Island Unit on Afognak, and Shuyak State Park would seem worth looking at. This would create a continuous swath of public land about 5 miles wide and 25 miles long!!

In discussing the one published marbled murrelet alpine record for the archipelago with Denny Zwiefelhofer, he felt, and I agree, that there wasn't much in the description that precluded the adult's being a Kittlitz's murrelet. The egg was collected so I wonder if the eggs of the two species can be distinguished and, if so, if the egg from the Kodiak nest was studied in that regard?

Sincerely,

Richard A. MacIntosh



US Forest Service
Chugach National Forest
Timber sale cutting units

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DRAFT

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Attorney Work Product

EXECUTIVE SUMMARY - Harlequin Duck Life History

The harlequin duck (Histrionicus histrionicus) has a disjunct holarctic distribution. The western population is more numerous with the greatest concentration of birds found in the Aleutian Islands of Alaska. Harlequin ducks breed and winter in relatively inaccessible areas and are therefore one of the least studied ducks in the northern hemisphere. Population estimates are limited and inexact; however, pre-spill wintering populations were estimated at 9,600 birds for the Kodiak Archipelago and 10,000 birds for Prince William Sound.

Harlequin ducks do not begin to breed until their second year. Egg laying is believed to begin between May 10 and May 30; 3-7 eggs are laid and incubated for 28-30 days. Broods would begin hatching in early to mid-July. Breeding birds conduct nesting and brood rearing inland next to turbulent mountain streams. Stream characteristics vary and preliminary information on nest sites found in Prince William Sound imply a considerable difference in preferred streams characteristics than published information from Iceland. Sam Patten found several nests at approximately 1000 feet elevation, next to cascading streams as narrow as 1 meter wide, further information will be available in the 1991 NRDA report. Most harlequin nest on the ground beneath dense vegetation, however, harlequins have been known to nest in tree cavities and rock crevices. Aquatic invertebrates are the primary prey for breeding birds and broods.

Immature birds remain on coastal habitats throughout the summer. Breeding males join the non-breeding birds in early July to form large flocks for the pre-basic molt. Protected bays, with anadromous fish streams, are preferred congregating areas. Marine invertebrates and mussels are the primary food source in winter and spring; once freshwater invertebrates become available within the intertidal zone, feeding behavior shifts to the mouths of the stream. Salmon roe is believed to be the principal food source when it becomes available. Hens with broods will return to coastal habitats in late August and will utilize many of the same molting areas used by the males.

Human impacts on the harlequin population are probably greatest through disturbance and habitat loss. Harvest levels are believed to be low for both subsistence and recreational hunting.

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HARLEQUIN DUCK

I. TAXONOMIC DESCRIPTION
   A. Common Name: Harlequin Duck
   B. Scientific Name: Histrionicus histrionicus
   C. Races: Currently, there are no races described.

II. RANGE
   A. Worldwide (Figure 1):
   Harlequin ducks have a disjunct distribution with at least two geographically isolated populations. The western population of harlequins breeds in eastern Siberia, north to the arctic circle, east to the Chukchi and Kamchatka Peninsulas. In North America, breeding populations range from the Seward Peninsula, south to the Aleutian Islands, east to the Mackenzie River then south to central California and the northern Rocky Mountains. Wintering populations concentrate along the coast of California to the end of the Aleutian Islands, then south to Korea and central Japan (Delacour 1959, Bellrose 1980).

   The eastern population of harlequins breed in Iceland, the southern half of Greenland, southeastern Baffin Island, and parts of Labrador. Wintering birds concentrate on the southern end of Greenland, near coastal areas around Iceland and extend down the coast of N. America to New Jersey (Delacour 1959, Bellrose 1980). The eastern harlequin duck is a casual visitor to the Great Lakes and accidental in Europe (Delacour 1959).

   B. Alaska
   The Aleutian Islands, Alaska Peninsula and the Alexander Archipelago contain the greatest numbers of breeding Harlequin ducks in their North American distribution (Bellrose 1980). The greatest wintering concentration of birds occurs in the Aleutian Islands, but wintering harlequins are also abundant in Prince William Sound and the Alexander Archipelago (Bellrose 1980). Bellrose (ibid.) estimated the wintering population in the Aleutian Islands to be between 600,000 and 1 million birds; however, **Patten**[1] cautions

---

[1] Patten, S.M. Jr., Alaska Department of Fish and Game. 333 Raspberry Road; Anchorage, Alaska 99559. Anchorage: (907) 267 - 2179. Fairbanks: 455-6101

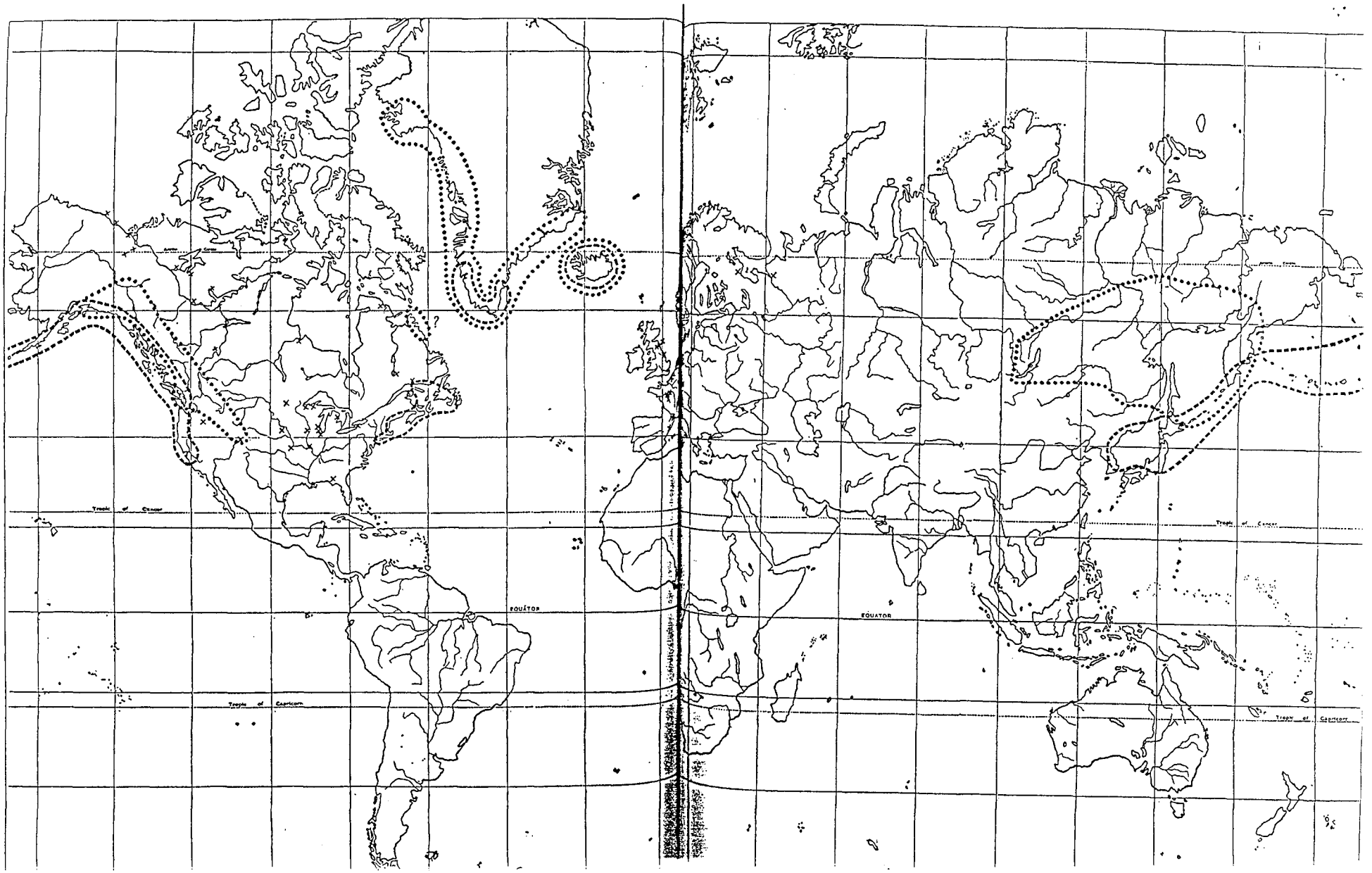

Figure 1. Breeding (...) and wintering (---) distribution of Harlequin ducks (copied from Phillips 1925).

that this estimate is considered to be too high (pers. com.). He also estimated the wintering population of harlequins in Prince William Sound at 10,000 birds. An estimate of 9600 wintering harlequins in the Kodiak Archipelago were extrapolated from winter surveys in 1979 and 1980 (Forsell and Gould 1981). The highest concentrations were found in Sitkaladik Narrows and between Narrow Cape and Ugak Island. There are no estimates for other areas impacted by the oil spill.

C. Population Status

Harlequin ducks are the least studied duck species in North America. There are no good data on population trends before the spill.

III. MIGRATION CHRONOLOGY

Harlequin ducks begin arriving on their wintering grounds in the Aleutian Islands in mid-September and remain there until May (Bellrose 1980). In interior Alaska, the birds begin to arrive on breeding grounds from mid-May, to late May in the Brooks range (Bellrose 1980). Birds which winter and breed in south-central Alaska may begin congregating near the mouths of suitable breeding streams in late April or early May (**Patten pers. comm.**). In July, males congregate in protected bays, with good feeding areas, for the prebasic molt. They congregate in extremely large flocks (Patten found a flock of 350 males in 1991) during the flightless portion of the molt. Non-breeding and failed-nesting females begin their molts in August and utilize many of the same molting sites as the males. Females with broods migrate to marine habitats in late August (**Patten pers. comm.**).

IV. BREEDING CHRONOLOGY

Very little is known about breeding behavior and chronology of Harlequins. Most of the information published in the literature are based on studies in Iceland.

Harlequin ducks do not reach maturity until their second year (Delacour 1959, Bengtson 1972, Bellrose 1980). In Alaska, laying is believed to begin between May 10 and May 30 (Bellrose 1980). Harlequins lay a total of 3-7 eggs with a 2 day laying interval, and incubate the eggs for 28-30 days (Bengtson 1966, Bellrose 1980). Males desert the females early in the incubation period.

There is very little information available on the brood rearing period. Given the incubation period, broods would be expected to hatch in early to mid-July. Bengtson (1972) describes a 30-40 percent mortality for ducklings during the first 2 weeks. Patten (**NRDA REPORT - 1990**) reports seeing 3.1 ducklings per hen in late summer. This is comparable to

the mean of 2.8 fully grown ducklings/breeding female found in Iceland over a 4 year period (Bengtson 1972).

V. HABITAT REQUIREMENTS

Harlequin ducks have unique habitat requirements because they use both marine and inland habitats. In coastal ecosystems, paired birds will be found in the intertidal reaches of mountain rivers and streams before moving inland to nesting habitats. Coastal areas are used throughout the summer by non-breeding birds, breeding males after the pair bonds are broken, and by failed nesting females (Bellrose 1980, Dzinbal and Jarvis 1982). Coastal habitats are used throughout the winter by all sex and age classes of harlequins.

A. Nesting and Brood Rearing Habitats

Harlequin ducks nest along rapidly flowing mountain streams. The width, turbidity and current velocity vary considerably, but most nests are located along shallow rivers and streams (0.5 - 1.0 meters deep) with gravel or rocky substrates (Bengtson 1972). Selection of streams is also related to nest site availability and the abundance of macroinvertebrates (Bengtson 1972). Early results from **NRDA Bird Study 11** (Patten 1990) identified 9 streams in Prince William Sound that are used by nesting Harlequins. A list of stream characteristics were developed (see Appendix I for a copy of these characteristics) which varied slightly Bengtson's (1972) findings. The results from the 1991 NRDA study are expected to provide substantially different information from published data. **Patten** (pers.com.) found more streams used for nesting (approximately 20 in PWS) than documented in 1990. Many of these streams were considerably different than previously identified streams, a complete description of these streams will be provided in the November report.

Published literature describes preferred nesting sites located on islands and islets (Bengtson 1972). Ground nests are usually located beneath shrubs and other dense vegetation. Harlequins will also nest in tree cavities and in rock crevices (Delacour 1959), but these nests have been documented less frequently than ground nests. Bengtson (1972) located 98 nests in Iceland, of these only 7 were more than 5 meters from water. The mean nesting density was 1.3 pairs/km. Although harlequins cannot be considered colonial nesting birds, Delacour (1959) states that several nests may be located close together on islands in high velocity streams. Harlequins appear to have high site tenacity, often returning to within 100 meters of

previous years nesting sites, females may use the same nest site for more than one season (Bengtson 1972).

In Prince William Sound, several of the nests located in 1991 were at approximately 1000 feet elevation, in timbered areas next to small, turbulent streams (Patten pers. com.). Patten described these streams as "pocket cascades", sometimes only 1 meter wide.

Slow stretches in oxbows, or lee sides of curves, are used by broods for feeding and resting. Outlets from lakes, beneath waterfalls and turbulent stretches of streams no more than 0.8 meters deep are favorite feeding locations for adults (Bengtson 1972). Young broods (Age classes Ia - IIb) feed mostly on surface insects and on insects from over hanging vegetation; older broods feed in the same areas and manners as the adults (Bengtson 1972).

B. Summer Habitats: Non-breeders and Males

Fjords and bays are used extensively by males and non-breeding females throughout the summer. In spring, harlequins congregate at the mouths of mountain streams, feeding in the bays and intertidal areas. Paired birds feed extensively in the intertidal areas before moving inland to nesting areas.

Dzinbal and Jarvis (1982) studied the summer habitat use and feeding ecology of harlequins at Sawmill Bay in Prince William Sound. They found that intertidal areas within the rivers were used for feeding until the second week of July. At that time, the ducks moved inland and fed in the lower 1 km of the creeks (beyond the intertidal zone). This shift in feeding areas corresponded with an increase in macroinvertebrates and an increase in salmon (Oncorhynchus spp.) spawning. In Sawmill Bay, males and nonbreeders rarely fed beyond the lower 1.5 km of the streams.

Dzinbal and Jarvis (ibid.) compared the relative amount of time harlequin ducks spent in a given habitat type, to the amount of time spent feeding within each habitat type. From these data they determined that the creek habitats were utilized more for feeding. Harlequins spent most of their time near small rock islands in the bays, but spent proportionately less of their time feeding in these areas. The unstated implication from these data are that harlequins use the rock areas for loafing and resting and the creek areas for feeding. Inglis et. al. (1989) found that harlequins preferred to rest on the banks of islands within the rivers, but also used rocks protruding from the water for loafing.

C. Wintering Habitats

Harlequins winter in small flocks (up to 10 birds) along exposed, rocky coasts. Foraging ducks use intertidal and subtidal areas throughout the coast line. They are more evenly distributed throughout the coastal areas during the winter, which shows a wider range of habitat use than during the summer (**Patten** pers. com.). During severe storms, the flocks will move to sheltered bays which offer protection from rough seas and strong winds.

VI. FOOD WEB INTER-RELATIONSHIPS

A. Predation

Predation is not believed to be a major source of mortality for adult harlequin ducks. Of the 98 nests observed by Bengtson (1972) 9 were depredated by raven (Corvus corax), mink (Mustela spp.), arctic skua (Stercorarius parasiticus), and arctic fox (Alopex lagopus). Ravens were believed to have destroyed 5 of the nests. Very little information is available about brood rearing and mortality. Bengtson (1972) estimated a 30-40 percent mortality for ducklings in the first two weeks after hatch, adverse weather during this time period may be a significant cause of mortality.

B. Feeding Behavior and Diets - Summer

Harlequin ducks feed almost exclusively on animal matter. Breeding birds and broods in Iceland, fed mostly on abundant Simuliidae (Diptera), but also fed on Chironomidae larvae and Trichoptera (n=31) (Bengtson 1972). Once salmon begin spawning, harlequins begin eating roe (Delacour 1959, Dzinbal and Jarvis 1982). It is unclear in the literature if brood movement downstream is linked to spawning. It is believed that breeding birds in Coastal ecosystems with short mountain streams, may fly from nesting areas to the mouths of the rivers for feeding (Bengtson 1972, Dzinbal and Jarvis 1982). This is apparently linked to shorter streams having lower nutrient quality and therefore less productive invertebrate populations (Bengtson 1972).

It is important to recognize that the information on feeding habits and preferences of harlequins in Alaska is extremely limited. Much of the information that follows is based on small sample sizes and observations.

The summer diets (n=5) of coastal harlequins in Prince William Sound consisted of a variety of crustacea and invertebrates (Dzinbal and Jarvis 1982). Feeding patterns suggest that the birds ate marine

invertebrates until freshwater invertebrates became abundant. Once salmon began spawning, the diets may shift predominantly to salmon roe.

C. Prey Species - winter
Wintering harlequins forage mostly along exposed coasts and in bays (Delacour 1959, Bellrose 1980). They are generally found in small groups, usually less than 10 birds and are seen foraging closer to shore than other sea-ducks (Bellrose 1980). Crustaceans and mollusks (Crustacea and Mollusca respectively) comprise the bulk of the winter diet for harlequins (Delacour 1959, Bellrose 1980, Dzinbal and Jarvis 1982). Other animals which supplement this diet include insects, starfish (Echinodermata), and fishes (Bellrose 1980, Dzinbal and Jarvis 1982).

VII. HUMAN INTERACTIONS

The holarctic distribution and migration patterns of harlequin ducks limits the hunting impacts on the species. The annual take of harlequins in Prince William Sound is unknown, but believed to be small since most harvesting is associated with using males as decorative mounts (**Patten pers. comm.**). There does not seem to be any significant Native use of harlequins; although, Nelson (1887 cited in Phillips 1925) mentioned that some Native populations killed male harlequins and stuffed them as toys for children.

Patten believes that disturbance to the molting flocks would be one of the greatest human-related impacts, aside from toxic spills, on the harlequin population. He expects to provide a detailed accounting of locations of molting flocks and potential impacts of disturbance in the NRDA report.

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Phillips, J.C. 1925 (1986). A natural history of the ducks. Vol. III. Dover Publ. Inc. New York pgs 363-383.

Copied from: Patten, S.M. 1990. Prince William Sound Harlequin Duck Breeding Habitat Analysis Feasibility Study. Appendix I. NRDA BIRD STUDY No. 11.

Table 2

Characteristics of Harlequin Nesting Streams in Prince William Sound

Characteristics
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

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To Stan Senner	From Crowley
Co. RPD	Co. Fairbanks
Dept.	Phone # 457-8000
Fax # 276-7178	Fax #

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MEMORANDUM **State of Alaska**

Department of Fish and Game Date: February 3, 1992

TO: Mark Fraker
ADF&G
OSIAR
Anchorage

FROM: Sam Patten
WB III
ADFG - DWC

Tel: 267-2376, 455-6101

RE: Justification for continuing research on Harlequin restoration in eastern PWS in 1992.

Harlequins have a low reproductive rate, strong fidelity to wintering and breeding areas, and feed in the intertidal. These factors will likely inhibit recovery of the western PWS Harlequin population from the oil spill. Management of a nearby source of immigrants (the eastern PWS population) is proposed as a restoration concept. Current timber harvests in eastern Prince William Sound threaten habitat of breeding Harlequins there. Identifying all breeding streams and acquiring old growth forest habitat in eastern PWS are critical for the restoration of Harlequins in the oil spill area. A thorough inventory of individual HADU using each stream in eastern PWS is necessary to determine breeding density, success, and frequency.

The HADU Restoration Project forsees eventual restoration implementation by studying the feasibility of habitat enhancement. We will test several artificial nesting cavity designs. These are based on natural cavities used by Harlequins as well as on nest boxes used by aviculturalists to breed Harlequins. The nest boxes have been designed by the aviculturalists during years of testing. The prototype nest boxes will be placed in the field in eastern PWS near known HADU nest sites. Because nest sites are a limiting factor for Harlequins breeding in Iceland and possibly PWS, increasing the number of nest sites could potentially increase breeding density along streams in eastern and western PWS.

This would increase the rate of recovery from the oil spill by: 1) increasing the number of emigrating Harlequins from eastern PWS (generally young and first-time breeders) and 2) increasing production directly in western PWS. The caveat here is, however, HADU's are no longer subjected to sublethal and reproductively inhibiting doses of petroleum hydrocarbons from the intertidal.

cc: Calkins
Senner
Crowley

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DEPARTMENT OF FISH AND GAME

COPY

Dave Crowley
1580 Alpine Vista Ct
Fairbanks, AK 99712
January 2, 1992

Stan Senner
Oil Spill Restoration Planning Office
Alaska Dept. Fish and Game
Anchorage, AK 99518

Dear Stan,

Hope you had a relatively restful holiday season. I would like to update you on the status of that graduate school position for me and try to proceed to the next phase. Dr. Bob Jarvis from Oregon State U., one of our peer reviewers for the Harlequin projects, has agreed to be my major advisor. I met with Bob at OSU in December to discuss the project and funding for a masters degree. He was pleased with the progress and results to date of the Harlequin Restoration Project and had very few comments on improving data collection. Our greater concern was funding. He indicated 2 approaches we can take: write up a 2 year contract between the State of Alaska (and possibly USFWS) and OSU that will cover tuition, health insurance, stipend, supplies, indirect costs and travel; or include the above costs in the annual Harlequin Project budget. The 2 year contract seems the better approach because the funding is provided up front for the entire masters project and I can get resident tuition ($1050 per term as opposed to $4700 nonresident!) under a Research Assistantship which are only awarded with a contract.

Bob and I estimated the total cost of a masters degree at $34,800, which is around $3000 less than my base pay during those same months. While in school, I would continue to fulfill my obligations to Fish and Game (as directed by Sam), mainly report and proposal writing. Bob indicated that the contract would probably have to pass through the Attorney General's office in both Alaska and Oregon. Sam mentioned that Assistant A. G. Swidirski may be supportive of the project.

Sam and I discussed the question certain to be asked by the State of Alaska: "What's in it for the State of Alaska?" We propose the following benefits to the state: 1. The Harlequin Restoration project, an expensive undertaking, would undoubtedly be improved scientifically with the academic support of a Harlequin expert (Jarvis) and a major, research-oriented university with <u>less</u> <u>overall</u> <u>cost</u> to the state. 2. The supporting agency (Dept. Fish and Game) receives a more highly

DEPARTMENT OF FISH AND GAME

trained and qualified employee. 3. ADFG could continue to benefit from ties to Oregon State University, a Land, Sea and Space Grant institution sharing many of the same concerns regarding natural resources as southern and Southeast Alaska.

Sam and I would like to meet with you for an hour or so to discuss means of funding and what our next step should be. We will both be in Anchorage for a few days starting January 20th (Sam is on leave until the 18th) and will contact you about a meeting time. I can be reached at 457-8000.

I would like to personally thank you for initiating the M.S. position under the Restoration Project. I feel very fortunate to be poised for the position and guarantee my best efforts.

Sincerely,

David W. Crowley

David W. Crowley

Am not sure that I did!
Stan

11-K1LH

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MEMORANDUM

State of Alaska

DEPARTMENT OF FISH & GAME

TO: Sam Patten
Game Biologist
OSIAR Division
Department of Fish and Game

DATE: October 2, 1991

FILE NO.: 17.7.7

TELEPHONE NO.: 267-2295

SUBJECT: Compilation of Harlequin Duck Stream Oiling Information

FROM: Kathrin Sundet KS
Habitat Biologist
Region II
Habitat Division
Department of Fish and Game

Litigation Sensitive
Attorney Work Product
Attorney-Client Privilege

The compilation of oiling information by Habitat personnel for PWS streams that are potentially utilized by Harlequin ducks has been completed. Attached is a table of 'harlequin duck streams' for 1989-1991, listing oiling observations and their sources by location and date, as discussed during our meetings in August and September. This memo will further describe the selection of streams, sources of oiling data, criteria used for summarizing oiling information, and availability of supplemental data.

Table contents

The original list of twelve streams which we received on August 18, has been expanded to approximately fifty-five streams based on a revised list by Tom Crowe and Rick Gustin. The attached stream oiling table is sorted by ADEC segment number, sub-segment, anadromous stream catalog number (ASC#), and date. For each stream, the stream number, location and oiling summary information is listed under a sub-heading. Where the ASC# could not be clearly identified, the information was listed by segment and subsegment numbers minus oiling summaries. Segment MA002 was included in the table, as it consists of four small islands offshore potential duck streams and Rick Gustin had mentioned that these islands were frequented by Harlequin ducks. The SOURCE DOCUMENT section will be further described in the next paragraph. The RATING column ranks the information source as 'detailed', 'medium' or 'general'. The DESCRIPTION column contains abstracted information from the original sources (where RATING is medium or detailed), or mostly quotes (where RATING is general) in an attempt to expedite further data searches, if necessary.

Sources of information

All available Habitat-generated data sources were used and supplemented with ADEC data, ADF&G Commfish/Sportfish survey sketches, and data from the joint government/Exxon surveys.

Habitat data sources consist of PWS 1989 logs, treatment and oiling summary reports, data forms and sketches associated with ANADSCAT (1990 Anadromous Stream Cleanup Assessment Team), Pre-ASAP (Habitat pre-screening for the 1989 August Shoreline Assessment Program), MAYSAP (1991 May Shoreline Assessment Program), treatment monitoring, the 1989/1990 Winter study data, and miscellaneous surveys conducted by Habitat in conjunction with other agencies. This information was supplemented with data from the photos, videos and sediment samples databases, where necessary. In some cases videos were reviewed and abstracted to further document oiling conditions.

As references for 1989 oiling conditions, oiling categories from the SCAT (Shoreline Cleanup Assessment Program, the earliest 1989 survey) and the ADEC Fall Beach Survey (Fall Walk-a-thon) were incorporated where applicable. Where Habitat oiling information seemed insufficient or oiling descriptions covered a wide range, ADEC Gundlach transect data, ADEC monitoring reports, references to descriptive ADEC photos, and detailed SCAT descriptions were added as available.

Oiling categories

Each stream heading in the oiling table contains oiling categories pertaining to the stream area: N/A (not applicable, or insufficient data to make a determination), NS (noted as not surveyed in sketch), and VL (very light) to H (heavy). M/H indicates medium oiling with heavy pockets (usually subsurface pockets). 1989 SCAT contains the SCAT survey category, 1989 DEC FALL SURVEY lists the oiling condition from the DEC tic-maps near the stream mouth, and HABITAT OILING SUMMARY lists separate categories for 1989 through 1991.

However, I urge you to be cautious in utilizing these categories, as oiling varied among years, agencies, and to some extent, varied slightly among observers. The designations are intended merely to provide a general index for comparative purposes. The following paragraph summarizes our criteria in evaluating oiling conditions from the compiled comments.

Oiling criteria

Assigning oiling categories by year to the compiled stream information was not a simple task as the quality and detail of observations (especially in 1989), varied widely and both oiling criteria and the character of the oiling itself changed over the years 1990 and 1991. Thus 1989 criteria largely ignored subsurface oiling, and although streams were monitored with some respect to subsurface contamination in 1990, this issue was not fully addressed until the 1991 MAYSAP survey.

The Habitat Division EVOS group jointly reviewed individual oiling comments for all Harlequin duck streams and assigned oiling categories along the following guidelines:

The SCAT and DEC Fall Beach surveys were used as comparisons for all other observations, and were thus not included in the Habitat oiling summaries. Whenever there were no Habitat observations for a given stream within a year, or information was considered insufficient, the Habitat summary was considered N/A. For each year, oiling was summarized with emphasis on the earliest and most detailed information of the season in order to reflect untreated conditions. In cases where only late-season observations were available, we made no attempt to back-extrapolate oiling to previous surveys like SCAT or the 1989/1990 Winter Study.

We used a combination of oiling criteria in an attempt to standardize oiling categories among the years, leaning heavily on sketches of oiling conditions and dimensions of oiled areas. In determining oiling criteria, we used a 'sifting process', applying major criteria first, then adjusting the categories with further considerations. A list of oiling criteria is available upon request.

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Additional information

In addition to the above oiling summaries, Habitat can provide further information on items rated as 'detailed' or 'medium'. Approximately 600 sediment samples (tracked in the Samples database by sample ID and ASC#) were taken by Habitat in PWS and can be analyzed at Texas A&M's GERG labs for toxic constituents upon request. Photos and videos documenting oiling information as indicated in the oiling table are available upon request for most streams.

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cc: Lance Trasky
Tom Crowe
Ken Middleton
Don Calkins
[redacted]
Rick Gustin
Mark Fraker

Bcc. Stan Senner

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STATE OF ALASKA

WALTER J. HICKEL, GOVERNOR

DEPARTMENT OF FISH AND GAME

Dave Crowley
1580 Alpine Vista Ct
Fairbanks, AK 99712
January 2, 1992

Stan Senner
Oil Spill Restoration Planning Office
Alaska Dept. Fish and Game
Anchorage, AK 99518

Dear Stan,

Hope you had a relatively restful holiday season. I would like to update you on the status of that graduate school position for me and try to proceed to the next phase. Dr. Bob Jarvis from Oregon State U., one of our peer reviewers for the Harlequin projects, has agreed to be my major advisor. I met with Bob at OSU in December to discuss the project and funding for a masters degree. He was pleased with the progress and results to date of the Harlequin Restoration Project and had very few comments on improving data collection. Our greater concern was funding. He indicated 2 approaches we can take: write up a 2 year contract between the State of Alaska (and possibly USFWS) and OSU that will cover tuition, health insurance, stipend, supplies, indirect costs and travel; or include the above costs in the annual Harlequin Project budget. The 2 year contract seems the better approach because the funding is provided up front for the entire masters project and I can get resident tuition ($1050 per term as opposed to $4700 nonresident!) under a Research Assistantship which are only awarded with a contract.

Bob and I estimated the total cost of a masters degree at $34,800, which is around $3000 less than my base pay during those same months. While in school, I would continue to fulfill my obligations to Fish and Game (as directed by Sam), mainly report and proposal writing. Bob indicated that the contract would probably have to pass through the Attorney General's office in both Alaska and Oregon. Sam mentioned that Assistant A. G. Swidirski may be supportive of the project.

Sam and I discussed the question certain to be asked by the State of Alaska: "What's in it for the State of Alaska?" We propose the following benefits to the state: 1. The Harlequin Restoration project, an expensive undertaking, would undoubtedly be improved scientifically with the academic support of a Harlequin expert (Jarvis) and a major, research-oriented university with <u>less overall cost</u> to the state. 2. The supporting agency (Dept. Fish and Game) receives a more highly

trained and qualified employee. 3. ADFG could continue to benefit from ties to Oregon State University, a Land, Sea and Space Grant institution sharing many of the same concerns regarding natural resources as southern and Southeast Alaska.

Sam and I would like to meet with you for an hour or so to discuss means of funding and what our next step should be. We will both be in Anchorage for a few days starting January 20th (Sam is on leave until the 18th) and will contact you about a meeting time. I can be reached at 457-8000.

I would like to personally thank you for initiating the M.S. position under the Restoration Project. I feel very fortunate to be poised for the position and guarantee my best efforts.

Sincerely,

David W. Crowley

David W. Crowley

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MEMORANDUM

State of Alaska

DEPARTMENT OF FISH & GAME

TO: Sam Patten
Game Biologist
OSIAR Division
Department of Fish and Game

DATE: October 2, 1991

FILE NO.: 17.7.7

TELEPHONE NO.: 267-2295

SUBJECT: Compilation of Harlequin Duck Stream Oiling Information

FROM: Kathrin Sundet KS
Habitat Biologist
Region II
Habitat Division
Department of Fish and Game

Litigation Sensitive
Attorney Work Product
Attorney-Client Privilege

The compilation of oiling information by Habitat personnel for PWS streams that are potentially utilized by Harlequin ducks has been completed. Attached is a table of 'harlequin duck streams' for 1989-1991, listing oiling observations and their sources by location and date, as discussed during our meetings in August and September. This memo will further describe the selection of streams, sources of oiling data, criteria used for summarizing oiling information, and availability of supplemental data.

Table contents

The original list of twelve streams which we received on August 18, has been expanded to approximately fifty-five streams based on a revised list by Tom Crowe and Rick Gustin. The attached stream oiling table is sorted by ADEC segment number, sub-segment, anadromous stream catalog number (ASC#), and date. For each stream, the stream number, location and oiling summary information is listed under a sub-heading. Where the ASC# could not be clearly identified, the information was listed by segment and subsegment numbers minus oiling summaries. Segment MA002 was included in the table, as it consists of four small islands offshore potential duck streams and Rick Gustin had mentioned that these islands were frequented by Harlequin ducks. The SOURCE DOCUMENT section will be further described in the next paragraph. The RATING column ranks the information source as 'detailed', 'medium' or 'general'. The DESCRIPTION column contains abstracted information from the original sources (where RATING is medium or detailed), or mostly quotes (where RATING is general) in an attempt to expedite further data searches, if necessary.

Sources of information

All available Habitat-generated data sources were used and supplemented with ADEC data, ADF&G Commfish/Sportfish survey sketches, and data from the joint government/Exxon surveys.

Habitat data sources consist of PWS 1989 logs, treatment and oiling summary reports, data forms and sketches associated with ANADSCAT (1990 Anadromous Stream Cleanup Assessment Team), Pre-ASAP (Habitat pre-screening for the 1989 August Shoreline Assessment Program), MAYSAP (1991 May Shoreline Assessment Program), treatment monitoring, the 1989/1990 Winter study data, and miscellaneous surveys conducted by Habitat in conjunction with other agencies. This information was supplemented with data from the photos, videos and sediment samples databases, where necessary. In some cases videos were reviewed and abstracted to further document oiling conditions.

As references for 1989 oiling conditions, oiling categories from the SCAT (Shoreline Cleanup Assessment Program, the earliest 1989 survey) and the ADEC Fall Beach Survey (Fall Walk-a-thon) were incorporated where applicable. Where Habitat oiling information seemed insufficient or oiling descriptions covered a wide range, ADEC Gundlach transect data, ADEC monitoring reports, references to descriptive ADEC photos, and detailed SCAT descriptions were added as available.

Oiling categories

Each stream heading in the oiling table contains oiling categories pertaining to the stream area: N/A (not applicable, or insufficient data to make a determination), NS (noted as not surveyed in sketch), and VL (very light) to H (heavy). M/H indicates medium oiling with heavy pockets (usually subsurface pockets). 1989 SCAT contains the SCAT survey category, 1989 DEC FALL SURVEY lists the oiling condition from the DEC tic-maps near the stream mouth, and HABITAT OILING SUMMARY lists separate categories for 1989 through 1991.

However, I urge you to be cautious in utilizing these categories, as oiling varied among years, agencies, and to some extent, varied slightly among observers. The designations are intended merely to provide a general index for comparative purposes. The following paragraph summarizes our criteria in evaluating oiling conditions from the compiled comments.

Oiling criteria

Assigning oiling categories by year to the compiled stream information was not a simple task as the quality and detail of observations (especially in 1989), varied widely and both oiling criteria and the character of the oiling itself changed over the years 1990 and 1991. Thus 1989 criteria largely ignored subsurface oiling, and although streams were monitored with some respect to subsurface contamination in 1990, this issue was not fully addressed until the 1991 MAYSAP survey.

The Habitat Division EVOS group jointly reviewed individual oiling comments for all Harlequin duck streams and assigned oiling categories along the following guidelines:

The SCAT and DEC Fall Beach surveys were used as comparisons for all other observations, and were thus not included in the Habitat oiling summaries. Whenever there were no Habitat observations for a given stream within a year, or information was considered insufficient, the Habitat summary was considered N/A. For each year, oiling was summarized with emphasis on the earliest and most detailed information of the season in order to reflect untreated conditions. In cases where only late-season observations were available, we made no attempt to back-extrapolate oiling to previous surveys like SCAT or the 1989/1990 Winter Study.

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cc: Lance Trasky
[redacted]
Tom Crowe
Rick Gustin
Ken Middleton
Mark Fraker
Don Calkins

Bcc. Stan Senner

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THE LIVING BIRD

ELEVENTH ANNUAL

of the

Cornell Laboratory of Ornithology

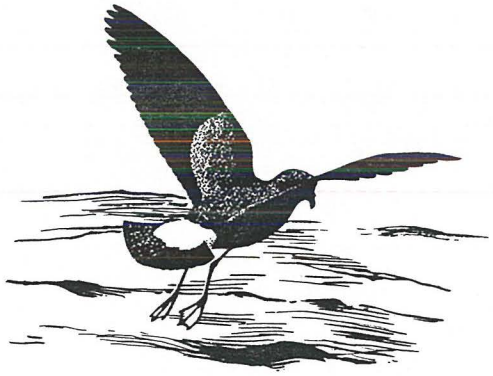
1972

Edited by

OLIN SEWALL PETTINGILL, JR.

and

DOUGLAS A. LANCASTER



Published by

The Laboratory of Ornithology

at

Cornell University, Ithaca, New York

1972

Stan,

Please provide any comments by October 15th. I will try and make corrections in time for the next RPWG meeting.

Karen

rey R. Bourne.

THE BLUE DUCK OF NEW ZEALAND

JANET KEAR

One can find no better introduction to the Blue Duck (*Hymenolaimus malacorhynchos*) than the quotation from Buddle (1951): "To those who know it . . . , the memory of that long-drawn-out whistle, *'whio,'* the call of the blue duck will bring a nostalgia, a longing to be back once more in the heart of the bush, high up in the beech forest, with the bare mountain tops glimpsed through a gap in the canopy; a rushing torrent cascading over huge boulders and broken rock, with here and there a still pool; the only sound that of the water, . . . such is the home of the blue duck."

The Blue Duck (Figures 1 and 2), one of the least known of the waterfowl, inhabits one of the world's loneliest and loveliest regions, the high country of New Zealand. Taxonomically something of a puzzle, the Blue Duck behaves little like the other dabbling ducks, with which it is usually placed, and appears to share its food niche with fresh-water fish (Kear and Burton, 1971). The drake, although highly territorial and aggressive, apparently mates for life and shares in the care of the ducklings.

The Blue Duck is astonishingly tame and confiding, often allowing a person to approach closely before taking off in flight. Yet despite its tameness, few people have studied it. According to Blackburn (1967), the vast majority of New Zealanders have never seen this unique bird, and many are unaware of its existence.

The following account deals with my brief study of the Blue Duck in the field between October 1968 and January 1969, brings together all the records of its breeding biology, and considers its taxonomic position in the light of our present knowledge.

Description

The Blue Duck is, as its name implies, basically blue in color — a dark slate blue, not unlike that of the water and the wet rocks against which it most often appears. Its crown is tinged with green. The feathers of its breast and upper abdomen are richly spotted with chestnut, and so beautiful that Maori women formerly wore them as ornaments around the neck. The wing is the same lead blue with the tips of the six outer secondaries narrowly bordered with white, the only remnants of the speculum which, in most dabbling ducks, extends over nine or 10 secondaries. Four or five of the innermost secondaries,

Figure 1. A pair of Blue Ducks standing above the waters of a mountain stream. A large and tame duck, it lives only in New Zealand. Courtesy of National Publicity Studios, Wellington.

sometimes called "tertials," have a longitudinal black line on the outer margin. When the wing is folded, hiding the speculum, these slightly iridescent, velvety markings are still visible. The legs and feet are dark brown, and the eyes a bright golden yellow.

The Blue Duck has one of the most peculiar bills of all the Anatidae. Mainly white, it is edged in black, and from the forward, or anterior, edges of the upper mandible rise a pair of soft black flaps (Figure 3), which overhang the lower jaw to a considerable extent and probably cushion the edges of the bill when the bird feeds (Kear and Burton, 1971).

Except in voice and size, the male and female are not readily distinguishable. The drake gives a long, drawn-out whistle, from which the species derives the Maori name of Whio; the female utters only a low rasping quack. On the average, the male is somewhat heavier than the female (Table 1).

Habitat

The Blue Duck, now mainly confined to the mountain regions of New Zealand, is even more strictly associated with water than most other ducks (Figure 4). In the bush, from sea level to tree line, it inhabits the swift, clear streams: " . . . where the foaming torrent, walled in on both sides, rushes impetuously over its shingle-bed, surging around the huge water-worn boulders that obstruct its course, and forming alternately shallow rapids and pools

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Studios, Wellington.

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of deep water" (Buller, 1888). The clean, well-oxygenated water in the turbulent streams that Buller described supports an abundance of invertebrate life that, in turn, supports the Blue Duck. The food supply seems to be one factor restricting the duck to a certain stream; the width of the stream another. Blue Ducks probably live permanently only on streams over 10 feet wide in places, although they certainly use smaller streams for feeding.

While difficult to find, the Blue Duck, with its patchy but wide distribution, is fortunately in no immediate danger of extinction. In the North Island, it inhabits mainly the mountain regions around Urewera and Tongariro National Parks. I spent most of my time in Urewera. On the South Island, the Blue Duck occurs throughout the western uplands, principally in Otago and Southland. Figure 5 shows the Blue Duck's recent distribution and all the sites where sub-fossil bones have been found (R. J. Scarlett, pers. commun.). Three sites were middens of moa-hunting Polynesians, probably indicating that the early inhabitants of New Zealand ate these ducks but never commonly. Only one of the remaining sites, all in caves and potholes, lies within the bird's present range. Mr. Scarlett (pers. commun.), although he knows of no true fossil remains of the Blue Duck, believes that the genus has been confined to New Zealand for many thousands of years.

We cannot assess the total number of Blue Ducks at the present time. The almost complete dependence of the species upon the streams and rivers of forested areas at any altitude and the bird's high degree of territoriality automatically restrict and localize the populations. Probably no more than one breeding pair occurs within each half mile of unmodified bush stream of suitable width. However, this vague estimate requires additional study and checking by banding groups of birds. New Zealand has thousands of acres of bush and many miles of seemingly suitable streams.

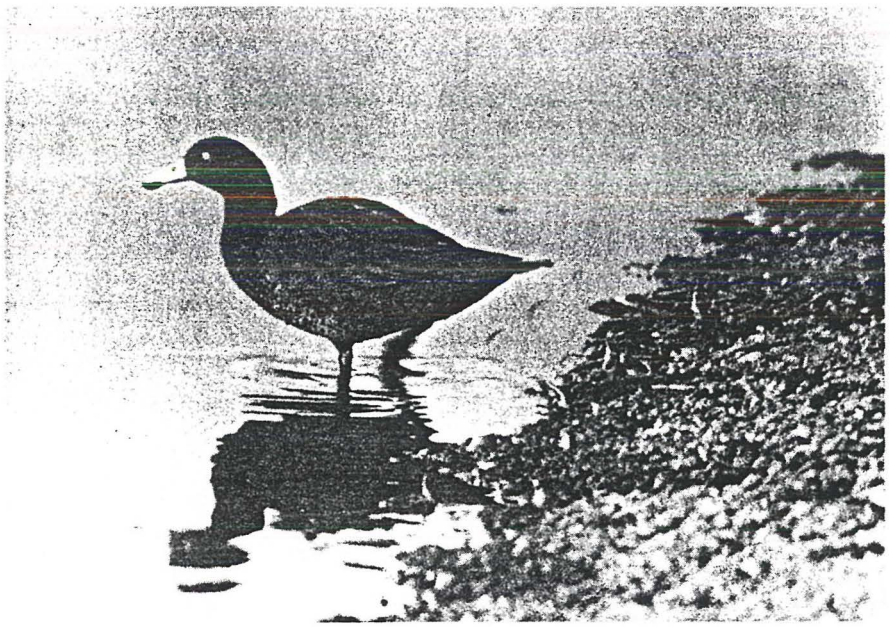

Figure 2. The Blue Duck has a strong bluish sheen to its dark gray body. The breast is heavily spotted with reddish brown. And the distinctive bill is pinkish white with a black tip. Photograph by E. E. Jackson.

During the last century, the Blue Duck not only has disappeared from parts of its former range, but also is less common within its present range. Buller (1888) wrote that soldiers, engaged in the war of 1869–1871 against the Maori Te Kooti, sometimes took 30 or 40 Blue Ducks in a day in Urewera country. I could not even see that number when I searched there in 1968. Phillips (1926) noted that the bird still lived on streams within 30 miles of Wellington; alas, this is no longer true.

Although easy to capture and, therefore, at times slaughtered quite ruthlessly, the Blue Duck's decline has undoubtedly been due more to the destruction of its habitat than to killing. The clearing of land for agriculture definitely expelled the birds from those areas (Guthrie-Smith, 1927). The cutting of the bush and letting in the sun altered the stream environment by warming it and by increasing the possibility of flooding rains eroding exposed banks. Persistent flooding scours a stream bottom, produces silt which smothers or washes away the insects upon which the ducks depend, and may mean that the stream, richer in soluble nutrients, carries less oxygen for future invertebrate colonizers.

The acclimation of numerous mammals in a land that originally had only bats and seals has been disastrous for some of the native avifauna of New Zealand. The deer, by removing some of the native cover and trampling the soil, have probably been responsible for much of the erosion. Rats, stoats, weasels, and polecats, plus the fairly plentiful wild cats, dogs, and pigs, all take eggs from ground nests and many prey on ducklings and incubating females. The introduction of insectivorous birds, which feed on the adult stages of the Blue Duck's invertebrate food, may also have effected the Blue Duck's decline. And finally, since the 1870's, trout introduced in most of the lowland streams have, we suggest, competed directly with the Blue Duck for food (Kear and Burton, 1971). Although such competition is still only conjectural, the birds live more commonly today on streams where the trout are scarce.

TABLE 1

Weights of Adult Blue Ducks*

Month	*Males*	*Females*
February	1075	850
April	800**	
May	755	680**
July	920**, 865**	790**, 695**
December	850**, 990**, 850**	740**
Average	890	750

*In grams.

**Captive birds.

Figure 3. One of the most characteristic features of the Blue Duck is the bill, in which the lateral flaps of the upper bill may protect the jaw during the bird's active search among the stones of rocky stream bottoms for the aquatic insects that comprise the bulk of its diet. Photograph by Graham Byford.

Breeding Biology

Breeding Season

Male and female probably mate for life and defend their territory the year round. However, only preliminary studies of their social and sexual behavior have been made and there is no proof (Kear and Steel, 1971). Repeated copulations in the spring seem to maintain the pair-bond and perhaps serve to synchronize the reproductive states of the pair.

The breeding season extends over a long period — from August of one year to June of the next — suggesting that one pair may raise two broods a year (Travers, 1972). Guthrie-Smith (1927) supposed that the Blue Duck could begin nesting in August because the first broods appeared in September; and, indeed, Whitten (1972) reported a clutch of seven eggs, found north of Gisborne on 9 August 1971. We now have records of 20 nests with eggs, including two that I have seen; and we know the hatching dates for six of them (Table 2).

From observations of ducklings whose ages could be estimated, it was deduced that, for most broods, hatching occurs in October. However, the first broods probably appear in August (Figure 6). Blackburn (1960) saw a pair with young about three weeks old, near Gisborne, on 8 September. At the other end of the long season, ducklings are not unusual in February and March, and we have one record (T. H. Steel, pers. commun.) of five- or six-weeks-old ducklings on the Waipoa Stream on 10 April. The very latest record is of an adult with young, near Gisborne, on 10 June (Blackburn, 1956).

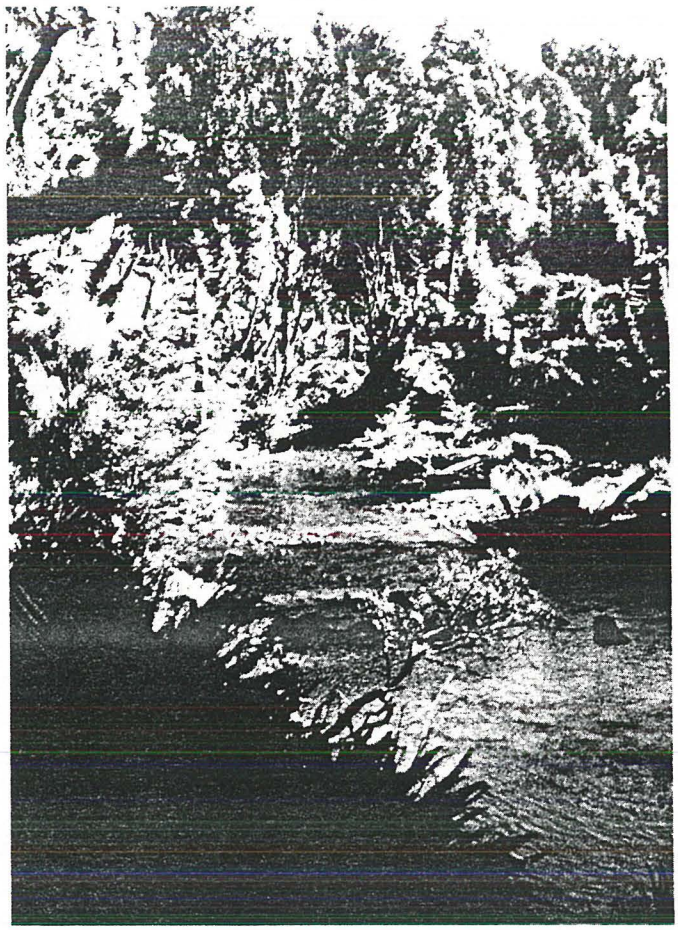

Figure 4. Typical habitat of the Blue Duck. The Waipoa Stream, North Island. Photograph by the author.

Many of these broods were in the North Island, and while there are not enough data to say that the breeding season varies according to latitude and altitude, it seems likely that, in the colder regions of the South Island and in the high mountains of both islands, Blue Ducks breed over a more limited period. The timing of egg-laying has probably evolved in relation to food supply. First, the female must have sufficient food to enable her to produce half her body weight in the form of eggs in about one week; and, second, six weeks later, the ducklings must have an abundance of food for growth. Because the food supply varies (Kear and Burton, 1971), it seems likely that a pair of Blue Ducks produces, on the average, only one brood a year. Nest-building, egg-laying, and incubation occupy 40 to 45 days, and the juveniles apparently stay with their parents until they attain mature plumage at the age of five months.

Nest Site

The choice of nest site varies. In the wild, Blue Ducks select natural burrows (Figure 7). At Mount Bruce Native Bird Reserve, they used an artificial

Island. Photograph by

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burrow. However, the species is by no means an obligate hole-nester (Potts, 1870; Buller, 1892). We have records of 18 sites: one each in a hollow log and hollow tree trunk; two each in rocky clefts in a bank, on ledges of rock on a cliff face, among the roots of a fallen tree, under logs overgrown by grass, beneath a bush of mountain flax, and under a *Carex* clump; and four under large clumps of tussock grass.

Normally, a canopy of vegetation prevents observation from above, as shown in a photograph by Howard (1963). The few exposed nests are relatively unaccessible as was the one on the cliff face, photographed by E. F. Stead (Oliver, 1955). Thus, the Blue Duck may select any site in the territory, usually well concealed but not necessarily so. Since three of the nests found in banks faced north, the sunny side, we may presume that the bird prefers warm, dry sites. There is no record of a Blue Duck nesting in an elevated tree site, such as the Astelia clumps favored by the New Zealand Grey Duck (*Anas superciliosa*), although Fulton (1908) stated that in North Canterbury Blue Ducks " . . . may be found nesting in trees."

Guthrie-Smith (1927) suggested that a pair may use the same site year after year, and this may well be true of successful sites. Since the recorded distances of Blue Ducks' nests from streams vary from a few feet to 30 yards, sudden rises in water level are a natural hazard. In the Urewera, one nest with eggs, only three and one-half feet above a stream, was undermined and washed away in December.

The nest itself is shallow and filled with any material within reach of the female. One nest contained leaves of the sedge *Uncinia,* grass, and leaves of Tawa, Mahoe, and Rimu trees, plus bits of ferns and moss and was lined with a quantity of gray-blue down which appeared to be less fluffy than the down in the nests of other ducks.

Eggs

All the eggs seen were pale buff. A total of 48 (Schönwetter, 1960–1961; Oates, 1902; Canterbury and Wellington Museums; original) measured an average of 65.1 × 45.1 millimeters, with a range of 58.5–72.5 mm × 43.0–50.0 mm. Four eggs, taken by Guthrie-Smith (1927), had a mean weight of 70.5 grams; a calculated weight, based on the linear measurements of 12 eggs, was 73 gm (Schönwetter, 1960–1961). Although no unincubated eggs were weighed during the present study, the average size given above indicates that a fresh weight of 73 gm would be typical. Compared to the weight of the adult female, 750 gm (Table 1), the weight of a single egg is 9.7 per cent of the adult weight. Such a percentage is high for ducks in general — the egg of the Mallard (*Anas platyrhynchos*) represents 5.3 per cent of its body weight (Kear, 1965) and that of the Tufted Duck (*Aythya fuligula*) 6.7 per cent (Kear, 1970b). However, the relative size of the eggs is not unusual for New Zealand waterfowl. In the Brown Teal (*Anas aucklandica chlorotis*) the percentage is 10.5 and in the Scaup (*Aythya novaezeelandiae*) 9.0 per cent (Lack, 1968).

Clutch Size

The meager information on the clutch size, shown in Table 3, is based on 13 nests either found in the wild and in museum collections or reported in the literature. The mean clutch size is 5.4 eggs and the most frequently occurring number is five. Oliver (1955) gave a clutch-size range of four to nine; Guthrie-Smith (1927) reported broods of nine young; and Mr. H. R. Roberts

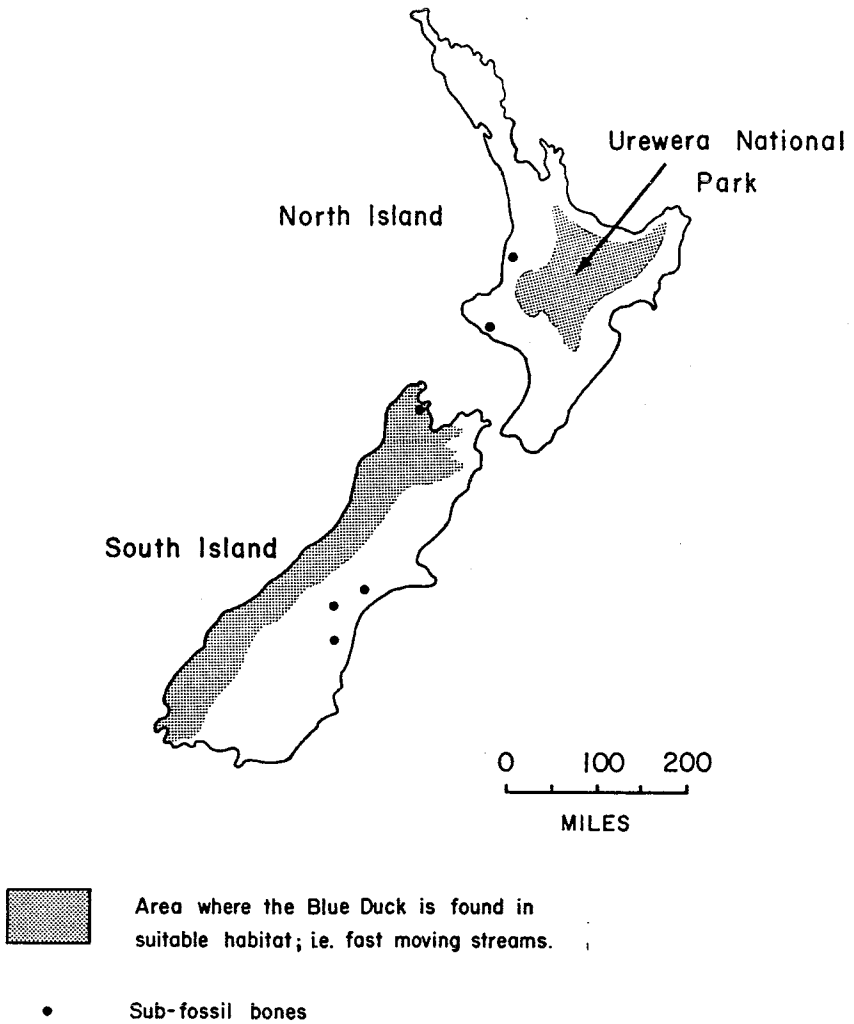

Figure 5. The distribution of the Blue Duck in New Zealand. The areas, indicated by cross-hatching, show where the birds occur today — always in forests cut by fast-moving streams. The dark squares pinpoint sites where sub-fossil bones of the Blue Duck have been found. Note that there is only one dot within the present area of distribution.

(pers. commun.) told me of one unusual brood with 10 ducklings. However, most broods number only three, four, or five. Five eggs is a small clutch for a dabbling duck — the Mallard lays 10 or 11 eggs on the average — but just as New Zealand waterfowl tend to lay larger eggs, they also tend to produce fewer of them. The average clutch of the Brown Teal is 6.0 eggs and that of the Scaup 5.4.

The relatively small clutch size in these birds may reflect a low rate of predation. Many pressures, such as large food stores necessary for egg development, the time needed to lay a given number, and the greater ease of incubating fewer eggs, may favor a small clutch in any species. However, a small clutch is an advantage only when predator pressure is also low and enough

young will survive. On the other hand, larger eggs might make the smaller number necessary. Lack (1968) suggested that there may be a selection for larger eggs because the ducklings, if heavier at hatching, have a better chance of surviving should feeding conditions be unfavorable.

Incubation Period

Eggs, collected and incubated artificially during the present study, hatched in 31 and 32 days, the last of the four ducklings appearing 36 hours after the first. Mr. C. R. Roderick (pers. commun.) thought that the incubation period of eggs, hatched by birds in captivity at the Mount Bruce Native Bird Reserve, was 31 days. The majority of dabbling ducks, the Anatini, hatch in 25 to 28 days (Lack, 1968). Within this group the only incubation period comparable in length to the period of the Blue Duck is that of the Bronze-winged Duck (*Anas specularis*), a South American dabbling duck.

TABLE 2

Records of Blue Duck Nests with Eggs

Month	*Number of nests*	*Hatching dates*
August	1	
September	1	
October	7	13, 17, 18
November	8	8, 15
December	1	24
January	2	

Only the female incubates. She leaves the nest to feed, drink, and bathe probably in the early morning and certainly just before darkness falls in the evening. The male accompanies her while she rapidly searches the shallow water for food, and they call softly to one another most of the time. After about 45 minutes, he escorts her back to the nest. It is at this time that one finds the nest most easily; the birds, if unaware of the human observer, simply lead one to it. The drake spends the night some distance away from the nest on a boulder in the middle of the river. During the day, he is hidden beneath an overhanging bank or a log (Steel, 1970; Kear and Steel, 1971), and the only indications of his presence on the territory at this time are gritty brown droppings splashed on the rocks.

Young

As I already noted, hatching commonly occurs in October and November (Figure 6). According to Steel (pers. commun.) one brood remained in the nest for 43 hours before traveling to the stream in the early morning. During that period, the male visited the nest frequently and was present when they went to the water. Unlike many duck species (Kear, 1970a), the Blue Duck male

shares in the care of the young. However, the ducklings' food and anti-predator displays, inconspicuous in both parents, are apparently unnecessary (Kear and Steel, 1971).

At hatching, the four captive ducklings averaged 45.5 gm, some 14 gm more than newly hatched Mallards. A peculiarity of the Blue Duck is a suggested sex-linked color difference in the spotting on the back which is chestnut in male ducklings and fawn-colored in females (Pengelly and Kear, 1970). We do not understand the significance of the difference and consider it quite surprising since in coloration the sexes of the adults are indistinguishable.

The ducklings' development in feathering, weight, and bill length was slower than that in species breeding at higher latitudes. The ducklings did not acquire their full juvenal plumage until they were eight weeks old and took their first flights when between 10 and 11 weeks old (Pengelly and Kear, 1970), a fledging period that is long even for ducks of the warm temperate regions (Lack, 1968, Appendix 16). Lack's suggestion (1968) that, in many birds, the fledging period is strongly correlated with the length of the incubation period seems to be true in the Blue Duck.

The young Blue Ducks stayed in the rather dull gray and brown juvenal plumage until they were five months old. Even then, some signs of immaturity remained. The bill changed more gradually from light blue to white, and the eyes from dark brown to golden yellow. The young birds seem to stay in the territory of the parents. We do not know how the family eventually breaks up. Possibly the adults chase away the young when they attain a mature plumage, and thus appear to be potential rivals.

Where the young birds go, how far they migrate, and how they find mates and territories of their own are still unanswered questions. Their long-range flying ability is probably good, but being tame they appear reluctant to take off. Once on the wing they are strong, swift flyers. The wing-beats of the adults were timed from motion picture film at eight completed strokes per second, or 480 per minute. This is faster than the 300 per minute obtained by Meinertzhagen (1955) for several *Anas* ducks, but slower than the 12 beats per second recorded by Johnsgard (1966) for the Torrent Duck (*Merganetta armata*).

The slow growth rate and the lengthy period of parental care, which probably evolved in relation to a limited amount of available food, have a selective advantage in that the species is able to make wide use of the available habitat. However, the slower growth means that the young are helpless and subject to predation over a longer period. In the Blue Duck, the relatively slow development presumably also evolved in association with a general lack of predators in New Zealand. The flightless ground rails (*Gallirallus*), now much reduced in range, may have taken a few eggs in the past. The Bush Hawk (*Falco novaeseelandiae*), Harrier (*Circus approximans*), and some of the gulls (*Larus*) may prey on very young birds. And circumstantial evidence suggests that the larger eels occasionally feast on ducklings. The white belly and dark upper parts of the ducklings could indicate some necessity for camouflage from beneath, but the significance of the downy plumage pattern is obscure. In view of the supposed low level of predation, it is also puzzling that both the juvenal and adult plumages are so cryptic and that the birds are very difficult to spot until they call — which they almost always do.

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Blue Ducks, *Hymenolaimus malacorhynchos*. Drawing by Robert Gillmor.

Slow development imposes certain restrictions on a species rearing its young in such a hazardous place as a mountain torrent. Although the ducklings usually come to little harm when moving downstream with the current, they sometimes have to go ashore and walk back to the top of the territory again. Until they are well grown and can fly, leading them and keeping them together in swift water and on the steep banks may be the principal value of dual parental care. Occasionally, ducklings are swept away over waterfalls, and for this reason and various others, the size of the broods declines with age.

I determined the diet of the ducklings only from an analysis of two samples of droppings. Three-day-old ducklings ate caddis fly larvae, stone fly and mayfly nymphs, and chironomid larvae. We also found parts of an adult fly, an adult beetle, and a mite (Kear and Burton, 1971). The droppings from 14-day-old ducklings contained similar items with a greater proportion of caddis flies, especially the species *Olinga,* the larvae of which inhabit a horny case.

Since ducklings need food more often than adult birds, a typical family party consists of offspring bobbing and dipping beneath the water and dashing across the surface while their parents float placidly nearby. The adults' feeding activity is greatest in the early morning and late afternoon. Their summer diet, all that we have investigated so far (Kear and Burton, 1971), consists of both case-living and free-living caddis fly larvae, other aquatic nymphs, and algae, and, for a short time, caddis fly pupae. This diet must change with the seasons because, so far as we know, all New Zealand caddis flies, except *Olinga,* take a year to complete their cycle and the larvae are more plentiful, though smaller, in mid-summer than in winter.

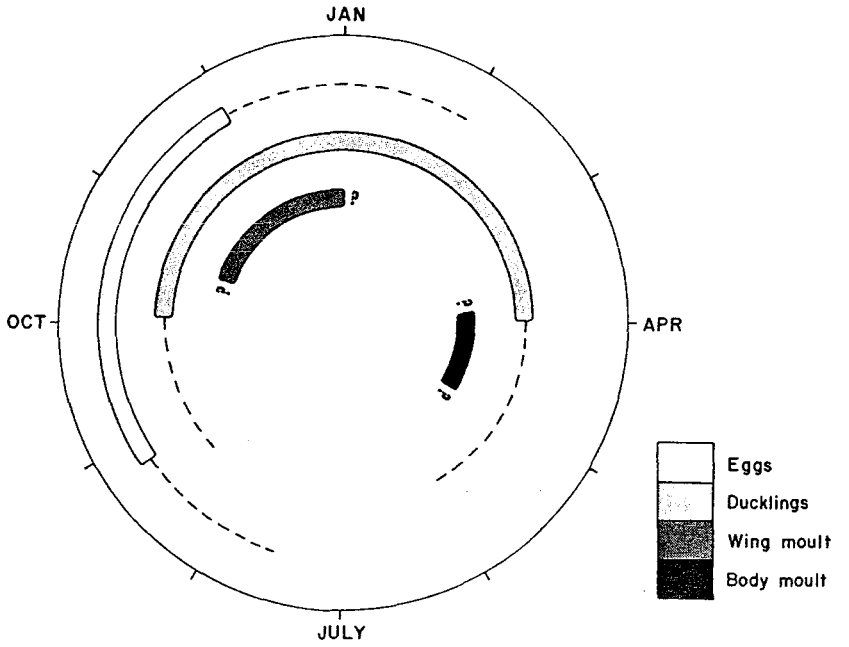

Figure 6. The annual cycle of the Blue Duck. The white bar shows eggs; the light gray, ducklings; the dark gray, wing molt; and the black, body molt. The dotted extensions are the extremes. Question marks beside the dark gray and black bars mean that the timing is only conjectural.

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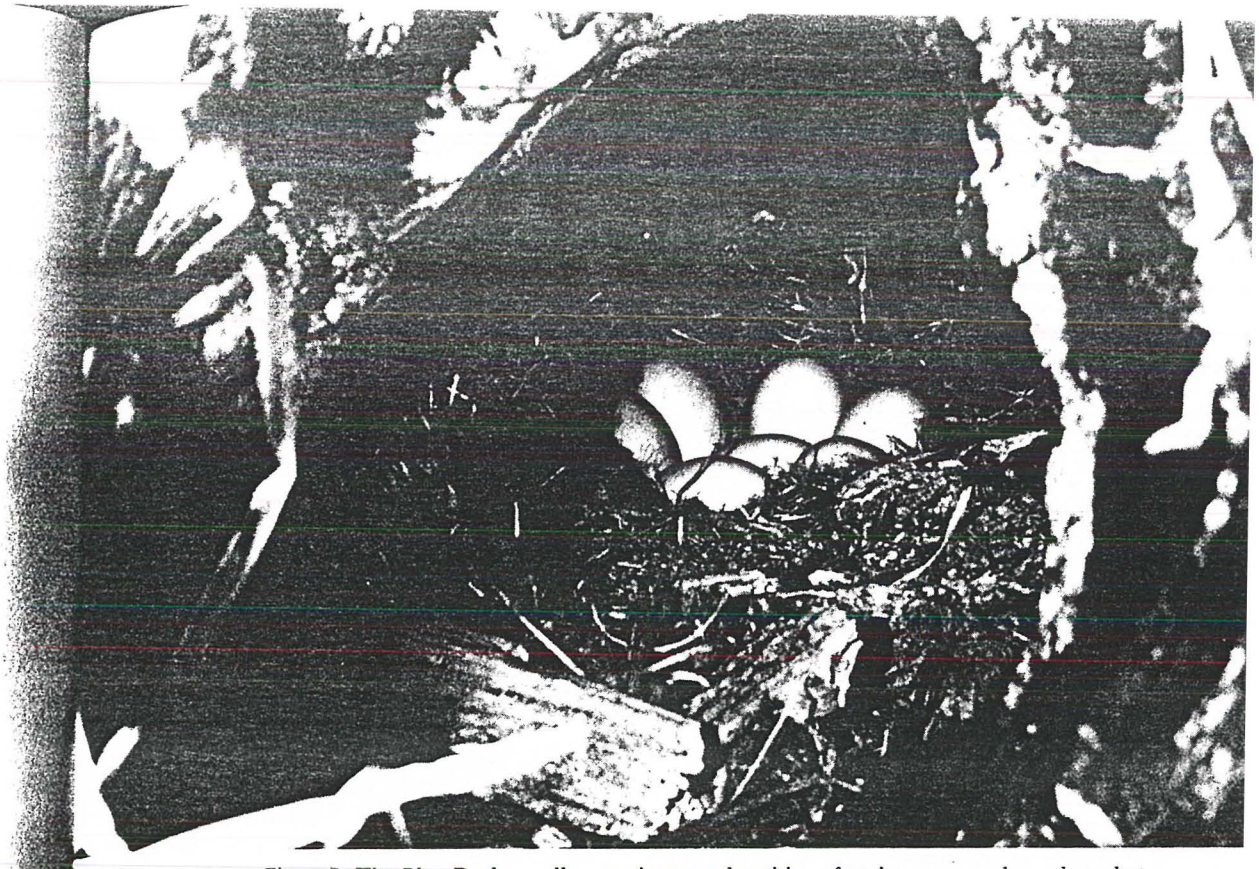

Figure 7. The Blue Duck usually nests in natural cavities, often in a tree as shown here, but sometimes in a hollow log, on ledges of rocky cliffs, beneath bushes, in shallow cavities in banks, among the roots of a fallen tree, and under large clumps of tussock grass. Photograph by A. J. Whitten.

Molt

The time of the wing molt in breeding birds is uncertain. There are no records of broods with flightless parents. In captivity, at Mount Bruce, the unsuccessful breeders dropped their primaries in late November and could fly again by mid-December (Figure 6), the female of the pair beginning her molt before the male. At Slimbridge, England, an unmated captive drake molted in early July, roughly the equivalent of January in New Zealand. At Gisborne, New Zealand, a captive female was in full wing molt when she died in May, indicating that the species can lose its feathers at almost any time although this bird's molt may not have been normal. We know even less about the timing of the second body molt which is common to all ducks (Delacour, 1956) and during which many species assume breeding plumage. The only evidence of this was in an adult male which acquired new contour feathers in February while still retaining his flight feathers.

Changes in body weight throughout the year are probably normal once the bird is mature. For the moment there are too few data for definite statements. Table 1 lists the weights of 13 captive or wild Blue Ducks.

Taxonomic Relationships

The taxonomic position of the Blue Duck is clouded. Delacour and Mayr (1945) suggested that the species might be an aberrant *Anas*. Delacour (1956) placed it tentatively with the dabbling ducks (Anatini) and Johnsgard (1965) followed this classification. There is now additional information on a number of characters.

For instance, the bony bulla of the male's syrinx is asymmetrical (Figure 8). Also, the Blue Duck has a tracheal tube of uniform diameter and a bulla that is evenly ossified and spherical in shape. Its general configuration resembles that of many dabbling ducks (Anatini), perching ducks (Cairinini, including the Torrent Duck, *Merganetta*), shelducks (Tadornini), and even eiders (*Somateria*) and the Harlequin Duck (*Histrionicus histrionicus*) according to Johnsgard (1961), but is particularly like the bulla of the Chiloe Widgeon (*Anas sibilatrix*) and North American Wood Duck (*Aix sponsa*). The bulla is larger and not as left-sided as that of Hartlaub's Duck (*Pteronetta*, a perching duck, sometimes called *Cairina hartlaubi*), nor as oval as that of the African Black Duck (*Anas sparsa*). The large size of the bulla is probably correlated with the very strong territorial whistle of the male.

TABLE 3

Clutch Size of the Blue Duck

Number of nests	2	7	2	1	1
Number of eggs	4	5	6	7	8

The simple voice of the duckling, especially the distress call, provides taxonomic clues (Kear, 1968) since, at this age, related species usually sound alike and unrelated ones do not. Figure 4 shows a sonogram tracing of the cry of an isolated duckling. The shape of the individual note is not unlike that of Hartlaub's Duck; it is also like that of the Mallard and a number of similar dabbling ducks such as the Yellow-billed Duck (*Anas undulata*), Grey Duck (*A. superciliosa*), Chestnut Teal (*A. castanea*), and even the Bronze-winged Duck (*A. specularis*) and the Crested Duck (*Lophonetta = A. specularioides*). The rate of performance is slow, the call being rendered at about three notes per second. The Yellow-billed Duck (*A. undulata*) and Mallard (*A. platyrhynchos*) have four; the Bronze-winged Duck (*A. specularis*) and Grey Duck (*A. superciliosa*) have five; the Chestnut Teal (*A. castanea*) and Hartlaub's Duck (*Pteronetta*) have six; and the Crested Duck (*Lophonetta*) has six and a half. The note of the Blue Duck chick (Figure 9), resonated at just below four kilocycles per second, is slightly lower than the *Anas* species listed above. But only the shape of the note is considered significant in classification (Kear, 1968); the size of the duckling probably determines the speed and frequency, at least within any group such as the dabbling ducks.

In color the Blue Duck downy young are unusual: black, white, and ginger, with the black suffused with a metallic green sheen (Pengelly and Kear, 1970). In patterning, however, they resemble the young of other dabbling and

perching ducks, and they do have the typical dorsal spotting despite statements to the contrary (Delacour, 1956; Johnsgard, 1965). The vertical dark stripe running from the eye to the crown is unusual, being found in the downy young of only two other species — the Torrent Duck (*Merganetta*) and the Black-headed Duck (*Heteronetta atricapilla*).

The Blue Duck's virtual lack of a wing speculum and the presence of the black edging on the innermost secondaries are unique features among the Anatini. But, as Johnsgard (1965) pointed out, black margins also occur on two similar feathers on the wing of *Pteronetta* where there is no speculum at all — not even the white border found in the Blue Duck. The black lines may assist in the imprinting of young on their parents since such lines would be particularly conspicuous to a duckling following an adult. No one has investigated this as yet.

The Blue Duck's social behavior again shows similarities to different duck groups. Its preflight signal is more like the Chin-lifting of *Tadorna, Pteronetta,* and some *Aythya* than the Neck-jerking and Head-shaking of most dabbling ducks (Kear and Steel, 1971). Its system of shared parental care seems to be a "primitive" feature in waterfowl that does not occur in diving ducks but is present in a few Anatini and Cairini such as *Anas specularis, A. sparsa, A. sibilatrix, Merganetta,* and *Pteronetta* (Kear, 1970a). The Blue Ducks give Head-bobbing, as is typical of all dabbling ducks, in the precopulatory situation with occasionally an intense bathing display by the female, perhaps like that described by Johnsgard (1965) for *Anas sparsa.* The male may touch the female on the back, as in *Aix sponsa* and *Anas sparsa,* yet after copulation he does not Bridle or Nod-swim as do most *Anas* males, but merely assumes a slightly erect posture not typical of any other species (Kear and Steel, 1971).

Biochemical studies sometimes reveal evolutionary relationships. However, in the case of the Blue Duck, Mr. A. H. Brush (pers. commun.) found the electrophoretic profiles of its feather proteins unique and unlike those in any other dabbling duck, all of which tend to be rather similar. On the other hand, Miss S. A. Stewart (pers. commun.), in a preliminary analysis of egg-white proteins, finds the Blue Duck closer to *Anas specularis* than to *A. platyrhynchos, Aythya,* or *Aix,* and only more distantly related to *Tadorna.*

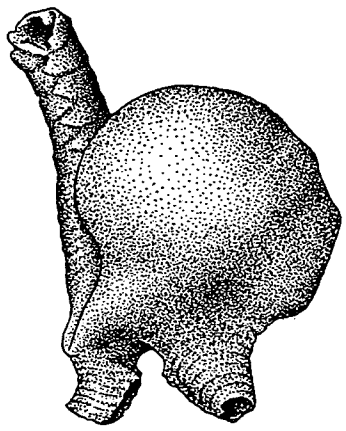

Figure 8. The trachael bulla of the Blue Duck. Note that it is spherical and asymetrical. For comparison with those in other ducks, see Johnsgard (1961).

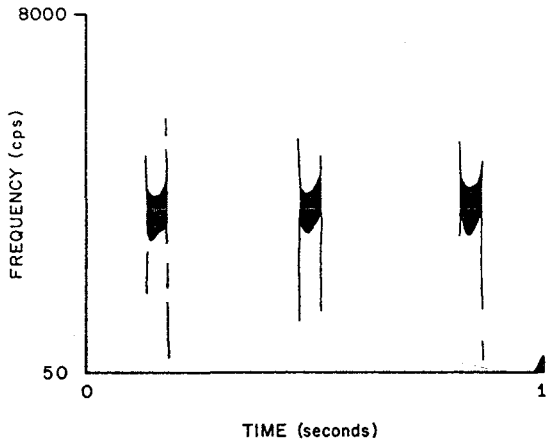

Figure 9. A sonogram tracing of the distress call of a young Blue Duck. Time on the horizontal scale equals one second; frequency on the vertical scale is 50–8,000 cycles per second. For comparison with the calls of other young ducks, see Kear (1968).

For the moment we should best think of the Blue Duck as deriving from an early stage in the evolution of the dabbling ducks from their perching, duck-like ancestors. It shows, perhaps, the greatest similarity to *Pteronetta* and *Anas sparsa* — respectively considered by Johnsgard (1965) as a possible link between perching and dabbling ducks and the most generalized *Anas* — although in a number of features it is different from both those species.

A banded population could provide excellent opportunity for studies of longevity, faithfulness to a particular mate, the possibility of double broods, and year-round defense of territory. Even though the population is small, one might investigate the significance of territory and test a number of hypotheses by manipulating its size or the food supply. The bird itself is so tame and easily caught, and the territory boundaries so clearly marked that the inconvenience of a remote study area might not be a disadvantage. Probably the security of this unique bird depends on the inaccessibility of its habitat.

Summary

I have reviewed the breeding biology of the Blue Duck (*Hymenolaimus malacorhynchos*), a species that has decreased in numbers over the last century and is now limited to remote mountain streams in New Zealand. The most important factors contributing to its decline include habitat destruction and the introduction of predators and possible food competitors.

Nesting occurs mostly in September, October, and November, but the breeding season extends over more than half the year. While the choice of nest site varies, it is most frequently in a river bank and well hidden. As in many New Zealand ducks, the egg, at 73 gm, is relatively large and the clutch of five relatively small. The female alone incubates for 31 to 32 days and the ducklings' growth is slow. They do not fly until they are about 10 weeks old.

A discussion of the species' taxonomic relationship, with reference to the tracheal bulla, plumage characters, duckling voice and pattern, and social display, leads to the conclusion that the Blue Duck shows affinities with the perching ducks (Cairini) and the dabbling ducks (Anatini) and, for the moment, belongs with the dabbling ducks.

Acknowledgments

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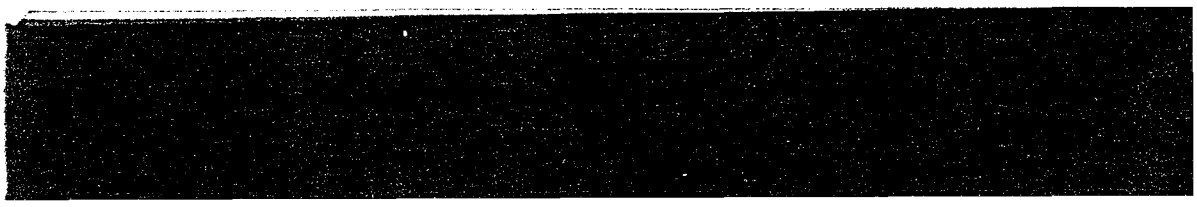

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INVERTEBRATE FOOD SUPPLIES AND DIET OF BLUE DUCK ON RIVERS IN TWO REGIONS OF THE NORTH ISLAND, NEW ZEALAND

Summary: Benthic invertebrates and samples of blue duck faeces were collected in September 1988 from sites along Manganuiateao River, central North Island, and in November 1988 from seven rivers and streams on the East Cape. The occurrence of invertebrate taxa in the faeces varied within and between rivers, and within pairs of birds and family groups on the East Cape. In both regions, most blue duck had been consuming large proportions of cased caddisfly larvae. These are thought to have been mainly species of *Helicopsyche* and *Pycnocentrodes* at the East Cape sites and *Beraeoptera roria* at the Manganuiateao sites. Plecoptera larvae were also relatively abundant in blue duck faeces from most Manganuiateao sites in September. Overall, blue duck consumed proportionately more cased caddisfly larvae than occurred in the benthos (especially at the East Cape sites), but fewer Chironomidae, *Coloburiscus humeralis* and leptophlebiid mayfly (mainly *Deleatidium* spp.) larvae. Factors that affect the type of invertebrate foods available to blue duck at a particular site could include habitat heterogeneity, chance encounter, frequency and magnitude of floods, and geographic differences in the pool of invertebrate colonists. Apparent selectivity or avoidance of some benthic invertebrate groups by blue duck may partly reflect predator evasion by fast-moving invertebrate species, and differences in activity and distribution on upper stone surfaces where invertebrates should be more susceptible to predation by blue duck.

Keywords: blue duck; *Hymenolaimus malacorhynchos*; aquatic invertebrates; predation; faecal analysis; North Island; New Zealand.

Introduction

The endemic blue duck (*Hymenolaimus malacorhynchos* (Gmelin, 1789)) is believed to have been widespread on rivers in New Zealand in pre-human times (Robertson, 1985), but populations are now largely restricted to forested, upland catchments in the central North Island and west coast of the South Island (Fordyce, 1976). Reasons for this decline are thought to include changes in land use, modifications to river flow regimes, and predation by introduced mammals (Fordyce and Tunnicliffe, 1973; Williams, *in press*). Kear (1972) suggested that changes in food resources through the feeding activities of introduced insectivorous birds and salmonids may also have detrimentally affected blue duck.

Aquatic invertebrates are the main foods of blue duck (Kear and Burton, 1971), and these are gleaned primarily from rocks in shallow water with moderate to fast current velocities (Veltman and Williams, 1990). Invertebrates are removed from stones with a bill that tapers towards the end and has a pair of soft, black flaps on each mandible (Kear and Burton, 1971). Blue duck can also feed on invertebrates by diving in deeper water and by grazing from emergent boulders, and they occasionally take adult insects from the water surface and drifting larvae from the water column (Craig, 1974; Fordyce and Tunnicliffe, 1973; Eldridge, 1986; Veltman and Williams, 1990). Work on the Manganuiateao River, central North Island, has shown that most diurnal feeding occurs close to the edges of riffles in the early morning and late afternoon in late summer and autumn, and throughout the day during winter, spring and early summer (Eldridge, 1986; Veltman and Williams, 1990).

Kear and Burton (1971) described the content of several blue duck faecal deposits, but no quantitative data have yet been published on diet and food supplies. I investigated the composition of aquatic invertebrate communities and blue duck diet on rivers in two regions of the North Island. My aim was to obtain quantitative data on diet at a variety of sites and to evaluate selectivity of benthic invertebrate prey in each region. I also collected some invertebrate samples from sites that did not support blue duck to see if the composition of benthic invertebrate faunas there differed from those sites with blue duck.

Methods

Study area

Samples were collected from the middle section of Manganuiateao River and its tributary Mangaturuturu River, central North Island, and from seven rivers and

streams on the East Cape (Fig. 1). Both regions have similar mean annual precipitation (2000-2500 mm) and soils (predominantly steepland yellow-brown earths and yellow-brown pumice soils) underlain by sedimentary rocks (McLintock, 1960; Gibbs, 1980; Molloy, 1988). Manganuiateao River (Fig. 1) originates on the western flank of Mt Ruapehu and flows for 80 km in a south-westerly direction into Whanganui River. Most samples at this site were taken from a 25 km-long stretch of river that started 27 km below the mountain source. In its upper reaches, Manganuiateao River and its tributaries drain an extensive area of indigenous forest of beech (*Nothofagus solandri* var. *cliffortoides*

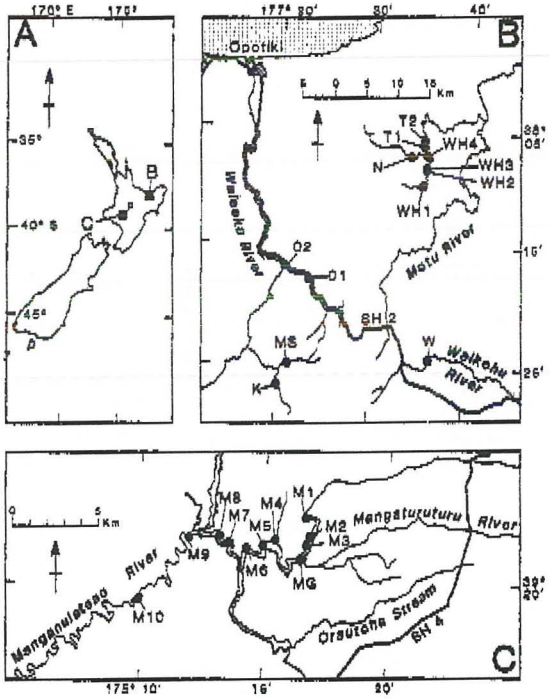

Figure 1: *Location of sampling sites (A) in the North Island of New Zealand; (B) East Cape and (C) Manganuiateao River. See text for site names.*

(Hook. f.) Poole and N. *menziesii* (Hook. f.) Oerst) and podocarps (including *Phyllocladus alpinus* Hook. f. and *Libocedrus bidwillii* Hook. f.). Around the study area the land was mostly in pasture and scrub, but a thin, semi-continuous strip of trees (consisting mostly of the exotic silver wattle *Acacia dealbata* Link., *N. fusca* (Hook. f.) Oerst and angiosperms such as *Beilschmiedia tawa* (A. Cunn.) Kirk, *Knightia excelsa* R. Br. and *Melicytus ramiflorus* J.R. & G. Forst.) grew along much of the river section studied.

The Manganuiateao River flows through a series of stable pools and riffles and the substrate is predominantly large (>26cm diameter), rounded boulders of andesite. Of the 11 Manganuiateao sampling sites (Fig. 1), one (MG) was on Mangaturuturu River just before its confluence with Manganuiateao River, and eight (M1-M8) were on the main channel above Ruatiti Domain (adjacent to M9; see Fig. 1), which represents the approximate downstream limit of blue duck distribution on Manganuiateao River (Williams, *in press*).

The 12 East Cape sites (Fig. 1) were on seven rivers and streams that drained steeplands and foothills of Raukumara Range. Flow at most sites was in a northerly direction, and large areas of pasture were present in some catchments, although scrub or indigenous forest was present alongside most sampling sites. The substrate at Waikohu River (W), Opato River (O) and Moanui Stream (MS) was predominantly boulders, whereas Koranga (K), Nga Upoko Tangata (N) and Whitikau (WH) Rivers had boulders and bedrock interspersed with cobbles (6-26cm diameter) and gravels (0.2-6cm diameter). In contrast, substrate at the Takaputahi (T) sites was mainly well sorted cobbles and gravels.

Faecal and/or benthic invertebrate samples were taken from the Manganuiateao sites in the spring (4-6 September) and from the East Cape sites in the early summer (21- 25 November) of 1988. Four sites (M9, M10, K, W; see Fig. 1) did not support blue duck at the time of sampling, so only benthic samples were taken from those sites. Similarly, benthic samples only were collected from MG and M7 (both within blue duck territories) because faecal deposits could not be located. Most faecal samples were collected as they were encountered while searching for birds down rivers. As a result, samples were taken from most blue duck territories on a section of river, and analyses should, therefore, be representative of blue duck populations on the sections of river visited.

Invertebrate sampling

Where possible, benthic invertebrate samples were taken from shallow (0.1-0.5 m) riffles (the main feeding areas of blue duck) near where faeces were found. The two benthic samples collected from site O were pooled for analysis because they were collected upstream and downstream of the site where faecal deposits were obtained.

Because the occurrence of some aquatic invertebrates on upper surfaces of stones (i.e., those surfaces probably most accessible to blue duck) can vary depending on time of day and several environmental variables (Elliott, 1968; Pierce, 1986;

Death, 1988), invertebrates substrate surfaces. This wa and brushing stones upstrea mm mesh) in a similar man efficiency at all sites in eac comparable information on invertebrate taxa. Samples in 70% isopropyl alcohol, a passed through 1 mm and (Invertebrates retained by th out on a white tray, and ma mesh sieve was sorted at 1(invertebrates were identifie microscope using the key c (1981).

Faecal analyses

Where possible, fresh (mo from emergent rocks and l East Cape samples, from b before banding. Developn juvenile) and sexes of bird recorded, enabling the die presumably fed in the sam compared. Where several from unknown birds were site (i.e., those from M1-M pooled for analysis. Faece 70% isopropyl alcohol foll

In the laboratory, fae magnetic stirrer and bulke deposits from known bird fractions (1/2 -1/16) using Subsamples obtained in th representing 46-592 inver whereas analyses of whol yielded 7-86 individuals. to digestion and diagnosti heads, mandibles, clyperu identified and counted at Identifications were made photos of prepared slides. the total sample were calc equations. Use of diagno analyst to focus on specif sorting, and reduced the overlooking fragments (I Massey University, *pers.*

The Leptophlebiida predominantly of *Deleati* included *Austroclima* spp Peters and *Zephlebia* spp contained mostly larvae (McLachlan). Cased cad (the "BCP" group) comp

Death, 1988), invertebrates were collected from all substrate surfaces. This was achieved by turning over and brushing stones upstream of a triangular net (0.5 mm mesh) in a similar manner and with similar efficiency at all sites in each region to provide comparable information on the relative abundance of invertebrate taxa. Samples were preserved immediately in 70% isopropyl alcohol, and in the laboratory were passed through 1 mm and 0.43 mm mesh sieves. Invertebrates retained by the 1 mm sieve were picked out on a white tray, and material caught by the finer mesh sieve was sorted at 10x magnification. All invertebrates were identified under a binocular microscope using the key of Winterbourn and Gregson (1981).

Faecal analyses

Where possible, fresh (moist) faeces were collected from emergent rocks and logs on rivers, or, for most East Cape samples, from bags in which birds were held before banding. Developmental stages (i.e., adult or juvenile) and sexes of birds that defecated in bags were recorded, enabling the diet of different birds that had presumably fed in the same stretch of river to be compared. Where several faecal deposits (up to three) from unknown birds were collected, samples from each site (i.e., those from M1-M6, M8, MS or O) were pooled for analysis. Faeces were frozen or preserved in 70% isopropyl alcohol following collection.

In the laboratory, faeces were dispersed with a magnetic stirrer and bulked samples or large single deposits from known birds were split into convenient fractions (1/2 -1/16) using a Folsom-type splitter. Subsamples obtained in this way contained fragments representing 46-592 invertebrates of different species, whereas analyses of whole (small) faecal deposits yielded 7-86 individuals. Fragments that were resistant to digestion and diagnostic of invertebrate taxa (whole heads, mandibles, clypera, terminal segments) were identified and counted at 8-64x magnification. Identifications were made from preserved material and photos of prepared slides, and numbers of individuals in the total sample were calculated using appropriate equations. Use of diagnostic fragments enabled the analyst to focus on specific search images during sorting, and reduced the possibility of misclassifying or overlooking fragments (I. Henderson and C. Veltman, Massey University, *pers. comm.*).

The Leptophlebiidae group was made up predominantly of *Deleatidium* spp., and also probably included *Austroclima* spp., *Mauiulus luma* Towns & Peters and *Zephlebia* spp. The *Hydropsychidae* contained mostly larvae of *Aoteapsyche colonica* (McLachlan). Cased caddisflies could be separated into (the "BCP" group) comprised of *Beraeoptera roria* Mosely/*Confluens hamiltoni* (Tillyard)/*Pycnocentria* spp., and *Olinga feredayi* (McLachlan), *Pycnocentrodes* spp., or *Helicopsyche* spp. on the basis of whole heads or clypera. However, unlike the other groups, this high taxonomic resolution was not possible on the basis of mandibles alone (I. Henderson and C. Veltman, Massey University, *pers. comm.*). Thus, information obtained from heads and clypera was used when comparing sites based on the presence or absence of invertebrate taxa in faeces for *O. feredayi*, *Pycnocentrodes* spp., *Helicopsyche* spp. and the BCP group, but these groups were combined into cased caddisflies when relative abundance was being considered.

Key fragments that could not be assigned to any of the taxonomic groups in Table 1 were designated as "Other" and were not included in subsequent data analysis. "Other" taxa recorded in faeces were unidentified Coleoptera (0.7 and 4% of total invertebrates at sites M3 and M2, respectively), and adult Tipulidae (0.2% at site M5). Some faeces from blue duck on Manganuiateao River also contained clumps of filamentous algae (particulary faeces from M3 and M6) which were still green, but these were not quantified.

Results

Composition of faeces and benthos

Of the 15 sites from which faeces were collected (combining faecal data from all birds), fragments of *Pycnocentrodes* spp. and Leptophlebiidae were found at 13 sites, *Helicopsyche* spp. and Hydrobiosidae at 12 sites, and the BCP group at 11 sites. These taxa were also found in all benthic samples from the same 15 sites and comprised 0.3–50% of the total invertebrate fauna in them. Leptophlebiidae and Hydrobiosidae comprised up to 36% and 7%, respectively, of invertebrates in faeces, whereas cased caddisflies comprised up to 100% of the faeces, and were relatively abundant in most samples (Table 1). Based on information provided by whole heads and clypera in the faeces or relative abundances of invertebrates in the benthos, *Helicopsyche* and *Pycnocentrodes* species probably made up most of the cased caddisflies in faeces from the East Cape sites in November, whereas larvae of *B. roria* were probably the dominant cased caddisfly in faeces from the Manganuiateao sites in September.

Chironomidae (1-35%) and Plecoptera (1-45%) were found in all faecal samples and corresponding benthic samples (9-40% and 2-19%, respectively) from Manganuiateao River. These taxa were recorded in faeces at only one or two of the East Cape sites (Table 1), even though they occurred in all benthic samples there. Hydropsychidae comprised a small proportion (0-3%) of the faeces at most Manganuiateao sites,

Table 1: *Abundance classes of invertebrate taxa found in faecal samples from the Manganuiateao and East Cape sites. For stage/sex abbreviations, A = Adult, J = Juvenile, m = male, f = female. For T2J, faeces from male and female juvenile birds were combined. Feacal samples represent single deposits (all N, T and WH samples) or up to 3 pooled deposits (all Manganuiateao sites, O, MS). For abundance classes: 6=>50% of individuals in faeces, 5=20-49.9%, 4=10-19.9%, 3=5-9.9%, 2=2-4.9%, 1=>0- 1.9%, – =not recorded.*

	Manganuiateao River							East Cape														
Site	M 1	M 2	M 3	M 4	M 5	M 6	M 8	N	T 2	T 2	T 2	WH 1	WH 1	WH 2	WH 3	WH 3	WH 3	WH 3	WH 4	WH 4	O	MS
Stage/sex								Am	Am	Af	J	Am	Af	Am	Am	Af	Jm	Jf	Am	Af		
Leptophlebiidae	4	1	2	2	1	4	1	5	2	3	2	2	3	-	-	1	1	1	-	2	-	2
Coloburiscus humeralis	1	1	2	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Nesameletus sp.	2	-	2	2	1	1	1	4	1	1	-	1	-	-	-	1	1	1	-	-	-	-
Plecoptera	4	5	4	4	2	3	1	-	-	2	-	-	-	-	1	1	1	-	-	-	-	-
Hydrobiosidae	1	1	-	1	1	2	3	2	-	1	1	1	1	-	1	-	1	-	2	-	-	1
Hydropsychidae	1	2	-	-	-	2	5	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-
Oxyethira albiceps	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	2	1
Cased caddisfly	6	2	5	6	6	6	1	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2
Chironomidae	2	1	5	2	3	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Aphrophila neozelandica	-	-	-	-	-	1	4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Elmidae	1	5	1	-	-	2	1	-	-	-	-	2	-	-	2	2	-	1	-	-	-	-
Archichauliodes diversus	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	1	1	1	-	-	-	-
Hydrophilidae	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

although at M8 they made up 47% of total invertebrates in the faeces but only 2% of the benthic fauna. Similarly, Elmidae comprised <4% of the faeces at most Manganuiateao sites except for M2 where they made up 40% (and where almost all Elmidae were adults) of invertebrates in the faeces, but only 0.3% (all of which were larvae) of the benthos.

Classification of sites

Sites within each region were clustered according to the presence or absence of invertebrate taxa in the faeces or benthos using Ward's linkage method and relative Euclidean distance measure (Fig. 2). Dendrograms were interpreted at the arbitrary level of 3 or 4 clusters.

All Manganuiateao sites sampled in September occurred in Cluster A (Fig. 2A). Though possibly due to differences in sampling month, this dichotomy probably reflects geographic differences as many species of the New Zealand aquatic invertebrate fauna have non-seasonal life cycles and are likely to be present at all times of year (Towns, 1981; Winterbourn, Rounick and Cowie, 1981; Boothroyd, 1987). Cluster B included most East Cape sites that supported blue duck, but not T1 which had fewer taxa (21) than the other East Cape sites (24-33), and occurred in Cluster A. Cluster C included the two East Cape sites (W and K) that did not support blue duck, but the Manganuiateao sites without blue duck (M9 and M10) were not distinguished from the other Manganuiateao sites on the basis of presence or absence of benthic invertebrate taxa.

Four faecal clusters were distinguished (Fig. 2B). Cluster D contained five of the seven Manganuiateao sites and, therefore, reflected to some degree the apparent geographic separation of the benthic samples. Unlike samples from these Manganuiateao sites, fragments of *C. humeralis* and Elmidae larvae were not recorded in faeces from M4 and M5. These sites were incorporated into Cluster E, along with several East Cape sites (Fig. 2B). The ecological basis behind Clusters E, F and G is unclear, and did not seem to be related to family group, sex or developmental stage of birds. An adult male at WH2 had been feeding exclusively on cased caddisfly larvae (most appeared to be *Helicopsyche*), and was the main outlier in the faecal cluster analysis (Fig. 2B).

Prey selection

Relative abundances of taxa recorded in the faeces (all birds at any site combined) or corresponding benthic samples in each region were averaged and used to calculate Ivlev's Electivity Index (D) which ranges up to 1 for positive selection and down to -1 for negative selection (Jacobs, 1974). Only those taxa that comprised ≥5% of the benthos or faeces at the East Cape or Manganuiateao sites were considered. Electivity indicies indicated that, overall, blue duck consumed Leptophlebiidae, *C. humeralis* and Chironomidae in lower proportions than they occurred in benthic samples in both regions (Fig. 3). In contrast, cased caddisflies were consumed in greater proportions than in benthic samples (particularly at the East Cape sites; Fig. 3), and overall comprised a major proportion numerically (>50% of individuals in faeces) of blue duck diet in both regions. Apparent preferences for

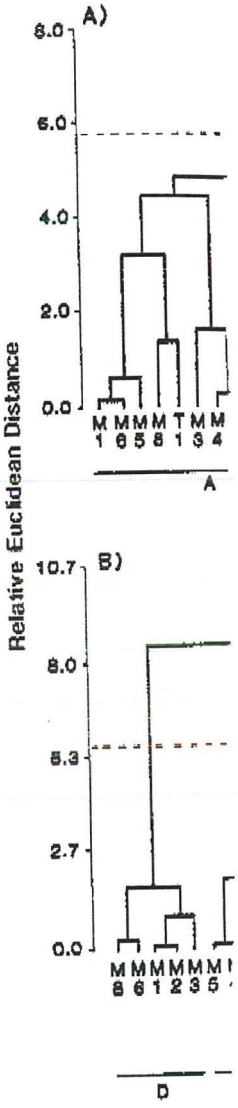

Figure 2: *Cluster anc of invertebrate taxa f of blue duck (B) at th sites. Abbreviations*

Hydropsychidae and River mainly reflecte taxa in faeces of blue

Discussion

Diet of blue duck

In addition to the 1

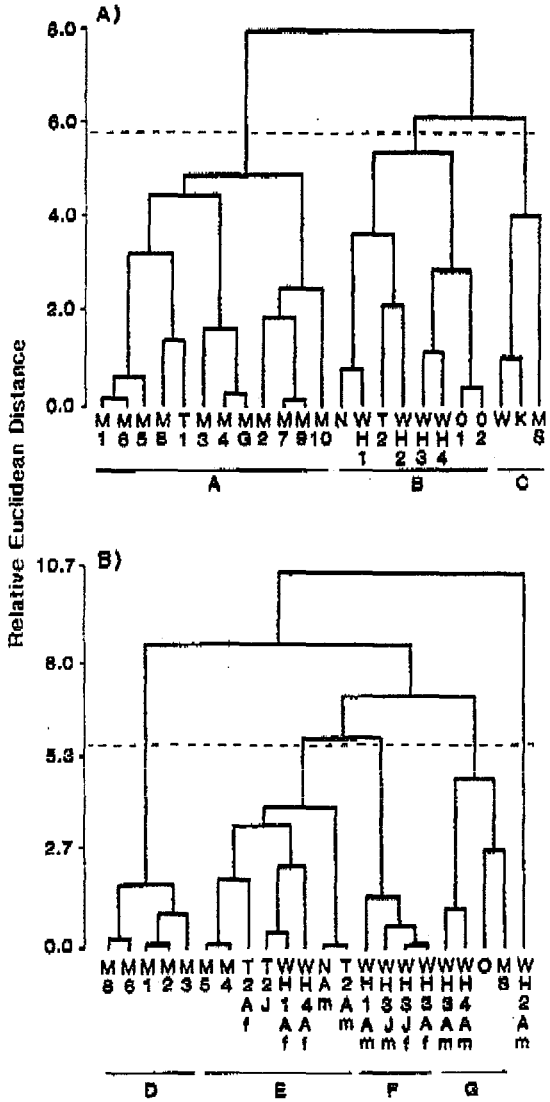

Figure 2: *Cluster analysis using presence/absence data of invertebrate taxa found in the benthos (A) and faeces of blue duck (B) at the East Cape and Manganuiateao sites. Abbreviations as for Table 1.*

Hydropsychidae and Elmidae larvae in Manganuiateao River mainly reflected high relative abundances of these taxa in faeces of blue duck from only one site (Table 1).

Discussion

Diet of blue duck

In addition to the 13 invertebrate taxa reported here, blue duck are also known to eat water mites, larvae of aquatic Muscidae and Blephariceridae (Diptera), possibly freshwater crayfish (*Paranephrops* spp.), Myriopoda and adults of several aquatic insect taxa (Craig, 1974; Kear and Burton, 1971; Williams, 1989). Most blue duck faeces collected in my study contained large proportions of cased caddisfly larvae, supporting observations on other rivers in September to December (Kear and Burton, 1971) that cased caddisflies can be a large component of blue duck diet. Harding (1990) found that blue duck in Arthur's Pass also consumed large numbers of berries from riparian shrubs in autumn, indicating that they are capable of exploiting other temporally abundant food resources.

The occurrence of invertebrate taxa in different faecal samples varied considerably between and within river systems, and this variability may partly reflect heterogenous distribution of the invertebrate prey. Factors that influence the distribution of benthic invertebrates include differences in substrate characteristics (size, depth and roughness), current velocity, and the availability of food resources (Hawkins and Sedell, 1981; Statzner, Gore and Resh, 1988; Jowett and Richardson, 1990).

Geographic location can also affect the composition of benthic invertebrate communities (Winterbourn, 1981), and this was reflected in my study by some apparent homogeneity within regions in the benthos and diet of blue duck. This suggests that the consumption of taxa by blue duck at a particular locality is partly influenced by the pool of available invertebrate colonisers. The occurrence of prey taxa in the diet of pairs of birds and their offspring at the East Cape sites was also variable even though they had presumably been feeding together in the same territory. This implies a certain element of chance or individuality in which prey taxa are encountered and consumed. Nevertheless, in a stable carbon isotope study on Manganuiateao River, Collier and Lyon (1991) found that feathers of different birds living in the same territories generally had similar $^{13}C/^{12}C$ ratios indicating that they had assimilated carbon from isotopically similar sources.

Other work on Manganuiateao River has shown that the invertebrate diet of blue duck also changes with time (Newton, 1989). Thus, diet changed from predominantly cased caddisflies for one date in January, to mainly Chironomidae larvae for two dates in March and May. These changes reflected temporal variations in the composition of the benthic invertebrate community that were effected, to a large degree, by the frequency and magnitude of floods (Collier and Wakelin, 1990). Stochastic flood events and subsequent invertebrate recolonisation patterns are likely to be other important factors influencing the abundance and composition of invertebrate food supplies for blue duck.

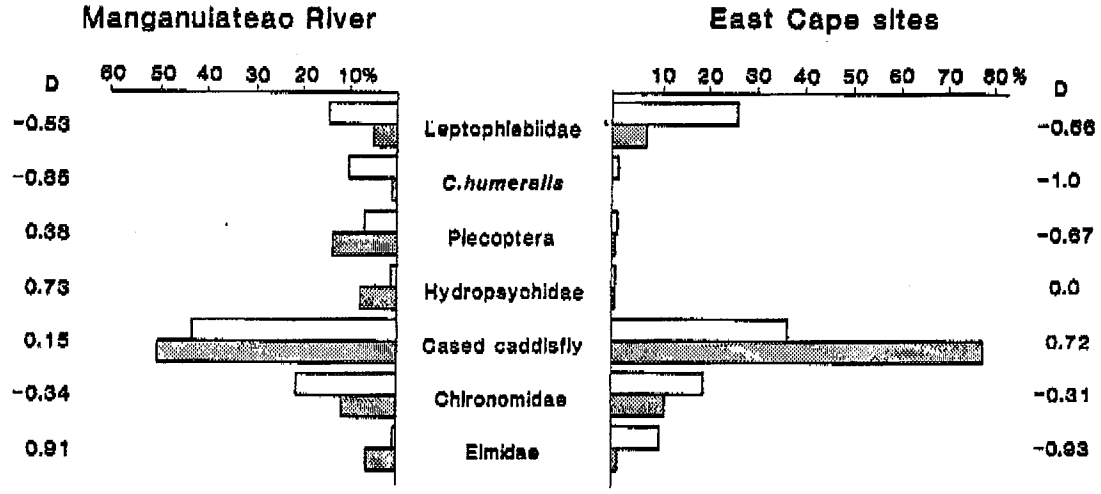

Figure 3: *Mean relative abundances of invertebrate taxa found in the faeces of blue duck (closed bars) and corresponding benthic samples (open bars) at the East Cape and Manganuiateao sites. Only those taxa that on average made up ≥ 5% of invertebrate numbers in the bethos or faeces in either region were considered. Ivlev's Electivity Index (D) was calculated using the method of Jacobs (1974).*

Prey preferences

In my study, cased caddisflies appeared to be the strongly preferred prey at the East Cape sites in September, whereas larvae of the mayflies *C. humeralis* and Leptophlebiidae were commonly eaten but in much lower proportions overall than they were collected in the benthos in both regions (Fig. 3). Cased caddisflies form a taxonomically broad group composed of a variety of species whose microhabitat preferences vary. For example, *Helicopsyche* commonly occur on the undersides of rocks or in hollows and cracks on rock surfaces (Cowley, 1978), and therefore would seem to be largely unavailable to blue duck. *Helicopsyche* was relatively common in the benthos of both sets of sites, but appeared to be abundant in blue duck faeces only at the East Cape sites in November. This may partly reflect differences in the surface topography of substrates between regions that could have affected the availability of refugia for *Helicopsyche* larvae.

Alternatively, other cased caddisfly taxa (e.g., *B. roria*) could have been more accessible to blue duck in Manganuiateao River in September. *B. roria* larvae often can be found on the upper surfaces of rocks with thin coverings of epilithon in Manganuiateao River (Collier and Lyon, 1991), and often congregate in areas of moderate current velocity (Cowley, 1978) such as those in habitats preferred by blue duck for feeding (Veltman and Williams, 1990). Similarly, although Pierce (1986) found *P. aureola* larvae mainly on undersides of stones in Cass River, South Island, other observations indicate that *Pycnocentrodes* commonly occur on surfaces of stones where they feed on epilithon, often in areas of rapid current velocity (Cowley, 1978). Thus, high consumption of some cased caddisflies can be partly explained by differences in activity and distribution on upper stone surfaces where larvae would be more susceptible to predation by blue duck.

The mayflies *C. humeralis* and *Deleatidium* spp. are found most often on the undersides of stones (Wisley, 1962; Pierce, 1986), and thus would not be expected to be favoured food items if prey availablity were substantially influenced by microhabitat use of upper stone surfaces. However, Pierce (1986) found that *Deleatidium* spp. larvae were active on upper surfaces of stones in the Cass River, South Island, in the early morning and evening. These periods correspond to peak diurnal feeding times for blue duck on Manganuiateao River during the non-breeding season (Eldridge, 1986), but, in the present study, faecal samples were collected during the breeding season when feeding periodicity is less pronounced (Veltman and Williams, 1990). Stable carbon isotope analyses of invertebrates and blue duck feathers on Manganuiateao River suggested that taxa like *C. humeralis* and *Deleatidium* contributed less to blue duck nutrition than other (more isotopically enriched) taxa (Collier and Lyon, 1991). Compared with cased caddisflies, these mayfly taxa are fast-moving and this may enable many to evade predation by blue duck.

The present study suggests that the diet of blue duck is largely influenced by the availability of

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Chris Edkins drafted

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invertebrate food resources at a particular site. Some of the apparent prey selectivity appears likely to reflect patterns of benthic invertebrate activity and distribution on stone surfaces. The resulting diet of blue duck on the dates sampled included large proportions of stony-cased caddisfly larvae whose total dry weight can comprise 83% inorganic material (Pierce, 1979). Cased caddisfly larvae are therefore likely to be of relatively low energy value (per unit dry weight) compared with mayflies such as *Deleatidium* which were generally eaten in lower proportions than they occurred in the benthos in my study. This observation is in contrast to that noted for some other endemic birds that feed on the benthos of New Zealand rivers. Wrybill (*Anarhynchus frontalis* Quoy & Gaimard, 1830) and black stilt (*Himantopus novaezealandiae* Gould, 1764) feed primarily on larvae of *Deleatidium* spp. even though other aquatic invertebrate prey, including many taxa eaten by blue duck, were also available (Pierce, 1979, 1986). Wrybills and black stilts glean benthic invertebrates with long, pointed bills, quite unlike the short, flat bill of blue duck. The bill morphology of blue duck seems more likely to result in non-specialised feeding that maximises prey intake on each foraging bout.

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E.G. WHITE[1] and J.R. SED

1 Centre for Resource Man
Avenue, Christchurch 4,
2 Centre for Computing and

A 20-YEAR RE
WITH INTERP

Summary: A 20-year c
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EIS
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ANCHORAGE TIMES
September 12, 1991 B1, B8

Spill tie cut from duck decline report

By DANIEL R. SADDLER
TIMES WRITER

Studies of environmental damage from the Exxon Valdez oil spill showed "significant failure" of Prince William Sound harlequin ducks to reproduce, and prompted state wildlife managers to delay duck hunting in the area.

But any mention of the spill as a possible cause of the birds' plight was cut from a public statement announcing the delay, an omission a state biologist who oversaw the studies attributed Tuesday to legal concerns.

"We know for a fact there was a significant failure of harlequins to reproduce out there," said Roy Nowlin, area management biologist in Cordova. "As far as a causal link to oil, I'm not going to make any statement."

On Aug. 30, the Alaska Department of Fish and Game announced the planned Sept. 1 start of harlequin season in the Sound would be delayed until Oct. 1. The season for the sea ducks, hunted mostly for their dramatic plumage, is to end Dec. 16.

By delaying hunting until October, when other harlequins arrive to spend the winter, managers hoped to spare the few remaining local ducks from annihilation, said Tom Rothe, state waterfowl coordinator for the U.S. Fish and Wildlife Service.

Biologists said ducks in the eastern Sound would likely repopulate the western part of the Sound, the release said.

"It's a fairly conservative approach to protecting those birds there in the summer," Rothe said. He said the studies show the western Sound has fewer harlequins than in the past, and that

See Ducks, back page

Ducks

Continued from page B1

those remaining are in poorer physical condition and producing fewer eggs.

"A review of recent survey data suggests that the number of harlequins in the Sound is down markedly from historic levels," said the one-page announcement of the closure.

That data came from more than $300,000 in research performed in the last two years by the Department of Fish and Game, and funded by the U.S. Fish and Wildlife Service, to determine the effect of hydrocarbon ingestion on sea ducks, Nowlin said.

The research is part of the $70 million effort by the federal and state governments to assess the damage to natural resources from the March 24, 1989, spill of nearly 11 million gallons of crude oil into the Sound.

Results of this research are being kept secret pending the resolution of legal claims against Exxon for damage to the environment, Nowlin said. That secrecy prompted the government lawyers and officials to cut any mention of the spill from early drafts of the release, he said.

"We certainly had discussions of what content should be in the news release," he said. "The Department of Law ... has their legal responsibilities and advised us to what should be included."

Alex Swiderski, the assistant attorney general to whom Nowlin referred legal questions, was out of his office Wednesday, and unavailable for comment.

Secrecy extended even to information gathered before the spill. Nowlin declined to give figures any more recent than a 1971 rough estimate of 10,000 to 15,000 harlequins in the Sound, saying Paul Gertler, of the Fish and Wildlife Service, had directed him to keep the figures secret.

"It is his desire that this remain confidential," Nowlin said. Gertler is on vacation and unavailable for comment, an employee at the Fish and Wildlife Service said Wednesday.

Nowlin had been program manager on injury assessment studies for the Oil Spill Impact Assessment and Restoration Division of Fish and Game before taking the job in Cordova about three weeks ago.

Some biologists said they were concerned that information from the spill damage studies being used for management of public resources was unavailable to the public.

Rothe said he understands the need for state lawyers to guard their ability to win a damage suit against Exxon.

"But on the other hand, that would have to be balanced with providing public information as to why we change hunting regulations, especially in this case where this was done at the last minute," Rothe said.

EIS D

HUNTING-TRAPPING

Emergency Order

ALASKA DEPARTMENT OF FISH AND GAME

Under Authority of AS 16.05.060

Emergency Order No.: 02-07-91

Issued at Anchorage
August 30, 1991

Effective Date: August 31, 1991
11:59 p.m.

Expiration Date: Indefinite, until superceded by subsequent order or action of the Board of Game

EXPLANATION:

This Emergency Order delays the opening of hunting season on harlequin ducks in Prince William Sound, Alaska Game Management Units 6(D) and 7, to October 1.

REGULATIONS:

Therefore, the following regulations in 5 AAC 85.065 (4) (B), Hunting Seasons and Bag Limits for Small Game, and Emergency Order 02-06-91 are amended to read:

Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Non-resident Open Season
(B) Sea ducks and mergansers		
(i) King and common eider, scoter, oldsquaw, [harlequin,] and mergansers		
Units 1-7, 9, 10 (Unimak Is. only), and 11-26 15 per day, 30 in possession	Sept. 1 - Dec. 16	Sept. 1 - Dec. 16
Units 8 and 10 (except Unimak Is.) 15 per day, 30 in possession	Oct. 8 - Jan. 22	Oct. 8 - Jan. 22
(ii) Harlequin duck		
Units 1-5, 6(A)-(C), 9, 10 (Unimak Is. only) and 11-26 15 per day, 30 in possession	Sept. 1 - Dec. 16	Sept. 1 - Dec. 16
Units 6(D) and 7 15 per day, 30 in possession	Oct. 1 - Dec.16	Oct. 1 - Dec.16
Units 8 and 10 (except Unimak Is.)	Oct. 8 - Jan. 22	Oct. 8 - Jan. 22
[(ii)](iii) Spectacled and Steller's eider		
Units 1-26	No Open Season	No Open Season

E15
P

Carl Rosier
Commissioner

By Delegation to:

Thomas C. Kothe
Waterfowl Coordinator

RELATED EMERGENCY ORDERS:

This emergency order amends Hunting Emergency Order 02-06-91, issued at Anchorage August 12, 1991, portions relating to harlequin duck season; all other provisions remaining in effect. Copies of that previous order may be obtained from sources on the attached distribution list.

EIS
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JUSTIFICATION:

The Alaska Department of Fish and Game has reviewed recent results from field studies on harlequin ducks in Prince William Sound, as well as historical survey data. From region-wide surveys during 1989-91, numbers of harlequin ducks in Prince William Sound appear to be markedly lower than historic levels. Data from recent studies indicate that a substantial proportion of harlequin ducks wintering western Prince William Sound are in poor body condition. Preliminary surveys of harlequin duck production in 1990 indicate that few potential breeding pairs occupied the western Sound during the nesting season and no broods were observed. Studies in 1991 recorded continued low numbers of harlequins during summer, little pair activity during scheduled observations of suitable breeding streams, and very few broods.

The department recognizes that sea duck harvest levels in Prince William Sound are traditionally low and have little significance to the wintering aggregation of harlequin ducks, as a whole. The department also recognizes that long-term recovery of the summer breeding population likely will proceed slowly through reoccupation of the western Sound by birds from the eastern Sound and elsewhere. However, the department is concerned about the potential effects of harvest focused on the remnant breeding birds in the western Sound during September, before larger aggregations of migrant harlequins arrive.

Given the recent data indicating reproductive failure of harlequin ducks in western Prince William Sound, the potential significance of September harvest, and lack of response time for the Board of Game to act prior to the opening of waterfowl season, the Department of Fish and Game finds that an emergency exists, and that this order is necessary to conserve remnant breeding harlequin ducks in western Prince William Sound and reduce harvest on harlequin ducks in adjacent areas that may serve as sources for repopulation.

E15
D

Emergency Order 02-07-91 (continued) August 30, 1991

DISTRIBUTION:

1. Lt. Governor
2. Department of Law
   - Asst. Attorney General, Natural Resources
   - Asst. Attorney General, Oil Spill Litigation
3. Commissioner, Department of Fish and Game
4. Division of Wildlife Conservation, ADFG
   - Director
   - Deputy Director
   - Regional Supervisors
   - State/Federal Regulation Coordinator
   - WIDB Coordinator
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5. Director, Division of Subsistence, ADFG
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7. Director, Division of Oil Spill
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9. Board of Game
10. Division of Fish and Wildlife Protection, ADPS
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11. U.S. Fish and Wildlife Service, Anchorage
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    - Asst. Regional Director, Law Enforcement
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    - Asst. Regional Director, Oil Spill
12. Regional Director, National Park Service, Anchorage
13. Regional Forester, U.S. Forest Service, Juneau
14. State Director, Bureau of Land Management, Anchorage

EIS
D

Carl L. Rosier, Commissioner

Public Communications
Box 3-2000
Juneau, Alaska 99802-2000
(907) 465-4112

Alaska Department of Fish & Game

NEWS

FOR IMMEDIATE RELEASE
August 30, 1991

Contact: Roy Nowlin, 424-3215
Cordova, Alaska

Cordova -- A significant failure of harlequin ducks to reproduce in western Prince William Sound has prompted postponement of the harlequin hunting season in Prince William Sound for one month.

The harlequin season was scheduled to open Sunday, but under an emergency order issued Friday hunters won't be allowed to take the colorful sea duck in Game Management Units 6(D) and 7, the Sound and eastern Kenai Peninsula, until October 1.

A review of recent survey data suggests that the number of harlequins in the Sound is down markedly from historic levels. Studies indicate that a significant proportion of harlequins wintering there have been found to be in poor body condition.

In 1990, few potential breeding pairs occupied the western side of the Sound. Studies this summer showed continued low numbers, little breeding activity near suitable nesting streams, and few broods of ducklings.

Historically, the sea duck harvest in Prince William Sound is low and has little significance to the winter population as a whole. But biologists said the precautionary September closure will protect the remnant breeding birds in the western part of the Sound. By October, harlequins from all over Alaska will be wintering in the Sound, and that aggregation will serve to lessen potential effects on the remnant western Sound population.

The September closure applies to the eastern Sound, also. Biologists said that area is the most likely source of harlequins to repopulate western areas, so a reduced harvest there is appropriate.

When the harlequin season opens October 1, the sea duck bag limit will be 15 per day with 30 in possession. The season will continue through December 16.

-30-

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P

Emergency Order No.: 02-07-91

Issued at Anchorage
August 30, 1991

Effective Date: August 31, 1991
11:59 p.m.

Expiration Date: Indefinite, until superceded by subsequent order or action of the Board of Game

EXPLANATION:

This Emergency Order delays the opening of hunting season on harlequin ducks in Alaska Game Management Units 6(D) and 7 to October 1.

REGULATIONS:

Therefore, the following regulations in 5 AAC 85.065 (4) (B), Hunting Seasons and Bag Limits for Small Game, are amended to read:

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Units 8 and 10 (except Unimak Is.) 15 per day, 30 in possession	Oct. 8 - Jan. 22	Oct. 8 - Jan. 22
<u>(ii) Harlequin duck</u>		
<u>Units 1-5, 6(A)-(C), 9, 10 (Unimak Is. only) and 11-26 15 per day, 30 in possession</u>	<u>Sept. 1 - Dec. 16</u>	<u>Sept. 1 - Dec. 16</u>
<u>Units 6(D) and 7 15 per day, 30 in possession</u>	<u>Oct. 1 - Dec.16</u>	<u>Oct. 1 - Dec.16</u>
<u>Units 8 and 10 (except Unimak Is.)</u>	<u>Oct. 8 - Jan. 22</u>	<u>Oct. 8 - Jan. 22</u>
[(ii)]<u>(iii)</u> Spectacled and Steller's eider		
Units 1-26	No Open Season	No Open Season

E15
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JUSTIFICATION:

The Alaska Department of Fish and Game has reviewed results from 1991 field projects on harlequin ducks in Prince William Sound, as well as recent historical data related to assessing effects of the Exxon Valdez oil spill and potential wildlife restoration measures. These surveys and studies indicate that very few potential breeding pairs of harlequin ducks occupied the heavily-oiled western Prince William Sound from May through July in 1990 and 1991, little pair activity was recorded during scheduled intensive observations of suitable breeding streams, and no broods were recorded on any of a variety of field surveys. Over all, numbers of harlequin ducks in Prince William Sound appear to be substantially lower than historic levels.

The department recognizes that traditional levels of harvest in Prince William Sound have little significance to wintering harlequin ducks as a whole, that improvement of harlequin duck productivity is most probably dependent on restoration of expansive intertidal feeding habitats that remain contaminated, and that long-term recovery of the summer breeding population will likely proceed slowly through reoccupation of oiled areas by birds from the eastern Sound and elsewhere. However, the department is concerned about the potential effects of harvest focused on the remnant breeding birds in the western Sound during September, before larger aggregations of migrant harlequins arrive.

Given the recent availability of breeding season data, the potential significance of September harvest, and the inability of the Board of Game to act prior to the opening of waterfowl season, the Department of Fish and Game finds that an emergency exists, and that this order is necessary to conserve remnant breeding harlequin ducks in western Prince William Sound and reduce harvest on harlequin ducks in adjacent areas that may serve as sources for repopulation.

EIS
D

Carl Rosier
Commissioner

By Delegation to:

Thomas C. Rothe
Waterfowl Coordinator

RELATED EMERGENCY ORDERS:

This emergency order amends Hunting Emergency Order 02-06-91, issued at Anchorage August 12, 1991, portions relating to harlequin duck season; all other provisions remaining in effect. Copies of that previous order may be obtained from sources on the attached distribution list.

EIS
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DISTRIBUTION:

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2. Asst. Attorney General for Division of Wildlife Conservation
3. Commissioner, Department of Fish and Game
4. Director, Division of Wildlife Conservation, ADFG
5. Director, Division of Subsistence, ADFG
6. Director, Division of Boards, ADFG
7. Board of Game
8. Director, Division of Fish and Wildlife Protection, ADPS
9. Detachment Commanders, ADPS-FWP,
10. Regional Supervisors, Div. of Wildlife Conservation, ADFG
11. WIDB Coordinator, Div. of Wildlife Conservation, ADFG
12. Senior Staff Biologist, Div. of Wildlife Conservation, ADFG
13. State/Federal Regulation Coordinator, Div. of Wildlife
14. Public Communications Section, ADFG
15. Regional Director, U.S. Fish and Wildlife Service, Anchorage
16. Regional Director, National Park Service, Anchorage
17. Regional Forester, U.S. Forest Service, Juneau
18. State Director, Bureau of Land Management, Anchorage

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

DIVISION OF WILDLIFE CONSERVATION

RAPIFAX # (907) 344-79[illegible]

EIS
D

FAX TRANSMITTAL SHEET

TO: STAN SENNER
ADF+G - OSIAR RESTORATION
ANCH

DATE: 8/29/91

NO. of PAGES: 5
(including this page

FROM: TOM ROTHE 267-2206
ADF+G - WILDL. CONSERV.
ANCH

MESSAGE:

REVIEW + COMMENT ASAP.

WHO CAN GIVE FINAL APPROVAL FOR PUBLIC INFO LANGUAGE RELATED TO EVOS? NEWS RELEASE IS COMING.

EIS
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CONFIDENTIAL-LITIGATION SENSITIVE

SPRING HARLEQUIN SURVEYS
OIL SPILL AREA, PRINCE WILLIAM SOUND 1991

LOCATION	SEGMENT	DATE	TIME	# FEMALES	# MALES	ACTIVITY
BAY OF ISLES,						
(WEST ARM)	KN201*	5/24	1300	-0-	-0-	
OTTER LAKE	KN018	5/24	2200	-0-	-0-	
BAY OF ISLES	KN022*	5/25	0800	5	10	SITTING
MARSHA BAY	(ALL)	5/26	0900	-0-	-0-	
RUA COVE	KN213	5/26	0830	-0-	-0-	
SNUG HARBOR	(ALL)	5/26	0930	-0-	-0-	
HOGAN BAY	(ALL)	5/26	1030	-0-	-0-	
LOWER PASSAGE	KN103*	5/26	1330	-0-	-0-	
FOUL PASS	IN031	5/26	1400	-0-	-0-	
LEWIS BAY	(ALL)	5/26	1500	-0-	-0-	
LOG JAM BAY	KN211\210*	5/26	1900	1	1	FEEDING
OTTER ISLAND	KN021*	5/26	2200	7	1	SITTING
BAY OF ISLES	KN019	5/26	2130	2	1	SWIMMING
HERRING BAY	KN144B*	5/29	0900	7	5	SITTING
ALL SEGMENTS FROM						
FROM HERRING PT. TO						
L. HERRING BAY		5/29	1300	-0-	-0-	
DRIER BAY,						
PORT AUDRY	KN575	5/30	0930	-0-	1	FLYING
MALLARD BAY	KN575	5/30	1000	-0-	-0-	
JOHNSON BAY,						
AT S ENTRANCE	KN554*	5/30	1140	9	5	SITTING
				(PLUS 5 OF UNDERTERMINED SEX)		
LOG JAM BAY	KN211*	5/31	1045	-0-	-0-	
NW BAY ELANORE	(ALL)	5/31	0900	-0-	-0-	
BLOCK ISLAND	(ALL)	5/31	0930	-0-	-0-	
FOUL PASS	INO31*	5/31	1000	-0-	-0-	
LOG JAM BAY	KN211*	5/31	1030	-0-	-0-	
BAY OF ISLES	KN022*	5/31	1110	11	6	SWIMMING
				(PLUS 3 OF UNDERTERMINED SEX)		
OTTER ISLAND	KNO21*	5/31	1900	10	10	SWIMMING
				(PLUS 15 OF UNDERTERMINED SEX)		
FOUL BAY	MA002	6/1	0930	15	17	SWIMMING
				(PLUS 30 OF UNDERTERMINED SEX)		
MAIN BAY	MA005A	6/1	1050	12	14	FLYING & SWIMMING
PT NELLI JUAN	MA001	6/1	1330	1	1	SITTING
BAY OF ISLES	KN021*	6/1	1530	(28 OF UNDERTERMINED SEX)		
GREEN ISLAND	GR302	6/2	1040	2	-0-	IN FLIGHT
LA TOUCHE IS.	LA21-LA37	6/2	1200	-0-	-0-	
JOHNSON BAY	KN554*	6/2	1345	1	1	FLYING
LOWER HERRING	(ALL)	6/2	1400	-0-	-0-	

EIS
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SPRING HARLEQUIN SURVEYS
PRINCE WILLIAM SOUND 1991

LOCATION	SEGMENT	DATE	TIME	# FEMALES	# MALES	ACTIVITY
HERRING BAY	KN144B*	6/19	1745	2	3	SITTING
BAY OF ISLES	KNO21*	6/19	1915	6	14	FLYING/SITTING
WEST ARM BOI	KN201*	6/20	0930	-0-	-0-	
BAY OF ISLES	KN022*	6/20	1025	3	9	FEEDING
FOUL BAY	INO31	6/20	1120	10	8	
				(10 OF UNDETERMINED SEX)		
JOHNSON BAY	(ALL)	6/20	1220	-0-	-0-	
DRIER BAY	(ENTRANCE)	6/20	1435	-0-	-0-	
JUNCTION IS.	CH011A	6/21	1230	-0-	-0-	
CHENEGA IS.	CH001	6/21	1320	-0-	-0-	
(stream mouth, too exposed to anchor)						
KAKE COVE	CH017	6/21	1400	-0-	-0-	
PLEIADES IS.	PL001	6/22	1110	1	-0-	(LOOKING SICK)
JOHNSON BAY (ENTRANCE)		7/6	1515	(3 OF UNDERTERMINED SEX)		
APPLEGATE IS.	AE004	7/7	1120	6	10	(MAYBE MOLTING)
PICTURESQUE COVE,						
CULROSS PASSAGE (NO SEG)		7/7	1230	(CREEK ENDING W/WATERFALL)-0-		
CULROSS IS.	CU011	7/7	1330	(CREEK ENDING W/WATERFALL)-0-		
S.NELLI JUAN	NJ001A	7/7	1335	(CREEK W\STEEP CASCADE)-0-		
ESHAMY BAY	EB007	7/7	1405	(GUNBOAT CREEK/CASCADE) -0-		
DELENIA IS.	DE001M	7/10	1215	2	4 (sitting on rocks)	
WHALE BAY W	WH504	7/10	1250	-0-	1 (sitting on rocks)	

TOTAL MALE	80
TOTAL FEMALE	85
TOTAL UNDETERMINED SEX	51
TOTAL	216

* = DUPLICATE SURVEYS

residents - late May through June

TOM/HQDSURVY.TWC

EIS
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CONFIDENTIAL-LITIGATION SENSITIVE

MOLTING AREA SURVEYS
OIL SPILL AREA, PRINCE WILLIAM SOUND 1991

LOCATION	SEGMENT	DATE	TIME	# HQDs TTL	# FLIGHTLESS
SW FLEMMING IS	FL003	7/19	1045	18	18
BAINBRIDGE IS.	BA006	7/19	1130	23	23
LUCKY BAY	KN600	7/19	1450	5	5
FOUL BAY	MA002	7/20	1230	57	57
APPLEGATE IS.	AG004	7/20	1130	8, 1 FEMALE	7
OTTER ISLAND	KN021	7/25	1145	5 MALES	2
FOUL PASSAGE	IN031	7/25	1815	5, 2 FEMALE	1
BAY OF ISLES	KN022	7/25	1730	25, 1 FEMALE	24
HERRING BAY	KN141A	7/25	1000	5, 1 FEMALE	3
CHANNEL IS.	GR004	7/26	1200	350	350
GREEN ISLAND	GR300	7/26	1250	50	50
GIBBON ANCHORAGE	GR002	7/26	1130	29	29
HERRING POINT	KN500A	8/3	1100	5	5
NW KNIGHT IS.	KN500A/B	8/3	1115	4	4
NW KNIGHT IS.	KN504	8/3	1200	11	10
JUNCTION IS.	CHO11	8/4	1215	26, FEMALE	25
MASKED BAY	NONE	8/4	1050	14	14
SMALL BAY	KN553	8/4	1400	7	7
ESHAMY BAY	EB009	8/5	1015	5	5
ESHAMY LAGOON	EB012/013	8/5	1040	7	7
CRAFTON ISLAND	CR004	8/5	1100	7	7

TOTAL COUNT 666
TOTAL FLIGHTLESS 653
TOTAL FEMALES 6

molting =
mid-July — August

PRLIMLST.TC3

* pull from larger area - i.e. these #'s not just resident
* females come in to molt after ♂'s

E15
D

CONFIDENTIAL-LITIGATION SENSITIVE

SPRING NET SITES
OIL SPILL AREA, PRINCE WILLIAM SOUND 1991

LOCATION	SEGMENT	DATE	AK STEAM CATALOG	NET TIME	RESULTS
SNUG HARBOR	KN402	6/3	ASC 226-30-16820	12 HOURS	-0-
MALLARD BAY	KN575	6/7	ASC 226-20-16980	12 HOURS	-0-
OTTER BAY	KN018	6/10	ASC 226-20-16880	12 HOURS	-0-
BAY OF ISLES (WEST ARM)	KN201	6/15	ASC 226-30-16870	12 HOURS	-0-
KAKE COVE	CH017	6/22	ASC 226-20-?????	12 HOURS	-0-
PADDY BAY	PA001	6/24	ASC 226-20-26010	12 HOURS	-0-
BRISTOLOF CRK.	NONE	7/4	ASC 226-20-16230	12 HOURS	-0-
WHALE BAY S.	WH502	7/8	ASC 226-20-16340	12 HOURS	-0-
WHALE BAY W.	WH504	7/10	ASC 226-20-16300	12 HOURS	-0-
IKTUA BAY	EV008	7/18	ASC 226-20-16300	9 HOURS	-0-
CULROSS PASS.	NONE	7/19	ASC 224-30-14800	9 HOURS	-0-
CAMP CREEK	KN132	7/6	ASC 226-30-16982	12 HOURS	-0-

(camp creek was 24 hour watch throughout the summer)

nothing seen either

TOM/PRLIMLST.TC3

CONFIDENTIAL

EIS
D

Table 1. Summary of harlequin duck population data from Prince William Sound and eastern Kenai Peninsula, 1989-1991, relevant to the Exxon Valdez Oil Spill damage assessment. (USFWS aerial and boat surveys)

DATE	SURV MODE	POP ESTIM[1]	INDEX COUNT	SURV KM	BIRDS/ KM	% SURV IN OIL	% HARL IN OIL
P W SOUND							
Feb 71	BOAT	19952	4002	4709	.850	27	37
Mar 89	AIR	9295	1785	4513	.396	31	42
May 89	AIR	14107	2729	4540	.601	29	22
Jul 89	BOAT	3887	--	--	--	--	--
Jul 89	AIR	3357	705	4920	.143	--	4
Aug 89	BOAT	6789	--	--	--	--	--
Oct 89	AIR	16924	2789	3870	.721	20	14
Mar 90	BOAT	10397	--	--	--	--	--
Mar 90	AIR	10868	2185	4720	.463	30	25
May 90	AIR	7770	1572	4745	.331	30	22
Jun 90	BOAT	5266	--	--	--	--	--
Jul 90	BOAT	9382	--	--	--	--	--
Aug 90	BOAT	7850	--	--	--	--	--
Oct 90	AIR	14952	2992	4700	.637	32	31
Mar 91	BOAT	11132	--	--	--	--	--
Jul 91	BOAT	8264	--	--	--	--	--
KENAI							
Mar 89	AIR	6479	1267	1903	.666	38	41
May 89	AIR	1918	375	1826	.205	33	17
Jul 89	AIR	1775	347	2178	.159	39	20
Mar 90	AIR	6418	1255	2026	.619	44	28
May 90	AIR	1120	219	1821	.120	37	12

[1] Estimates from boat surveys are provided by FWS, but survey length is not given. For aerial surveys counts are expanded by boat:air comparison factor of 5.114:1 and standardized for the average survey length of 4590km, but not adjusted by a species visibility ratio. 1971 survey adjusted to 400-m equivalent.

Table 2. Best seasonal comparisons of harlequin duck population data from Prince William Sound, 1989-90, related to the Exxon Valdez Oil Spill. (USFWS boat and aerial surveys)

DATE	SURVEY MODE	POP ESTIM[2]	BIRDS/ KM	% SURVEY IN OIL	% HARL IN OIL
FALL					
Oct 89	Air	16924	.721	20	14
Oct 90	Air	14952	.637	32	31
WINTER					
Feb 71	Boat	19952	.850	27	37
Mar 89	Air	9295	.396	31	42
Mar 90	Boat	10397	--	--	--
Mar 90	Air	10868	.463	30	25
Mar 91	Boat	11132	--	--	--
SUMMER					
Jul 89	Boat	3887	--	--	--
Jul 89	Air	3357	.143	--	4
Jun 90	Boat	5266	--	--	--
Jul 90	Boat	9382	--	--	--
Jul 91	Boat	8264	--	--	--

[2] Estimates from boat surveys as provided by USFWS. Estimates from aerial surveys adjusted by boat:air expansion factor of 5.114:1 and standardized for the average survey length of 4590km. Estimate from 1971 boat survey adjusted from 200-m data to 400-m width (x 1.353).

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Table 6. Composition (%) of the statewide duck harvest in Alaska, 1969-88[a].

Year	Dabbling ducks	Diving ducks	Sea ducks/ mergansers
1966	86.5	10.3	3.0
1967	84.6	10.1	5.1
1968	89.6	8.9	1.8
1969	83.8	10.1	6.1
1970	86.0	9.0	5.0
1971	89.7	5.9	4.3
1972	90.0	7.6	2.3
1973	90.5	8.7	0.9
1974	82.3	16.4	1.4
1975	88.0	5.8	6.2
1976	82.6	9.5	7.9
1977	88.2	10.3	1.5
1978	82.5	11.1	6.5
1979	87.5	8.2	4.2
1980	85.0	12.5	2.5
1981	87.8	9.9	2.3
1982	85.4	11.0	3.6
1983	82.7	15.3	2.2
1984	88.3	9.6	1.8
1985	84.0	10.9	4.9
1986	82.7	13.1	4.2
1987	84.8	10.1	5.1
1988	79.7	9.7	10.6
$\bar{x}$	85.6	10.2	4.2
S.D.	±3.0	±2.7	±2.5

[a] Based on FWS parts collection surveys.

1989 10.7 %

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Table 4. Proportion (%) of duck, goose, crane, and snipe sport harvests and hunter activity in the fall by geographic region from the state survey for 1989-90.

Harvest Region	Hunter Days	Dabblers/ Divers	Sea Ducks	Geese	Cranes	Snipe
North Slope [a]	0.0	0.0	0.0	0.0	0.0	0.0
Seward Peninsula	1.2	0.7	0.2	3.0	8.1	0.0
Upper Yukon Valley	2.3	1.3	0.0	0.0	0.0	0.0
Lower Yukon Valley	0.4	0.5	0.3	0.3	0.0	0.0
Central	25.8	28.4	3.8	35.7	79.0	20.7
Yukon Delta	1.0	1.4	1.4	1.4	0.0	0.0
Cook Inlet	32.7	39.9	26.0	18.2	6.5	30.2
Gulf Coast	6.6	4.8	2.0	5.5	0.0	1.7
Southeast	14.8	12.6	18.2	20.0	4.8	42.2
Kodiak	9.1	4.6	41.0	0.0	0.0	0.0
Alaska Peninsula	5.0	5.4	2.9	14.2	1.6	5.2
Aleutian Chain	0.5	0.0	1.8	0.0	0.0	0.0
Unknown	0.6	0.5	0.1	2.7	0.0	0.0
Statewide Days/Harvest	33,069	46,681	5,606	5,879	625	1,170

[a] No questionairres returned from the North Slope region.

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Table 4. Proportion (%) of duck, goose, crane, and snipe sport harvests and hunter activity in the fall by geographic region from the state survey for 1988-89.

Harvest Region	Hunter Days	Dabblers/ Divers	Sea Ducks	Geese	Cranes	Snipe
North Slope	0.7	0.1	1.0	0.7	0.0	0.6
Seward Peninsula	2.7	1.1	2.0	3.7	9.2	0.6
Upper Yukon Valley	1.6	0.9	0.0	0.9	2.3	0.0
Lower Yukon Valley	0.8	1.7	0.0	2.0	0.0	0.0
Central	17.4	21.1	3.0	13.2	69.5	11.6
Yukon Delta	1.4	2.0	2.3	0.1	5.3	5.5
Cook Inlet	41.0	45.3	37.3	37.1	9.2	52.4
Gulf Coast	7.3	6.3	3.2	6.8	0.0	7.9
Southeast	15.2	11.4	17.2	10.5	3.8	19.5
Kodiak	5.8	5.4	24.0	0.2	0.0	0.0
Alaska Peninsula	5.1	4.2	2.6	24.3	0.8	1.8
Aleutian Chain	0.8	0.2	7.2	0.0	0.0	0.0
Unknown	0.7	0.5	0.1	0.5	0.0	0.0
Statewide Days/Harvest	44,625	78,065	6,364	8,781	1,443	1,807

Table 4. Proportion (%) of duck, goose, crane, and snipe sport harvests and hunter activity in the fall by geographic region calculated from the state survey for 1987-88.

Harvest Region	Hunter Days	Dabblers/Divers	Sea Ducks	Geese	Cranes	Snipe
North Slope	0.1	0.0	0.0	0.2	0.0	0.0
Seward Pen.	0.8	0.4	0.8	0.6	2.6	0.0
Upper Yukon Valley	1.2	1.0	0.2	0.8	0.4	0.8
Lower Yukon Valley	0.8	0.8	0.0	0.2	0.0	0.0
Central	20.0	22.3	3.2	14.6	79.4	20.5
Yukon Delta	0.9	0.6	2.5	2.8	0.0	2.5
Cook Inlet	40.3	43.3	28.4	29.9	10.3	35.1
Gulf Coast	5.5	6.3	5.8	3.4	0.7	9.3
Southeast	19.4	15.0	24.6	20.4	5.5	28.7
Kodiak	4.7	3.5	29.7	0.0	0.0	0.8
Alaska Pen.	5.3	5.9	1.7	26.3	1.1	2.0
Aleutian Chain	1.0	0.5	2.9	0.1	0.0	0.1
Unknown	0.2	0.3	0.2	0.1	0.0	0.1
Statewide Days/Harvest	57,828	69,627	6,597	5,389	1,014	2,654

Table 4. Species composition of the duck harvest, 1986-87 waterfowl season. [a]

Species	Yukon Valley	Central	Cook Inlet	Gulf Coast	Southeast	Kodiak	Alaska Peninsula	Percent of total statewide [b]
Mallard	11.3	24.5	31.1	33.3	47.3	40.6	16.5	30.0
Pintail	--	6.0	14.7	7.2	5.6	4.3	25.6	12.2
American Wigeon	60.9	23.9	12.0	38.2	10.7	5.7	18.9	18.1
Green-winged Teal	22.2	10.4	13.3	5.2	23.2	4.3	18.5	13.7
Shoveler	--	9.8	8.6	3.8	2.4	--	1.1	5.9
Blue-winged Teal	--	--	0.5	1.3	--	--	--	0.3
Gadwall	--	--	1.8	--	0.4	16.2	5.8	2.5
Total Dabblers	94.4	74.6	82.0	89.0	89.6	71.1	86.4	82.7
Lesser Scaup	--	10.7	0.3	--	0.4	--	0.6	2.6
Greater Scaup	--	--	2.0	--	--	--	3.7	1.2
Bufflehead	5.6	11.2	4.9	--	2.8	--	--	4.6
Common Goldeneye	--	0.8	0.1	1.9	--	2.8	4.4	1.5
Barrow's Goldeneye	--	--	4.2	1.4	0.4	13.8	--	2.2
Ringneck	--	--	1.7	--	--	--	--	0.6
Canvasback	--	0.2	0.4	--	--	--	--	0.3
Redhead	--	--	0.2	--	--	--	--	0.1
Total Divers	5.6	22.7	13.8	3.3	3.6	16.6	8.7	13.1
White-winged Scoter	--	--	0.7	--	--	--	--	0.3
Surf Scoter	--	--	0.7	2.6	1.2	--	--	0.6
Harlequin	--	--	0.7	1.3	4.8	4.3	2.2	1.6
Steller's Eider	--	--	--	--	--	--	2.2	0.3
Common Merganser	--	--	--	1.3	0.4	--	--	0.2
Oldsquaw	--	--	0.6	--	--	8.2	--	0.7
Hooded Merganser	--	--	--	0.6	0.4	--	--	0.1
Red-breasted merganser	--	--	0.2	1.9	--	--	0.6	0.3
Total Seaducks/ Mergansers	--	--	2.9	7.7	6.8	12.5	5.0	4.2
Total	100	97.3	89.7	100	100	100	100	99.9

[a] No harvest reported by FWS for the North Slope, Seward Peninsula, Yukon Delta, and Aleutians.
[b] Includes birds harvested in unknown locations.

Table 3. Proportion (%) of calculated duck, crane, and snipe fall sport harvests and sport hunter activity by geographical region, 1985-86.

Harvest Area	Hunter Days	Dabblers/Divers	Sea Ducks	Cranes	Snipe
North Slope	0.0	0.0	0.0	0.0	0.0
Seward Pen.	0.7	0.7	1.3	0.0	0.0
Upper Yukon Valley	0.8	0.2	0.0	0.0	0.0
Lower Yukon Valley	0.1	T	0.0	0.0	0.0
Central	21.5	26.0	1.3	57.1	6.8
Yukon Delta	3.2	3.2	6.1	37.1	15.9
Cook Inlet	36.9	36.4	27.3	4.3	55.7
Gulf Coast	4.8	5.0	4.0	0.0	0.0
Southeast	19.2	18.6	18.4	0.0	21.6
Kodiak	6.6	5.3	40.4	0.0	0.0
Alaska Pen.	6.0	4.6	1.3	1.4	0.0
Aleutian Chain	0.0	0.0	0.0	0.0	0.0
Statewide Days/Harvest	52,856	79,604	7,186	1,270	1,597

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Table 3. Calculated hunting activity and duck harvest for specific locations in Alaska where more that 0.1% of the harvest occurred in 1989-90.

Location	Ducks		Hunter days	
	Calculated harvest	% of state total	Calculated days	% of state total
Susitna Flats	7,053	13.5	2,864	8.7
Minto Flats	6,338	12.1	2,138	6.5
Palmer hay Flats	3,602	6.9	2,370	7.2
Portage	1,624	3.1	1,261	3.8
Delta	1,465	2.8	2,057	6.2
Tok-Nothway	1,431	2.7	535	1.6
Redoubt Bay	1,414	2.7	504	1.5
Tanana Flats	1,347	2.6	1,170	3.5
Copper River Delta	1,321	2.5	1,513	4.6
Kachemak Bay	1,296	2.5	313	0.9
Mendenhall	1,010	1.9	867	2.6
Potter's Marsh	1,002	1.9	1,210	3.7
Trading Bay	985	1.9	333	1.0
Duncan Canal	976	1.9	535	1.6
Kenai River/Flats	985	1.9	524	1.6
Pilot Point	833	1.6	363	1.1
Healy Lake	791	1.5	585	1.8
Icy Striat	766	1.5	434	1.3
Stikine River Flats	606	1.2	403	1.2
Cold Bay	598	1.1	716	2.2
Old Harbor	513	1.0	81	0.2
Naknek River	513	1.0	232	0.7
China Poot Bay	505	1.0	101	0.3
Kalsin Bay	480	0.9	575	1.7
Woman Bay	463	0.9	484	1.5
Ugashik	463	0.9	141	0.4
Eielson AFB	438	0.8	595	1.8
Denali Highway	362	0.7	202	0.6
Middle Bay	345	0.7	514	1.6
Ketchikan Area	337	0.6	192	0.6
Petersberg Area	337	0.6	514	1.6
Seward	303	0.6	91	0.3
Chickaloon	295	0.6	161	0.5
Goose Bay	286	0.5	101	0.3
Prince William Sound	286	0.5	282	0.9
Prince of Whales	269	0.5	182	0.5
Kake	261	0.5	121	0.4
Angoon	253	0.5	161	0.5
Creamer's Field	227	0.4	222	0.7
Jim Creek/ Swan Lakes	210	0.4	222	0.7
Swanson River	202	0.4	141	0.4
Greater Kenai Peninsula	194	0.4	171	0.5

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Table 3. (Cont).

Location	Ducks: Calculated harvest	Ducks: % of state total	Hunter days: Calculated days	Hunter days: % of state total
Yakutat	177	0.3	151	0.5
Raspberry Striats	168	0.3	30	0.1
Kink River	152	0.3	262	0.8
Sitka Area	143	0.3	202	0.6
Seymore Canal	135	0.3	40	0.1
Skilak Lake	118	0.2	40	0.1
Nome	101	0.2	91	0.3
Golovin	101	0.2	61	0.2
Pagadshak	101	0.2	212	0.6
Adak	101	0.2	212	0.6
Salcha River	93	0.2	91	0.3
Eagle River (S.E. AK)	93	0.2	101	0.3
Montegue, Hitchenbrook, & Hawkins Islands	84	0.2	61	0.2
St. James Bay	84	0.2	81	0.2
Lynn Canal	84	0.2	20	0.1
Subtotals	44,721	85.5	27,838	84.2
Statewide Totals	52,287	100	33,069	100

Duck-hunting closure linked to oil-spill data

By DOUG LOSHBAUGH
Homer News

The recent closing of the harlequin duck hunting season in Southcentral may be providing a clue to at least some of the damage done by the 1989 Exxon Valdez oil spill, knowledge locked away while government and the oil company face off in court.

Citing a rapidly failing population and a significant failure of harlequins to reproduce since the spill, state biologists recently postponed the scheduled Sept. 1 hunting opening for harlequins in Prince William Sound and on the outer coast of the Kenai Peninsula until October. That's when the local population will be bolstered with migrants from nesting sites in the Interior.

Exxon spokesman Karsten Rodvik said there is not enough data to say the harlequin population has dropped, and allegations the birds are failing to reproduce are pure speculation.

But a recent state news release announcing the postponed hunt says differently.

"A significant failure of harlequin ducks to reproduce in western Prince William Sound has prompted

Please see Page B-3, **DUCKS**

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ADN 14 Sept 1991

DUCKS: Season closed

Continued from Page B-1

postponement of the harlequin hunting season," reads the release from the state Department of Fish and Game. "In 1990, few potential breeding pairs occupied the western side of the Sound. Studies this summer showed continued low numbers, little breeding activity birds to eventually repopulate the western Sound.

A federal notice of effects of the spill, filed in U.S. District Court in Anchorage in April, said more than 2,000 sea duck carcasses were recovered after the spill, including more than 200 harlequins. The notice said that species was most affected by the spill because

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Session View - 3/4

Message ID: 572-6484
Date: 3/3/92 9:49 AM
From: Andy Gunther 70724,2057
Subject: Message for Stan Senner

Attn: Art Weiner

Message for Stan Senner

Stan,

This paper may contain reference to the work on competition between blue ducks and salmon for invertebrate food:

Collier, K.J.1991. Invertebrate food supplies and diet of blue duck on rivers in 2 regions of the north Island, New Zealand. New Zealand Journal of Ecology 15, 131-138.
Bob Spies

[Navigator: Message deleted after reading]

Catastrophes and Conservation: Lessons from Sea Otters and the *Exxon Valdez*

JAMES A. ESTES

CATASTROPHES, SUDDEN AND WIDESPREAD DISASTERS, CAN either occur naturally or be caused by human beings. When human-caused, these events elicit feelings of shock and anger, often leading to costly litigation over personal loss and environmental damage. Perpetrators of catastrophes often spend vast sums of money ostensibly to prevent or undo the damage, and such expenditures are encouraged by law and public sentiment. It seems that people want to see the guilty party pay for environmental damage, the assumption implicitly being that funds expended result in harm prevented or undone. But is this assumption true? In the following commentary, I consider a recent and well-known case—the effort to save sea otters after the *Exxon Valdez* oil spill. Despite immense expenditures, the emerging facts lead to two conclusions: population losses were poorly documented, and few animals were saved. These findings cast doubt on our ability to protect sea otters from future spills and lead to troubling questions about how to recognize and document the effects of catastrophic events, and, ultimately, the utility of highly visible and expensive efforts to save wildlife from perceived environmental catastrophes.

The Exxon Valdez spill. On 24 March 1989, the *Exxon Valdez* ran aground on Bligh Reef in northeastern Prince William Sound, spilling more than 10 million gallons of crude oil (*1*). Catastrophic losses were expected and a monumental effort was made to save sea otters (*2*). The costs were high, but what were the benefits? Specifically, how many otters were killed, how many were saved, and how might a different course of action have improved these figures?

Effects of the Exxon Valdez spill on sea otters. The *Exxon Valdez* spill spread over a linear distance of more than 700 kilometers and soiled an estimated 5300 kilometers of shoreline (*3*). While cleaning up and capturing oiled wildlife for rehabilitation, 878 sea otter carcasses were recovered—a minimal estimate of loss. However, many animals killed by the spill undoubtedly were not found. Losses have been estimated from pre- and post-spill surveys, although in my view these surveys shed little light on the population-level effect, mainly because the size and distribution of the population just prior to the spill is poorly known. This is because a comprehensive survey of Prince William Sound and adjacent waters was not done immediately after the spill but before oil dispersed into southwestern Prince William Sound and the northern Gulf of Alaska. Thus, although the *Exxon Valdez* spill undoubtedly killed many sea otters and may have reduced populations substantially, available data lack the power to demonstrate population changes.

Rescue and rehabilitation of oiled sea otters. In total, 357 sea otters were captured and delivered to rehabilitation facilities (*2, 4*). Of these, 123 died in captivity. Thirty-seven of the 234 survivors were judged unsuitable for return to the wild and were transferred to aquaria and other permanent holding facilities; 25 of these animals were still alive 10 months later. The remaining 197 survivors were released by August 1989, 45 of them with surgically implanted radios. Twenty-two of the instrumented animals were dead (11) or missing (11) the following spring, thus indicating relatively low post-release survival of the captured and treated animals (*5*).

At best, 222 sea otters (the 197 released and 25 living in captivity) were captured and rehabilitated. This represents about 18% of the minimal number contaminated (878 found dead in the field and 357 brought to the rehabilitation facility). However, the percentage of contaminated otters that were successfully rehabilitated was lower than this. For one, many contaminated sea otters probably were never found. Available data suggest that only about one in five acute deaths were recovered (*4*). Second, some otters captured for rehabilitation were unoiled, and others were so lightly oiled that they may have fared better if left in nature to their own devices (*6*). About 70% of the animals brought to the rehabilitation facilities were determined to be uncontaminated (61), lightly oiled (123), or of unknown status (68) (*7*). Finally, rescue efforts probably caused some mortality in and of themselves because otherwise healthy captive sea otters suffer a 5 to 10% stress-induced mortality rate under the best of circumstances (*4, 8*).

Cost of capture and rehabilitation. Capture and rehabilitation costs for sea otters alone was $18.3 million (*9*). Assuming that 222 otters were saved (the maximum possible), costs exceeded $80,000 per animal.

The *Exxon Valdez* spill is broadly perceived as an environmental catastrophe. However, expected catastrophic declines in the region's sea otter population cannot be demonstrated, not because they did not occur but because the necessary information is lacking. Furthermore, efforts to rehabilitate oiled sea otters following the spill were extremely expensive and ineffective. Some improvements are possible with better planning. However, post-spill capture and rehabilitation probably cannot be used to substantially reduce sea otter losses from future spills, and the use of such measures to conserve populations is unrealistic.

How then should we prepare for and respond to environmental catastrophes of this kind? The *Exxon Valdez* experience suggests several points of possible general application. First, the effects must be properly documented, especially at the levels of populations, communities, and ecosystems. Such documentation is necessary if we are to know that a catastrophe was indeed a catastrophe. By no means is this clear for sea otters and the *Exxon Valdez*. Second, it is important to evaluate the need for and effectiveness of intervention on behalf of wildlife. If a species or population is not threatened with decimation or extinction by the event, and if methods are not available to protect or rehabilitate affected wildlife, should the time, money, and anguish be put forth to save a few individuals? Finally, in preparing for future catastrophes, post-event mitigation should be used only as a line of last resort. Planning of this kind tends to lull the public and policy-makers into a false sense of readiness. By far the more effective strategies are to reduce risks and to enhance threatened species or populations in anticipation of potential catastrophic loss.

U.S. Fish and Wildlife Service, Institute of Marine Sciences, University of California, Santa Cruz, CA 95064.

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4. U.S. Fish and Wildlife Service, Anchorage, Alaska, unpublished data.
5. C. W. Monnett *et al.*, in (*1*).
6. J. Ames, in (*1*), and G. R. VanBlaricom, in (*1*), present further discussion and opposing views on this issue.
7. T. M. Williams *et al.*, in (*2*).
8. K. B. Schneider, personal communication.
9. R. W. Davis, in (*2*).

United States Department of Agriculture | Forest Service | Washington Office | 14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

Reply to: 2670 **Date:** June 7, 1994

Subject: Formal Consultation Authorities

To: Regional Foresters

Forest Service Manual 2670 identifies that Regional Foresters request formal consultation or conferencing with the U.S. Department of the Interior Fish and Wildlife Service (FWS) or the U.S. Department of Commerce National Marine Fisheries Service (NMFS). Recent changes in consultation authorities within the FWS have given many field offices authority to render biological opinions. With this change it may be more expedient for Forest Supervisors to request formal consultation or conferencing directly with the appropriate FWS or NMFS office. At the same time we recognize that it may be easier to oversee compliance with the Endangered Species Act Section 7 procedures and ensure that threatened and endangered species impact resolutions through informal consultation avenues are exhausted before requesting formal consultation by retaining consultation authorities at the regional office.

With this letter you have the authority to delegate formal consultation or conferencing authority to the Forest Supervisor. If you do so, coordinate with the appropriate FWS and NMFS offices to ensure that the delegation will work smoothly with the regulatory agencies. You must have their concurrence with any consultation process changes. It is important that mechanisms be instituted to ensure consistency between forests when a species range overlaps several forests. Only delegate this authority if you can ensure process consistency, Section 7 compliance, pursuance of informal consultation, etc. Notify this office if you decide to delegate this authority, and identify what steps are being taken to (1) ensure Section 7 compliance, (2) ensure that informal consultation steps have been exhausted before requesting formal consultation, (3) determine how effects across species ranges which overlap more than one forest, region, or FWS field office will be assessed, and (4) track cumulative effects across a species range. This change in consultation authority will be part of the upcoming revision to FSM 2670.

/s/ Joan Comanor
for

JACK WARD THOMAS
Chief

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United States Department of Agriculture Forest Service
Alaska Region P.O. Box 21628
Juneau, AK 99802-1628

Reply to: 1590

Date: August 31, 1994

Mr. David Allen, Acting Director Region 7
U. S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Dear Dave:

In response to your memorandum of August 12, 1994, we have enclosed for your review and concurrence, our determinations regarding the biological assessments for the threatened and endangered species that are in the area of consideration or which use the area. Based on the analysis by the *Exxon Valdez* Oil Spill Restoration interdisciplinary team, there would be no actions that would result in any adverse impacts to any of these species.

The species assessed were:

Species	Determination
Short-tailed albatross (*Diomedea albatrus*)	No adverse effects
American peregrine falcon (*Falco peregrinus anatum*)	No adverse effects (may benefit)
Arctic peregrine falcon (*Falco peregrinus tundrius*)	No adverse effects
Aleutian Canada goose (*Branta canadensis leucopareia*)	No adverse effects
Steller's eider (*Polysticta stelleri*)	No adverse effects (may benefit)

If possible, we request that this consultation be expedited. If there remains any specific questions regarding compliance with Section 7 of the Endangered Species Act, please contact Rod Kuhn the *Exxon Valdez* Oil Spill Restoration Plan EIS Team Leader directly or the U.S. Fish and Wildlife Service EIS team member, Gerry Sanger, at 278-8012.

Sincerely,

PHIL JANIK
Regional Forester
940831 1215 EAM 1590 06
Enclosure

RECORD COPY

cc:
Rod Kuhn

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United States
Department of
Agriculture

Forest Service

Alaska Region

Engineering and Aviation Management

USDA Forest Service, AlaskaRegion - Regional Office, P.O. Box 21628, Juneau, AK 99802

Fax Transmittal

To: Rod Kuhn

Unit/Company:

Fax Number: (907) 276-7178

Voice Number:

From: Jim Wolfe

Unit/Company: EAM

Fax Number: (907) 586-7555

Voice Number (907) 586-8866

Remarks:

J. Wolfe

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Rd.
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:
DES

SEP 8 1994

Mr. Phil Janik, Regional Forester
U.S. Forest Service
Alaska Region
P.O. Box 21628
Juneau, Alaska 99802-1628

Dear Mr. Janik:

We have reviewed your August 31, 1994, biological assessment (enclosure), along with the preliminary information presented in the draft *Exxon Valdez* Oil Spill Restoration Plan Environmental Impact Statement. The information presented in the source documents regarding the proposed restoration activities is not project specific. Although the information is general, it is unlikely that any listed species under our jurisdiction occur within the action area. Therefore, the Fish and Wildlife Service concurs that the proposed activities will not likely adversely affect the endangered or threatened species under our jurisdiction addressed in your biological assessment. It will be important, however, to reevaluate this determination on a case-by-case basis as more detailed project descriptions are developed, or if new information reveals that listed species will be impacted in a manner not previously addressed.

The above comments are provided in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). If you have comments or questions, please contact Jon Nickles at (907) 786-3605.

Sincerely,

Rowan W. Gould

Acting Regional Director

Enclosure

RECEIVED
SEP 13 1994
FOREST SERVICE
R-10, E&AM, RO

WORKING COPY

EIS
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of the Interior

VICE

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AUG 12 1994

Memorandum

To: Regional Director, National Park Service
Attention: Sandy Rabinowitch, Acting Chief, Coastal Programs Division

From: ~~Acting~~ Regional Director
Region 7 R. Daniel Lumtor

Subject: Review of Draft Environmental Impact Statement for the *Exxon Valdez* Oil Spill Restoration Plan for Endangered Species Act Compliance

At the request of Mr. Phil Janik (July 20, 1994, letter (Re:1590)), the U.S. Fish and Wildlife Service (Service) has reviewed the Draft Environmental Impact Statement (Draft EIS) for the *Exxon Valdez* Oil Spill Restoration Plan for compliance with section 7 of the Endangered Species Act (Act) of 1973, as amended. According to established procedures, we are transmitting the following comments to Mr. Janik, through your office.

The Service has no previous record of section 7 consultation on the proposed restoration actions discussed in the Draft EIS. We recognize that there are many parties to the Draft EIS (including the Service); however, for the purposes of this letter we are considering the U.S. Forest Service as the lead "action agency."

Under 50 CFR 402.12, the first step in section 7 consultation is for the action agency to request a list of threatened and endangered species from the Service. The following list of species occurring within the *Exxon Valdez* Spill restoration project area is provided for your consideration.

Species	Status
Short-tailed albatross (*Diomedea albatrus*)	Endangered - rare, pelagic, non-breeding
American peregrine falcon (*Falco peregrinus anatum*)	Endangered - migrant
Arctic peregrine falcon (*Falco peregrinus tundrius*)	Threatened - migrant (proposed for delisting)
Aleutian Canada goose (*Branta canadensis leucopareia*)	Threatened - migrant
Steller's eider (*Polysticta stelleri*)	Proposed Threatened - winter resident

Through section 7 consultation, the action agency is required to determine whether the actions they fund, conduct, or permit may affect listed species. In the case of Steller's eider, section 7 conferencing is required if the action agency determines that the proposed restoration activities are likely to jeopardize the continued existence of this proposed species. Typically, these determinations are documented in an Endangered and Threatened Species Biological Assessment section within the Environmental Consequences chapter of the Draft EIS. We recommend that you prepare a biological assessment to document the expected impact of the proposed restoration actions on the listed and proposed species occurring within the action area.

If during the preparation of the biological assessment, the action agency determines that the proposed restoration activities are not likely to adversely affect listed species, concurrence from the Service may be requested, and upon receiving concurrence consultation may be concluded. In the event that site-specific actions would adversely affect a listed species, the action agency should continue informal consultation with the Service to determine if adverse effects can be eliminated. If it is determined that adverse affects to a listed species cannot be avoided or that incidental take of listed species would occur, then formal consultation would be required. Based on general descriptions of proposed actions within the Draft EIS, we do not anticipate that the proposed restoration activities would result in adverse effects to these species.

In addition to the listed and proposed species, the Service is also monitoring the status of the following candidate species:

Marbled murrelet (*Brachyramphus marmoratus*)	Candidate 2 - resident
Kittlitz's murrelet (*Brachyramphus brevirostris*)	Candidate 2 - resident
Harlequin duck (*Histrionicus histrionicus*)	Candidate 2 - resident
Northern goshawk (*Accipiter gentilis*)	Candidate 2 - resident
Olive-sided flycatcher (*Contopus borealis*)	Candidate 2 - summer resident

The Draft EIS discusses impacts to marbled murrelets and harlequin ducks.

Category 2 candidate species are designated when the best available scientific and commercial information indicates the species might qualify for protection under the Act, but the Service needs further status survey information, evaluation of threats, or taxonomic clarification before the need for listing can be determined. Candidate species are not afforded legal protection under the Act, but we encourage the action agency to carefully consider the needs of candidate species in your project design.

It is possible that listed species within the jurisdiction of the National Marine Fisheries Service (NMFS) may be affected by the proposed restoration activities. We recommend that the action agency contact NMFS for their comments.

We appreciate the opportunity to review the Draft EIS for compliance with the Act. If you have further questions or need clarification of the consultation process, please contact Jon Nickles, Chief, Division of Endangered Species, (907) 786-3605.

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United States Department of Agriculture Forest Service
Alaska Region P.O. Box 21628
Juneau, AK 99802-1628

Reply to: 1590

Date: August 31, 1994

Mr. David Allen, Acting Director Region 7
U. S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, AK 99503

Dear Dave:

In response to your memorandum of August 12, 1994, we have enclosed for your review and concurrence, our determinations regarding the biological assessments for the threatened and endangered species that are in the area of consideration or which use the area. Based on the analysis by the *Exxon Valdez* Oil Spill Restoration interdisciplinary team, there would be no actions that would result in any adverse impacts to any of these species.

The species assessed were:

Species	Determination
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Aleutian Canada goose (*Branta canadensis leucopareia*)	No adverse effects
Steller's eider (*Polysticta stelleri*)	No adverse effects (may benefit)

If possible, we request that this consultation be expedited. If there remains any specific questions regarding compliance with Section 7 of the Endangered Species Act, please contact Rod Kuhn the *Exxon Valdez* Oil Spill Restoration Plan EIS Team Leader directly or the U.S. Fish and Wildlife Service EIS team member, Gerry Sanger, at 278-8012.

Sincerely,

PHIL JANIK
Regional Forester

Enclosure

cc:
Rod Kuhn

Biological Assessment of the Proposed Action on Endangered and Threatened Species

Following is a biological assessment of the effects of the Preferred Alternative (Alternative 5) on Threatened and Endangered Species known to occur within the EVOS area. The Office of Endangered Species, Fish and Wildlife Service, Region 7, determined the occurrence of the species considered. As Restoration actions are proposed, each will be re-evaluated for compliance regarding its effects on rare and endangered species.

Current Endangered and Threatened Species in EVOS Area

Short-tailed Albatross (*Diomedea albatrus*) - Status: Endangered
A remnant population of short-tailed albatrosses breeds on a small island off Japan (AOU 1983). The species is considered a rare summer and fall visitant to oceanic and continental shelf waters of the Gulf of Alaska (DeGange and Sanger 1986). None were sighted anywhere in Alaskan waters during surveys of the Alaskan Outer Continental Shelf Environmental Assessment Program in the 1970's, and there have been few sightings in the Gulf of Alaska in the past 10 years. Alternative 5 will not affect the short-tailed albatross because the chances of this species occurring in the EVOS area are extremely small.

American peregrine falcon (*Falco peregrinus anatum*) - Status: Endangered
Actions proposed under Alternative 5 will not affect American peregrine falcons that may migrate through the EVOS area. Through habitat acquisition, Alternative 5 would provide more habitat for avian prey of this sub-species than would likely occur under the No Action Alternative in the long term.

Arctic peregrine falcon (*Falco peregrinus tundrius*) - Status: Threatened
This race of peregrine falcon has been proposed for de-listing, and will not be affected by Alternative 5 because the chances of it occurring in the EVOS area are extremely small. There is some doubt whether there are any records for this race within the EVOS zone. However, any habitat acquisition will provide added protection to any Arctic peregrine falcons and their avian prey that may occur in the EVOS area.

Aleutian Canada goose (*Branta canadensis leucopareia*) - Status: Threatened
This endangered race of Canada goose breeds on a few islands in the Aleutians, and on one of the Semidi Islands, just within the southern limits of the EVOS region. This sub-species is believed to migrate directly between breeding islands and their wintering grounds in the Pacific Northwest. There are no records of this race within the EVOS zone other than at the Semidi Islands. Therefore, Alternative 5 should have no adverse affect on the Aleutian Canada goose, although any habitat acquisition will provide added protection to any Aleutian Canada geese that may happen to occur in the EVOS area.

Steller's eider (*Polysticta stelleri*) - Status: Proposed Threatened
This species was considered a rare winter visitant to the EVOS area in the early 1970's (Islieb and Kessel, 1973), and none have been seen since the EVOS during intensive marine bird surveys of PWS in March or July (Agler, Seiser, Kendall and Irons, written comm., 1994). Actions proposed under the Preferred Alternative will not affect this species adversely. Cleaning remaining oil from beneath mussel beds, a proposed summer restoration action, would benefit intertidal foraging habitat by decreasing the chances for oil contaminating the eider's food supply.

OIL SPILL COORDINATION OFFICE

Alaska Region

TO: Rod Kuhn FAX: _____

UNIT: _____ Verification No. _____

FROM: Dave Gibbons FAX: _____

REMARKS: _____

Total number of pages (including cover): 3

Date Sent: 8/31 Time: _____

Prince William Sound

Cochrane Bay
Culross Island
Culross Passage
Mainland
Perry Passage
Perry Is.
Dutch Is. Group
Lone Passage
Lone Island
Storey Island
Peak Island
Naked Island
Cabin Bay
McPherson Bay
Outside Bay
Bear Harbor
Agnes Island
Applegate Island
Port Nellie Juan
Main Bay
Blue Fiord
Mainland
Eshamy Bay
Ingot Island
Eleanor Island
Smith Island
Little Smith Island
Sphinx Island
Herring Bay
Knight Island
Bay of Isles
Dangerous Passage
Chenega Island
Squirrel Island
Hive Tree Island
Bear Bay
Hummy Island
Square Island
Knight Island
Snug Harbor
Hummy Bay
Whale Bay
Mainland
Green Island
Little Green Island
Port Bainbridge
Bainbridge Island
Hogg Bay
Swanson Bay
Evans Island
Elrington Island
Latouche Island
Danger Island
Montague Strait
Herring Bay
Montague Island

MAP AREA

Mussel Bed Key

UNOILED

OILED

Oiling Key

- Heavy Oiling
- Moderate Oiling
- Light Oiling
- Very Light Oiling
- No Oiling
- Unobserved

N

ADEC

MUSSEL BED LOCATIONS
in Prince William Sound

Data Source: Alaska Department of Fish and Game
Dr. Sam Patten, Wildlife Conservation Division
Rick Gustin, ADF&G
Alaska Department of Environmental Conservation

Date:	4/6/94
File Name:	MUSLBEDS

0 2 4 6 8
KILOMETERS

Cartographer: Ward Lane
Map Projection: UTM, Zone 6

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oiled mussel bed
map used in Restoration
Plan EIS