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Identification of Upland Habitats Used by Wildlife Affected by the EVOS: Marbled Murrelets

Lead Agency: U.S. Fish & Wildlife Service

DRAFT

Preliminary Draft Report

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Kathy Kuletz
U.S. Fish & Wildlife Service
1011 E. Tudor Rd.
Anchorage, Alaska

I. STUDY TITLE

Identification of Upland Habitats Used by Wildlife Affected by the EVOS

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III. EXECUTIVE SUMMARY

The Restoration Planning Work Group identified protection of upland habitats as one way to assist the natural recovery of species which depend on upland habitats for some stage of their life. To fulfill this objective, planning agencies need specific information on habitat requirements of species affected by the EVOS. Restoration Feasibility Study Number 4 was a pilot study to determine the potential for establishing the appropriate data base. This report is a preliminary summary of results from the marbled murrelet portion of the project.

The marbled murrelet is a noncolonial seabird that nests inland in trees and on the ground. Little is known about its nesting habitat requirements in Alaska. Naked Island, in central Prince William Sound, served as the base for the marbled murrelet pilot study. The "intensive dawn watch method" was found to be effective under remote Alaskan conditions. The observer recorded murrelets flying overhead or into trees at dawn, when birds fly inland to their nests. A total of 57 watches, including 6 at dusk, were conducted between 9 June and 18 August at 22 sites. A total of 2,428 "detections" (the visual or auditory observation of 1 or more murrelets) were made. No activity was recorded during "dusk watches".

Murrelet activity patterns were similar to those reported in the southern portion of its range, with the majority of detections occurring 30 minutes before and after dawn. There was variability within and among sites, but in general, detections peaked late July and declined rapidly after 10 August. Behavioral observations served as indicators of an area's use as a nesting site as opposed to a flight corridor.

Seven sites were visited more than once, making it possible to track variability, seasonal patterns and behavioral changes over time. Although no nests were found we were able to map several stands with high activity, indicating a semi-colonial nesting distribution. At areas with high activity, multiple observers were used to narrow down potential nest sites. This method narrowed down the search areas for several nests, and on two occasions murrelets were observed to land in trees.

Habitat parameters were recorded in the field and taken from topographic maps, aerial photos and a U.S. Forest Service habitat map. For nine stations, mainly in the South Cabin Bay drainage, fine scale habitat analysis will be provided by the USFS to include

in the final report. A preliminary review of raw data suggest greater murrelet use of inland areas at the heads of bays as opposed to the outer peninsulas. Slopes facing north or west may have greater use than slopes facing east or south. Open bog meadows, especially at the heads of bays, are used as flight corridors to upper wooded areas.

IV. INTRODUCTION

Marbled murrelets are noncolonial seabirds that breed along the eastern Pacific from Northern California to Alaska. In 1990 the Canadian government listed them as a threatened species in British Columbia. They are currently being considered for threatened or endangered status along Washington, Oregon and California. An estimated 95% of the total population in U.S. waters occurs in Alaska, with Prince William Sound second only to Southeast Alaska in murrelet abundance (Mendehall 1988). Murrelets were subject to direct mortality form the 1989 oil spill, and proportionally more were killed relative to their numbers at risk (Piatt et al. 1989). Direct mortality probably affected the wintering population of marbled murrelets in the Sound (estimated at 25,000), which is only about 20% of the summer breeding population (between 80,0000-101,000) (K.Laing, pers. comm.). In contrast, murrelet numbers are higher in Kodiak during the winter (Zwieflelhofer and Forsell, 1989), and murrelets wintering there may also have been affected.

Full analysis of boat survey data is not available to date to determine if there has been significant injury on the population level. However, compared to March, 1972 surveys, the March shoreline surveys in 1990 (Bird Study 2) showed a significantly greater decline of murrelets in oiled areas than in unoiled areas. (K. Laing, pers. comm.). Summer surveys suggest displacement from nearshore areas occurred in 1989, possibly from human disturbance (S.Klowsewski, pers.comm., Kuletz, unpubl. data). In addition, 6 out of 9 marbled murrelets collected in the spill zone in 1989 showed petroleum hydrocarbon contamination of the liver (Robinson-Wilson, pers. comm.). Additional samples are still being analyzed.

Preservation of breeding habitat would assist the natural recovery of the murrelet population, and protect it from a second adverse impact. Unlike most other seabirds, it is not possible to locate conspicuous sites as being important to large numbers of nesting birds within a region. Murrelets are secretive and widely scattered during the breeding season. In the lower latitudes, the birds are known to nest in trees and have a strong preference for old-growth habitat, ie., large trees with epiphytes and an open understory (Marshall 1988). However, in Alaska, it is not known whether these birds have the same requirements for nesting habitat, and several ground nests have been found. The purpose of this study was to develop information which could be used to identify terrestrial sites critical to breeding marbled murrelets.

The basic methods used in this study were developed in Oregon and California (Nelson 1989, Paton et al. 1989). These methods depend on an extensive road system, large numbers of observers and minimal logistical complications. A primary consideration in this study was testing and adapting the methodology under remote Alaskan conditions.

Ongoing damage assessment studies based on Naked Island provided a base to conduct a pilot study on monitoring marbled murrelet breeding activity. With funds from the Restoration Planning Team, an extra field technician, equipment and supplies were added to assist in the project.

Previous field work on Naked Island showed the area to have a murrelet population estimated at about 3,000 birds (Oakley & Kuletz 1979). Except for a few individual Kittlitz's murrelets sighted in early June, all identified murrelets were marbled murrelets. The island is relatively small (Fig. 1a and 1b.), and isolated from the mainland and large islands. It was a common occurrence to hear murrelets flying over camp, suggesting upland nesting (Kuletz, unpubl. data). It was postulated that these factors would make it easier to locate areas of nesting activity.

IV. OBJECTIVES

A. Develop and test methods for establishing the presence of breeding birds.

B. Develop and test methods for locating nest sites.

C. Identify and characterize nest habitats and sites.

D Define the parameters of and develop a proposal for a full-scale upland habitat study for marbled murrelets.

E. Determine the costs of implementing a full-scale restoration project concerning upland habitat use by marbled murrelets.

VI. METHODS

Objective A: Testing methods to establish the presence of breeding birds.

The presence of murrelets inland has been documented in the southern portion of its range using the "dawn watch" (Nelson 1989, Paton et al. 1989). Murrelets visit their nests from May through August to exchange incubation duties and feed their 1 chick. They can be heard and seen flying inland at dawn, and to a lesser extent, sunset. Official dawn time for this study was obtained from the Kenai FAA, and originates from the Nautical Almanac Office, U.S. Naval Observatory, Washington D.C., in the table for Latitude 60 34 W, Longitude 151 15 W. From 9 June to 18 August, the course of this study, official dawn ranged from 0334 to 0523 hours. The starting time for a watch was determined by official dawn, and efforts were made to be at the station at least 45 min. prior to dawn. The starting time for the dawn watches ranged from 0238 to 0440 hours. The typical watch extends from 1 hour prior to and 75 min after official sunrise, plus 15 min. past the last detection. During the watch, an observer describes into a tape recorder murrelet numbers, flight directions, altitude and behavior.

Three watch types have been used in Oregon and California: 1) transects, whereby an observer travels along a line, (usually in a car), stopping 10 minutes at each "station" a given distance apart. 2) a grid system, whereby an observer rotates among 4 points on a grid, with each sub-station 50-100m apart, staying at each sub-station about 20 minutes. This is best done in areas with open understory. 3) intensive surveys, whereby the observer remains at one station during the entire dawn watch. The first two methods were tried and rejected for the Naked Island area. Traveling in rough terrain is slow and interferes with observations, and results are biased for the location the observer is monitoring at dawn. Thus, all the data reported here were derived from intensive dawn watches.

Seven sites near camp, in South Cabin Bay drainage, were field marked with flagging and metal tags during the day and marked on a topographic map (Fig. 1b). These were visited several times during the season to obtain variances and seasonal patterns within an area. Another group of stations were used to try methods which might apply to more temporary remote sites. We attempted to test the efficacy of a near-shoreline station as an indicator of murrelet use further inland. These twelve sites were visited once, and required on-site camping by an observer delivered to a beach by Zodiac. The observer spent two nights in the area. The first dawn, the observer established a station approximately 200m from the shoreline. For the second dawn watch the observer moved inland, usually between 500-1000 m (flight distance) from the first site and at higher elevation. To test for a correlation between nearshore and adjacent inland sites, South Cabin Bay was represented by site 1 and site 6, which was also visited only once. The 7 paired sites were then ranked and tested for significance with a Spearman's rank correlation.

Observers spent 2-4 dawn watches with the Principal Investigator to become familiar with the recording protocol, murrelet calls and flight patterns. Following the dawn watch, the observer transcribes the tape recording onto a field data form (Appendix A). A "detection" is defined as the visual or auditory observation of 1 or more murrelets acting in a similar manner at a given point in time (Nelson 1990).

The types of detections fall into 3 basic categories: 1) Audio, where only vocalizations are used to determine presence, directions, behavior and estimated number of birds. 2) Visual, where the murrelet is seen but is silent. These observations provide a more exact description of flight behavior and number of birds. 3) Both audio and visual, where an observed bird is vocalizing. Additional categories we eventually added were 4) Stationary calls, coming from the trees, 5) Wing beats, made by birds landing but not usually seen. 6) "Jet" sounds, a distinctive dive-bombing maneuver which is felt and heard, but not seen. This action may be directed at the observer. These latter 3 categories were also added, independently, by researchers in Oregon and California in 1990.

The range of behaviors are, in order of their degree of association with the immediate area: 1) Landing in trees or making stationary calls. 2) Circling below the canopy. 3) Flying through the station below canopy. 4) Circling above the canopy. 5) Flying overhead high above canopy. 6) Flying at a distance >100 m from the station's center (being the observer).

Objective B: Develop and test methods for locating nest sites.

Once areas of murrelet activity were located, a more intensive "ground search" method was employed to narrow down potential nest sites within a slope or tree stand. These methods basically followed those outlined by Naslund et. al.(1990). This involved using 2 or more observers to "stake out" a clump of trees during a dawn watch to determine if birds flying into the trees are passing through enroute to other stands or actually stopping in the immediate area. Eventually the multiple observers focus on individual trees and branches. The silent and fast approach of the birds going into a nest in low light necessitate this intensive approach (Nelson, pers. comm.). At Naked Island, the "ground search" technique was used on 5 occasions.

Objective C: Identify and characterize nest habitats and sites.

Stations were characterized by distance from the ocean, slope degree and aspect, elevation and major surrounding habitat types. More detailed data on which habitats within view of a station were used by murrelets will be obtained by mapping flight directions and visual observations of birds entering tree stands made at each watch. These results will require additional data organization and analysis and are not presented in this report.

Aerial photos of Naked Island, provided by the U.S. Forest Service, were used to assist in station location and defining habitat parameters. The Forestry Science Lab (USFS) used an Analytical Plotter 190 to analyze the aerial photos. These provided slope incline, aspect, primary cover and average tree height at 3 sites within our study areas, covering 9 stations, 7 of which were in the South Cabin drainage. On-site field notes and photographs will also be used to define and catalog habitats, tree stands and individual trees of interest.

Objective D and E: Expanding the restoration project

A more complete analysis of data and consultations with peer reviewers is required before objectives D and C can be fulfilled. They will be developed and described in the final proposal to be submitted for the 1991 Restoration Project.

VIII. RESULTS

Objective A: Develop and test methods for establishing the presence of breeding birds.

<u>Time of day</u>

Murrelet detections were made as early as 75 min prior to and as late as 90 min after dawn (Fig. 2a). However, the majority of birds were active inland from 30 min prior to and after official dawn. Numbers of birds peaked within 10 min of dawn and declined afterward. There was no obvious difference in distribution of peak murrelet activity between early and late season watches, although no statistical tests have been done at this time (Fig 2b). During the 6 dusk watches, no murrelets were detected. However, on two extremely foggy evenings, murrelets were heard circling over camp intermittedly for over an hour. Similar behavior was noted over camp at about 0900 on a day when heavy fog was at ground level.

<u>Total Detections and Time of Year</u>

The mean total number of detections at stations visited more than once (N=7 stations, 30 watches) ranged from 38-82 detections per watch. At stations visited once (N=16) the total number of detections ranged from 1 to 112. The wide range of detection levels in the latter group is likely a reflection of the wider area throughout the island represented by those stations. The stations with multiple visits were concentrated in the south Cabin Bay drainage (Fig. 2)

Seasonal changes in detection levels are evident when graphed by date (Fig. 3a), despite variability in detection levels among stations. Overall, there appears to be an increase after mid July, with the peak in late July. Even at stations with previously high detection levels, in the south Cabin Bay drainage, there is a decline after 1 August (Fig. 3b). Very low numbers were recorded after 10 August.

Types of Detections

Eighty-five percent of the total detections for the summer were audio only (Fig. 4). Visual detections accounted for 11%, with 4% of the total having both visual and audio components. These percentages are the same as reported in Oregon and California (Nelson 1989). The percentage of visual or visual/audio detections of the total varied among stations (Table 1), ranging from 0 to 33%

Visual observations have been shown to be the most important in distinguishing a flight corridor from a potential nesting area (Nelson, pers. comm.). As an example, the types of behavior noted during visual detections at stations 1 and 2 show differences in the relative occurrence of site-specific activities and more distant observations (Fig. 5). Station 1 was centered in an open meadow at the head of South Cabin Bay, where birds were primarily observed circling or flying high or at great distance. Station 2, only 600 m away, was at the base of a slope of mixed conifers, where birds were observed circling and flying below canopy and on 2 occasions landing in trees.

Flock Sizes

Visual observations allow the observer to count the number of birds flying inland. Of the 318 visual detections where the number of birds was noted, 24% were of single birds and 65% were of pairs. The largest group was 5 birds, observed once. Thus, 72% of the 575 birds visually observed were in pairs (Fig.6). Particularly when circling, the pairs often split up and flew figure-eights or counter to each other. Often, one bird would disappear into the trees while the other continued to circle or fly out to sea. Perhaps for this reason, single birds were more frequently seen flying low through the station, and pairs were more likely to be circling high above the canopy (Fig. 7; X =11.86, df=5, $P<0.05$).

Remote Sites

For the 7 paired dawn watches, there was a significant correlation between the number of detections made at the nearshore site, and the number observed the second dawn further inland ($Rs=0.85$, $0.01<P<0.05$). In 5 of the 7 pairs, the second watch further inland had fewer detections than the nearshore site, suggesting that the birds were dispersing to different areas further inland.

Objective B: Develop and test methods for locating nest sites.

To narrow down and isolate suspected nesting sites, 2-4 observers were used to simultaneously observe an area of high murrelet activity. A more detailed report on these efforts will be included in the final report. To summarize, the effort did work, but it took considerable observer-hours away from other portions of the project.

Because of the time required to locate good areas, our "stake out" efforts did not begin until late July and were tried on 5 occasions until August 5. Although we observed pairs landing on specific branches on two occasions, the branches did not appear to be likely sites for nests. Since pairs and prospecting birds frequently land in nearby trees, especially after late July, these may not have been nest site branches (Nelson, pers. comm.)

The stake out method was done near station 2. It enabled us to make more accurate estimates of the actual number of pairs using a slope or stand of trees. Because birds appear to come and go from the trees during circling forays, the detections are believed to be repetitive observations of the same birds, especially in areas where they appear to be nesting. An observer alone, particularly during a single visit to a station, would usually not be able to provide a reliable estimate of the number of pairs in the area.

Objective C: Identify and characterize nest habitats and sites.

The compilation of habitat data is not completed for this report. A summary of characteristics taken from topographic maps is presented in Table 2. Most of the stations had a general southwesterly or westerly orientation, although of 5 targeted slopes analyzed by the Analytical Plotter, 3 had northwesterly aspects and one had a northerly aspect. Elevations of the stations ranged from 16-207 meters, and flight distance from the water from 150-1000 meters. Forest Service analysis of selected polygons lists 7 vegetation types, consisting of different cover percentages of mixed Conifer old-growth and Hemlock old-growth and muskeg. Sampled tree heights ranged form 4 to 23 meters within these same polygons.

DISCUSSION

The overall goal of this pilot study was to determine if methodologies used in California, Oregon and Washington could be applied to an Alaskan population of murrelets. This required investigating basic aspects of murrelet behavior such as the occurrence of a dawn activity period and outlining the seasonal nesting period. In addition, it was necessary to substantiate the suspected tree nesting of murrelets in Alaska.

This project was successful at demonstrating the applicability of the dawn watch to murrelets in Alaska. The low level of dusk activity (or its detectability) makes dusk watches inefficient. However, once specific trees are located, an observer may be able to observe chick feeding at night (Nelson pers. comm.). The intensive survey was found to be the most practical and useful for roadless areas. In areas with logging roads, the transect method could be attempted again. Similarly, high alpine tundra may be amendable to the grid method of dawn watches. In all cases, it is important that observers be well trained in distinguishing separate "detections" and describing behavioral observations.

Behavioral observations, besides indicating the proximity of nests, can serve as cues to phenological stages as well. Many of the inland observations coincided with observations made at-sea. For example, stationary calls were heard only twice prior to mid-July. After mid-July they were heard at almost every watch. According to K. Nelson, these calls are occasionally made by adults, but more frequently by chicks. Juveniles appear on the water at Naked Island after July 19 (Kuletz, unpbl. data), and peak around the last week of July and first week of August. Thus, peak egg laying occurs in late May and hatching in late June. The increase in detections in late July reflects an increase in numbers of adults on the water.

Similarly, as adults leave the Naked Island waters, their detections inland decline. By late August, the majority of murrelets on the water are juveniles, and most adults are absent (Kuletz, unpbl. data). The percentage of birds observed in pairs inland is similar to the percentage of pairs on the water (Kuletz, unpubl. data).

Although no nests were found, this was partly due to the limitations of locating high activity sites and the lack of time the research team was able to devote to this project. Where ground search techniques have worked in the lower 48, several years of preliminary work were done prior to success. At a site like Naked Island, with a much higher density of murrelets, it should be possible to locate actual nests in the season following initial ground work. Efforts in 1991 could begin as early as mid May at sites already located.

Because birds were flying into the trees and circling forested areas, they were likely using the trees as nest sites. Although no dry or alpine areas are on Naked Island, it is still possible birds might be using forest ground burrows, or the base of alders. Two murrelet nests (Kittlitz's or marbled) have been found in Prince William Sound at the base of an alder (G. Balough, pers. comm. and Jeff Hughes, pers. comm.).

The use of multiple observers during a dawn watch has the added advantage of providing an estimate of the number of pairs using a specific area. This will become important in determining relative use among fine-grained habitat types. It will also provide an index of murrelet nesting distribution relative to at-sea concentrations. At Naked Island, it will be possible to compare numbers and relative distribution at-sea to the upland distribution.

Getting to the sites before dawn became more difficult under poor weather conditions and as the season progressed, when light levels were lower prior to dawn. Eventually, on-site camping was resorted to even for sites near camp. For future surveys it is recommended that observers be equipped to camp on-site whenever possible. For sites which will be visited repeatedly, a well cut and marked trail should be a priority. The limitations of field personnel to cover areas difficult to reach could be alleviated by using self-timing recorders set at selected sites.

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Table 1

SUMMARY OF TOTAL MURRELET DETECTIONS BY STATION

STATION	N	DETECTION TYPES: AUDIO	BOTH	VISUAL	TOTAL	MEAN	SD	MIN	MAX	CV
001	5	208	7	17	232	46.60	29.85	27	97	64.07
002	9	486	28	109	623	62.67	37.77	9	135	60.28
002A	2	132	8	23	163	81.50	6.36	77	86	7.81
003	3	108	3	2	113	37.67	27.68	12	67	73.49
005	4	124	14	22	160	40.75	27.18	19	80	66.71
006	1	16	2	6	24	24.00	.	24	24	.
007	4	184	4	4	192	48.00	16.41	32	70	34.19
008	3	105	9	10	124	41.34	10.60	30	51	25.64
008B	1	53	2	4	59	59.00	.	.	.	.
009	1	39	1	0	40	40.00	.	.	.	.
010	1	77	0	0	77	77.00	.	.	.	.
011	1	37	0	0	37	37.00	.	.	.	.
012	1	2	0	0	2	2.00	.	.	.	.
013	1	76	0	0	76	76.00	.	.	.	.
014	1	79	1	32	112	113.00	.	.	.	.
015	1	26	0	0	26	27.00	.	.	.	.
016	1	4	0	0	4	4.00	.	.	.	.
017	1	20	1	0	21	21.00	.	.	.	.
018	1	1	0	0	1	1.00	.	.	.	.
019	1	50	2	9	61	61.00	.	.	.	.
020	1	63	0	1	64	65.00	.	.	.	.
021	1	32	0	2	34	34.00	.	.	.	.
022	1	5	0	0	5	5.00	.	.	.	.

VISUAL DETECTIONS BY STATION

STATION	N	BEHAVIOR OBSERVATIONS: LAND IN TREE	CIRCLE LOW	FLY THROUGH LOW	CIRCLE HIGH	FLY OVER HIGH	FLY BY DISTANT	TOTAL VISUALS
001	5	0	0	1	11	6	3	21
002	9	1	22	20	66	16	9	134
002A	2	1	4	8	14	2	1	30
003	3	0	2	1	1	1	0	5
005	4	0	7	5	6	12	0	30
006	1	0	1	3	1	0	3	8
008	4	0	1	0	3	1	1	6
008B	3	0	5	2	8	3	1	19
009	1	0	3	0	2	0	1	6
010	1	0	0	0	0	1	0	1
011	1	0	0	0	0	0	0	0
012	1	0	0	0	0	0	0	0
013	1	0	0	0	0	0	0	0
014	1	0	4	10	0	0	17	31
015	1	0	0	0	0	0	0	0
016	1	0	0	0	0	0	0	0
017	1	0	0	0	1	0	0	1
018	1	0	0	0	0	0	0	0
019	1	0	2	1	6	0	0	9
0020	1	0	0	1	0	0	0	1
021	1	0	2	0	0	0	0	2
022	1	0	0	0	0	0	0	0

file: station

Table 2

11/11/90 Dawn Watch Stations- w/ summaries Page 1

Station	DRAINAGE	Nwatches	Sumdet	Det/watch	SLOPE ASPECT	SITE ELEVATION	METERS FROM WATER
001	S. CABIN BAY	5	233	47	270	100	300
002	S. CABIN BAY	11	624	57	225	150	300
003	INNER OUTSIDE BAY	3	113	38	225	100	350
005	S. CABIN BAY	4	163	41	270	200	750
006	S. CABIN BAY	1	24	24	225	500	900
007	S. CABIN BAY	4	192	48	225	400	600
008	S. CABIN BAY	3	124	41	225	700	1000
009	N. CABIN BAY	1	40	40	270	50	300
011	BASS HARBOR	2	37	19	135	100	150
012	MCPHERSON BAY	1	2	2	135	450	450
013	MCPHERSON BAY	1	76	76	315	150	300
014	BASS HARBOR	2	113	57	225	300	600
015	TUFT PT. AREA	2	27	14	225	250	150
016	OUTSIDE BAY	2	4	2	315	450	300
017	S. CABIN BAY	1	21	21	315	250	300
018	S. CABIN BAY	1	1	1	360	550	500
019	N. CABIN BAY	2	61	31	225	100	800
020	BOB DAY BAY	1	65	65	315	150	300
021	LILJEGREN PASSAGE	2	34	17	45	300	900
022	OUTSIDE BAY	1	5	5	270	250	300
010	S. Cabin	1	77	77	225	620	1000

Figure 1a

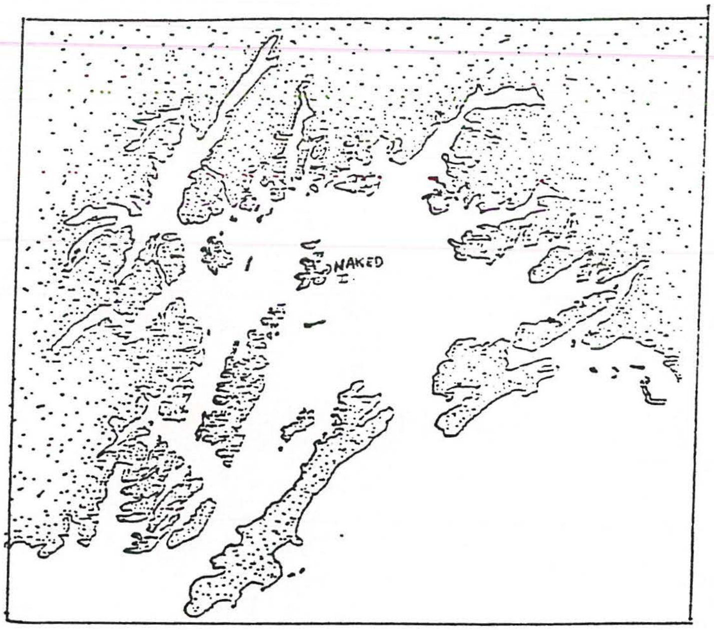
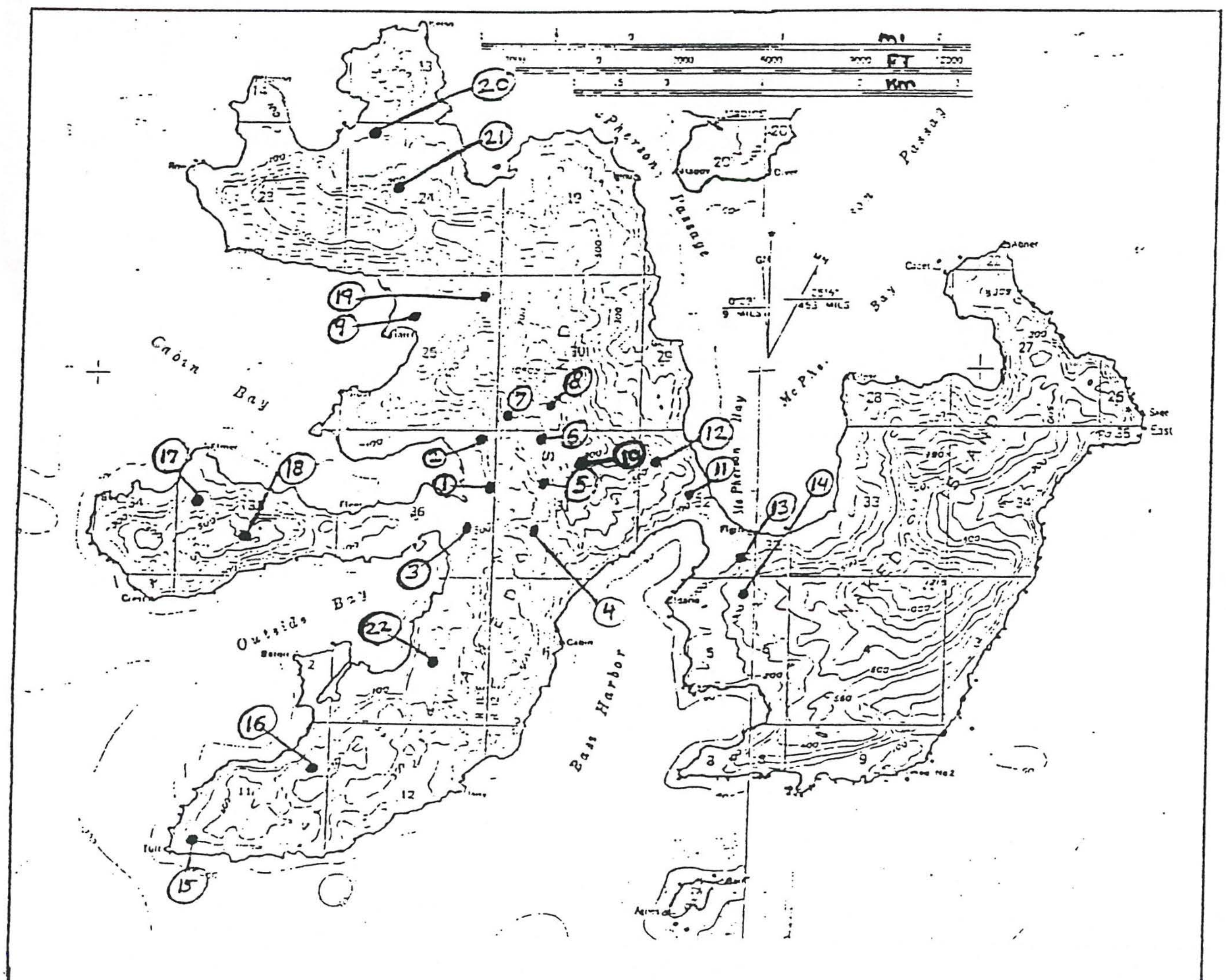


Figure 1a. Location of Naked Island in Prince William Sound, Alaska.

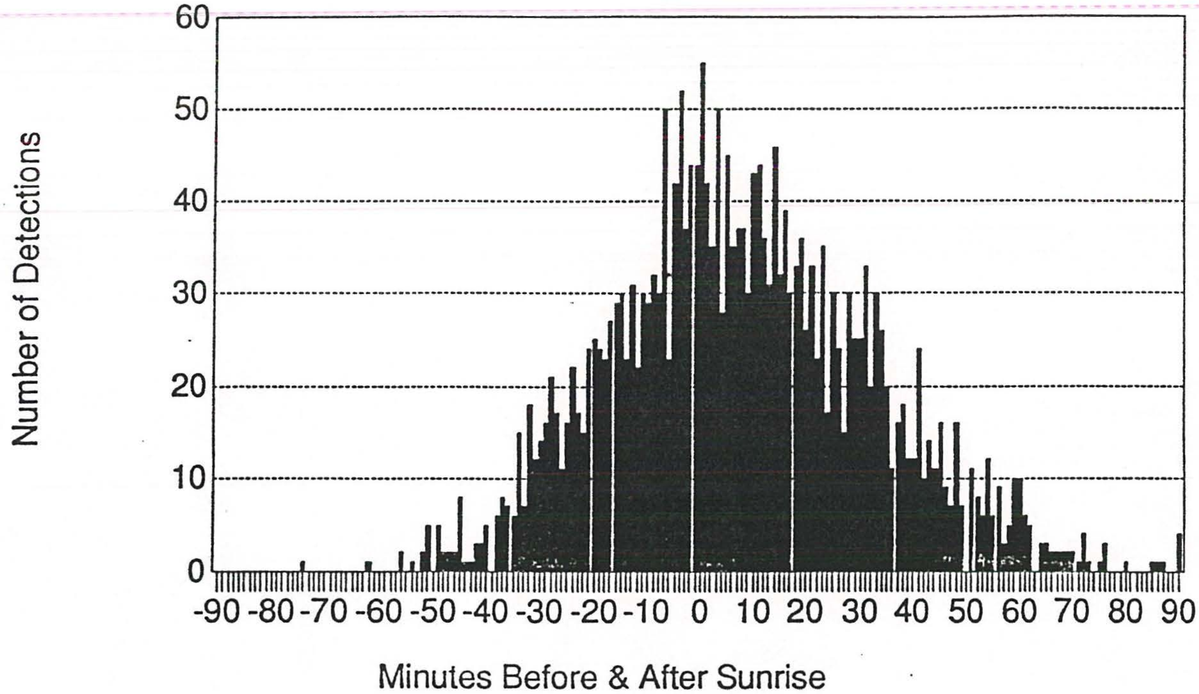
Figure 1b. Location of dawn watch sites on Naked Island.

Figure 1b



Total Murrelet Detections at Sunrise

Naked I. 1990. 47 watches, 2,428 obs.



Total Murrelet Detections at Sunrise

Before vs After 12 July in 1990

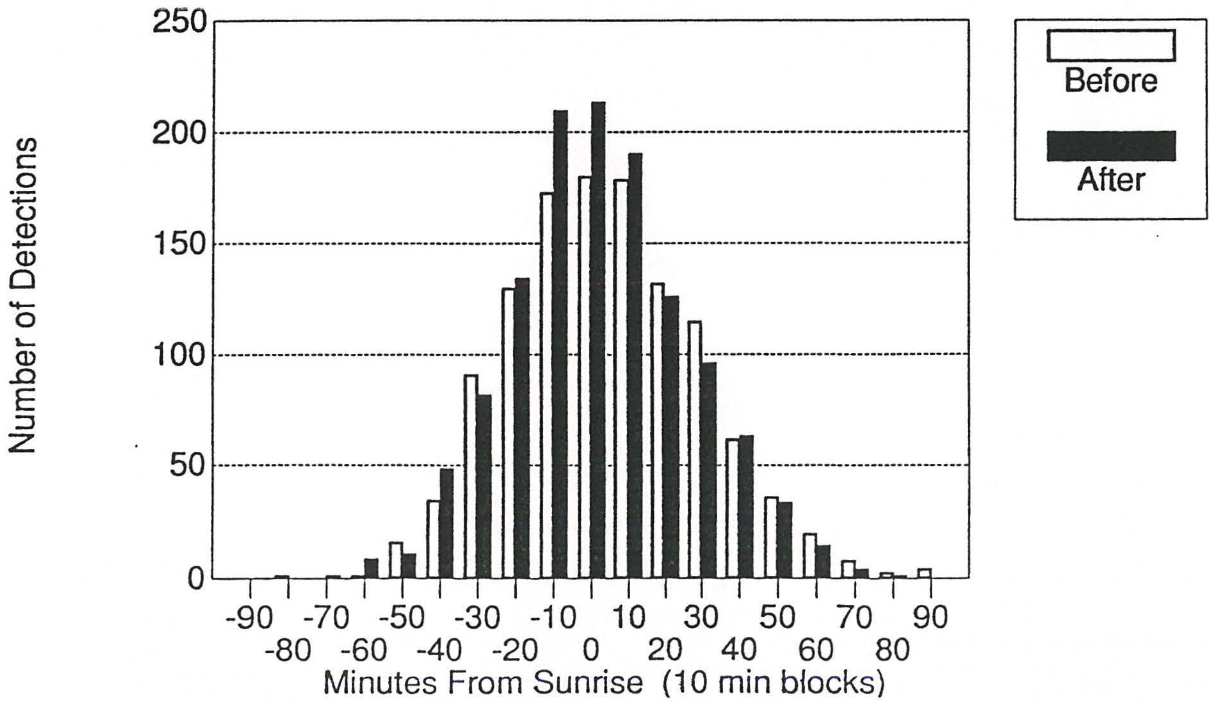


Figure 3b

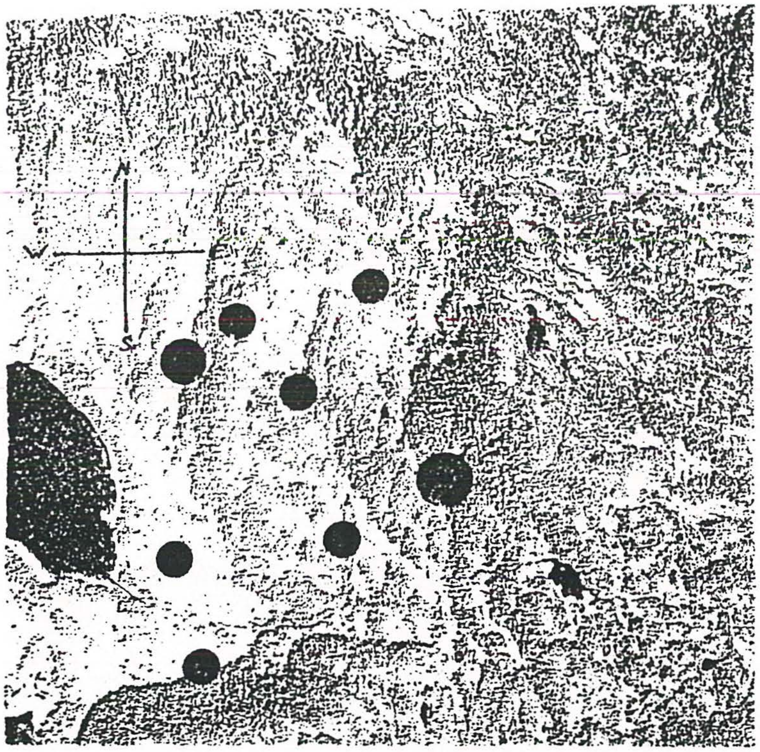
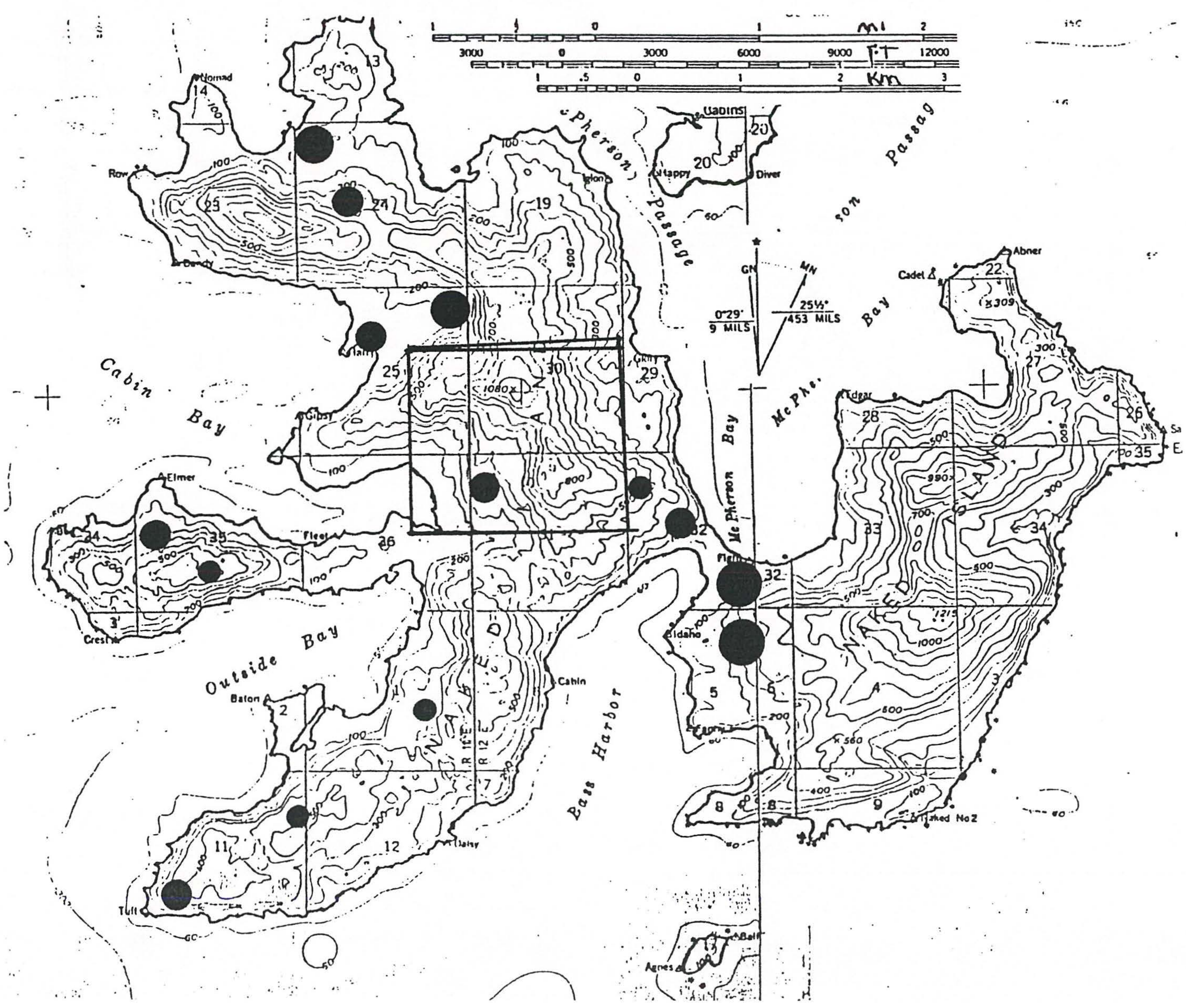


Figure 2a. Relative numbers of murrelet detections at dawn watch sites around Naked Island. See Figure 2b for detail of inset area (S. Cabin Bay drainage).

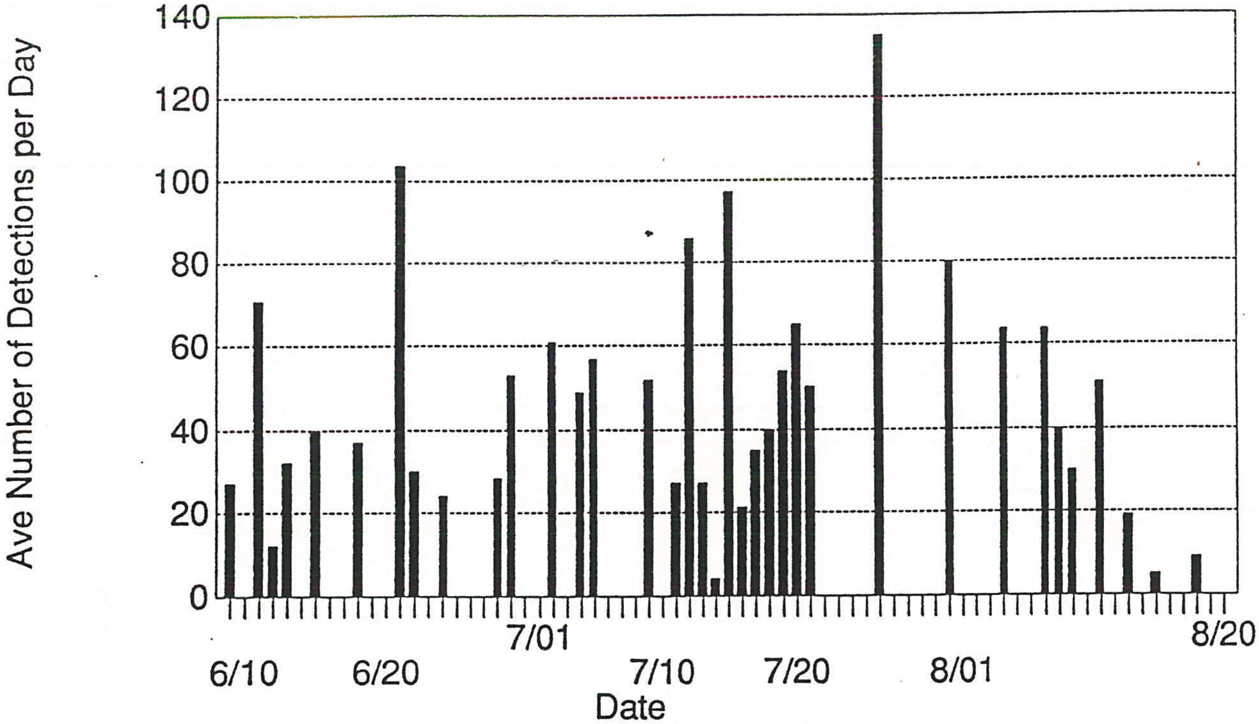
- 0-20 detections
- 20-50 detections
- 50-75 detections
- 75+ detections

Figure 3a



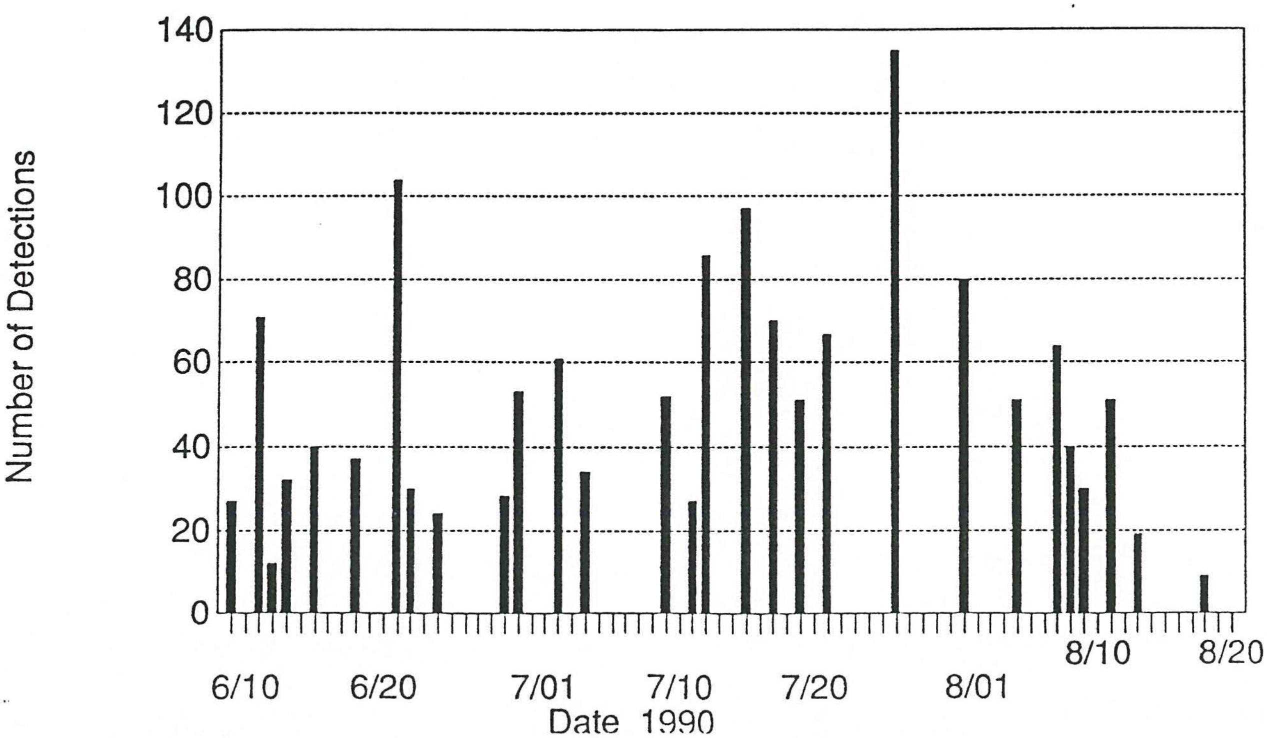
Murrelet Detections by Date, Naked I.

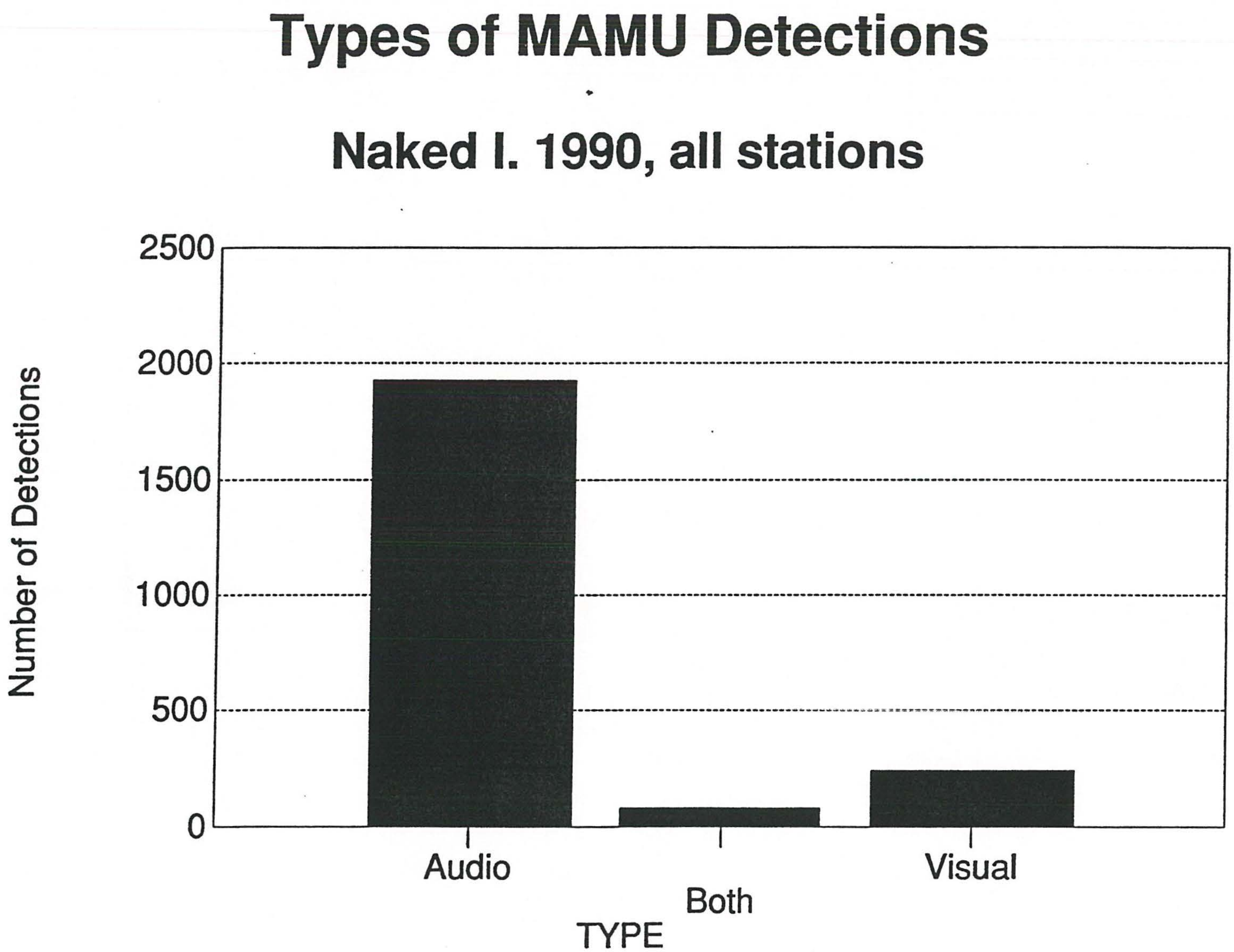
Total Detections, all Stations, 1990



Murrelet Detections by Date, Naked I.

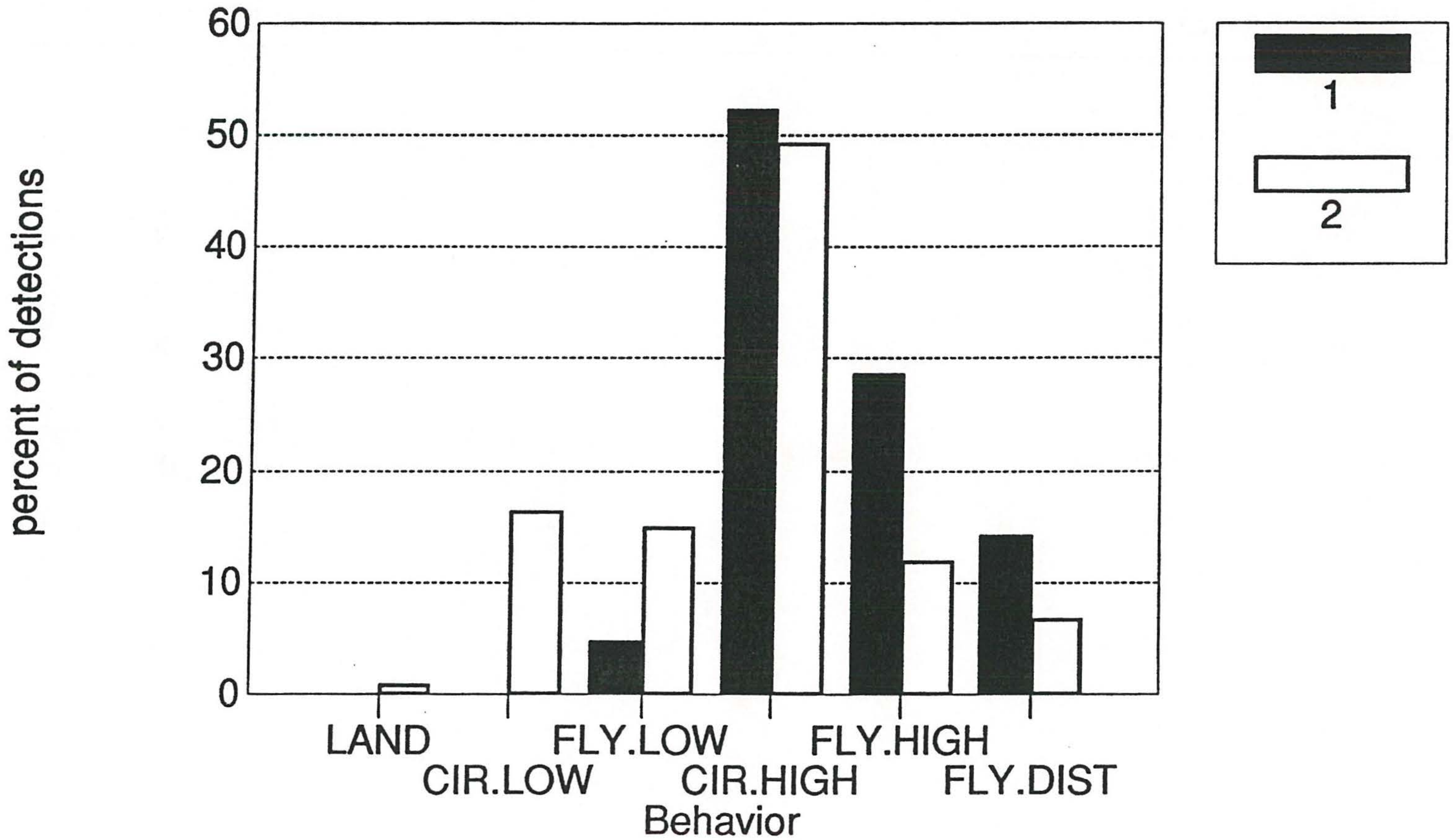
Stations in S. Cabin Bay Drainage




Types of MAMU Detections
Naked I. 1990, all stations
Number of Detections
2500
2000
1500
1000
500
0
Audio
Both
Visual
TYPE

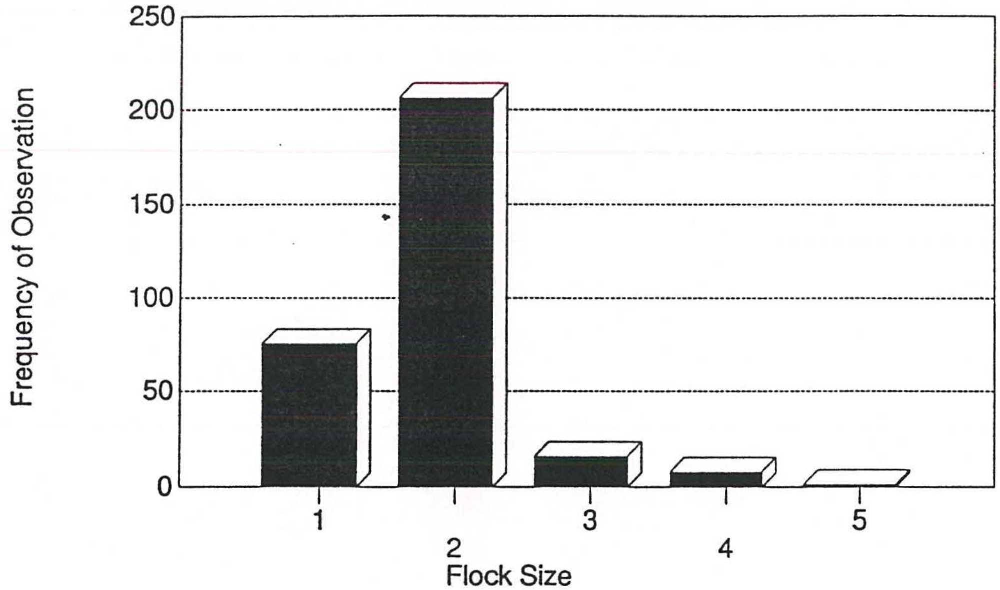
Behavior of Visual Detections

statios 01 & 02, Naked I. 1990



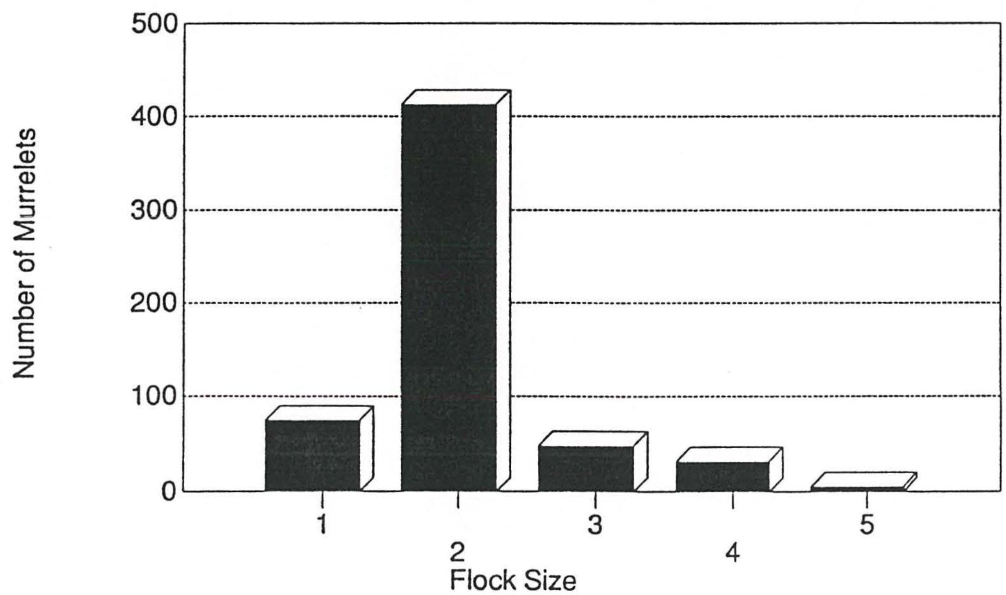
Frequency of Murrelet Flock Sizes

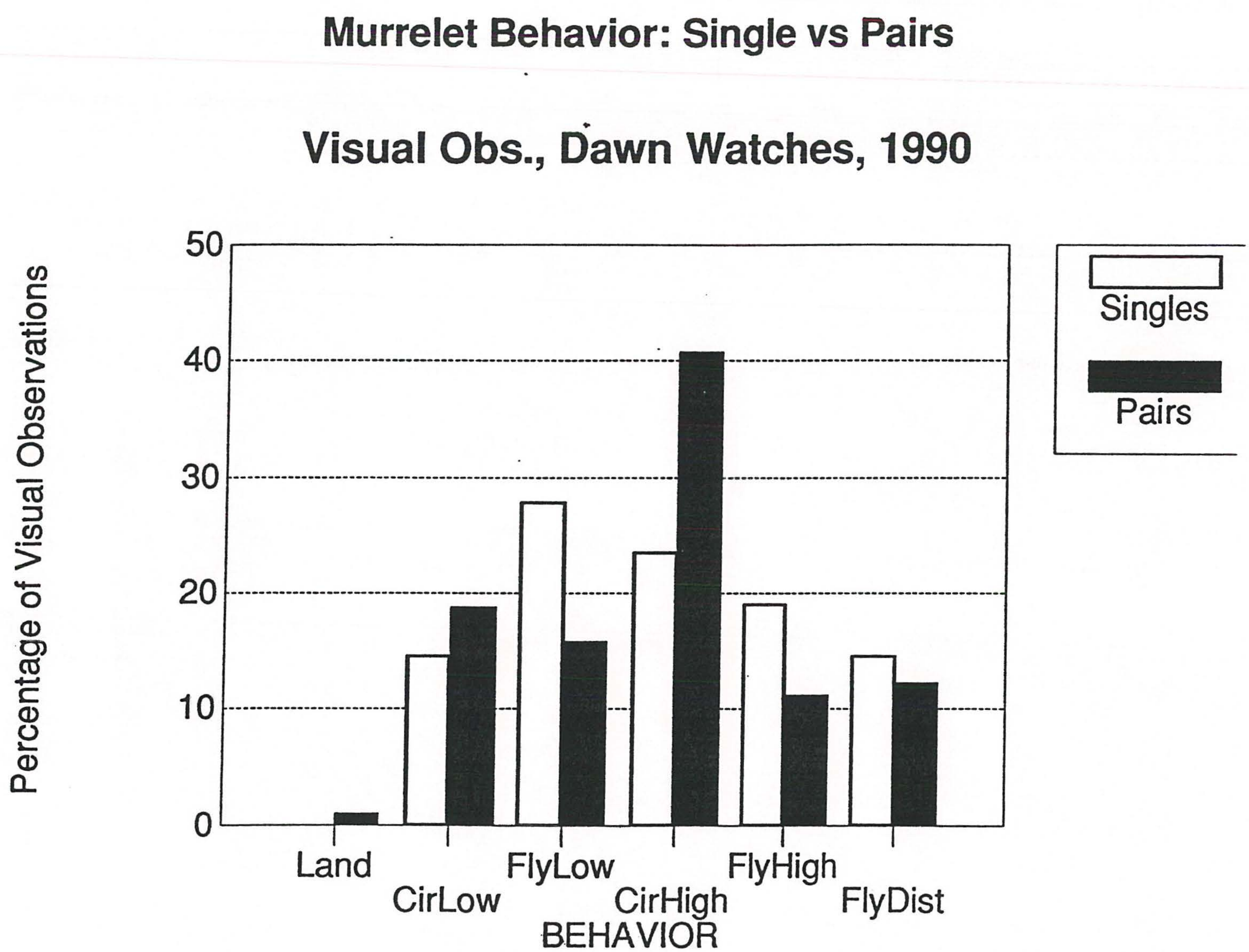
Inland Visual Detections 1990 (N=318)



Number of Murrelets by Flock Size

Inland Visual Detections 1990 (N=575)




Murrelet Behavior: Single vs Pairs
Visual Obs., Dawn Watches, 1990
Percentage of Visual Observations
50
40
30
20
10
0
Singles
Pairs
Land
CirLow
FlyLow
CirHigh
FlyHigh
FlyDist
BEHAVIOR

Appendix A

MARBLED MURRELET INTENSIVE INVENTORY FORM

Observer's Name: ______________________ State/Province: ______________________
Starting Location: ______________________
Transect Description: ______________________
Distance between stations: _____ (Meters/km/miles-circle one); Distance to birds in: (Meters/Feet-circle one)

	Observer Initials	Mo.	Day	Year	St/ Pv	Transect	Percent Cloud Cv	Pre- cip	Station Number
1									

	Time of Observa.	Num. bird	Beh	Typ	Direct. Going	Call secs.	Obs. secs.	Distance to bird (m)(ft)	Num. bird	Beh	Typ	Direct. Going	Call secs.	Obs. secs.	Distance to bird (m)(ft)
2															
2															
2															
2															
2															
2															
2															
2															
2															
2															
2															

Beh. (Behavior): F=Fly over; C=Circle; B=Circle Below; T=Fly Through; L=Land. Typ. (Type): A=Audio; V=Visual; B=Both.

Return form to: Marbled Murrelet Survey, C.J. Ralph, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA 95521
Notes: Place observations on the back of this sheet concerning special behavior, etc.

Appendix B.

No.	ID.NO.	Date	Station	Start	Sunrise	Weather	% clouds	WindSpeed	WindDir.	AirTemp	# Detections
1	DN004	6/09/90	001	238	338	2	100	5	13		27
2	DN005	6/11/90	002	252	337	1	100	0	0	9.00	71
3	DN006	6/12/90	003	251	336	0	20	0	0	6.00	12
4	DN008	6/13/90	007	330	335	1	100	5	13		32
5	DN009	6/15/90	002	255	334	1	90	0	0	8.00	31
6	DN010	6/15/90	007	316	334	1	60	0	0	8.00	50
7	DN011	6/18/90	005	315	334	4	100	7		7.00	37
8	DN012	6/21/90	002	310	334	5	100	10	13	5.50	104
9	DN013	6/22/90	008	220	334	0	0	0	0		30
10	DN014	6/24/90	006	250	335	1	80	5	45	5.00	24
11	DN015	6/28/90	001	252	337	1	80	0	0	9.00	28
12	DN016	6/29/90	002	250	338	0	0	0	0	9.00	53
13	DN007	7/02/90	002	310	341	1	100	0	0	13.50	45
14	DN017	7/02/90	2A	320	341	1	100	0	0	13.00	77
15	DN018	7/04/90	003	255	344	2	90	0	0		34
16	DN019	7/04/90	011	247	344	1	60	0	0	14.00	37
17	DN020	7/04/90	013	300	344	0	0	0	0	10.00	76
18	DN022	7/05/90	012	300	345	1	100	0	0		2
19	DN023	7/05/90	014	300	345	1	100	0	0		113
20	DN025	7/09/90	002	332	352	1	100	0	0		60
21	DN026	7/09/90	002	305	352	1	100	5	45	10.00	52
22	DN027	7/11/90	005	310	355	1	90	10		9.00	27
23	DN029	7/12/90	2A	325	357	1	100	0	0		86
24	DN030	7/13/90	015	310	359	0	0	0	0	17.00	27
25	DN031	7/14/90	016	305	401	4	100	5		10.50	4
26	DN033	7/15/90	001	312	403	4	100	10			97
27	DN034	7/16/90	017	335	405	1	90	0	0	13.00	21
28	DN035	7/17/90	018	330	407	0	10	0	0	10.00	1
29	DN036	7/17/90	007	315	407	0	10	0	0		70
30	DN038	7/18/90	009	315	409	0	0	0	0	8.50	40
31	DN039	7/19/90	019	315	411	0	0	0	0	8.50	61
32	DN040	7/19/90	0088	320	411	0	0	0	0		59
33	DN041	7/19/90	008	340	411	0	10	0	0		43
34	DN042	7/20/90	020	330	413	3	100	0	0	13.00	65
35	DN043	7/21/90	021	330	415	0	0	0	0	11.00	34
36	DN046	7/21/90	003	325	415	0	0	0	0		67
37	DN047	7/26/90	002	338	427	4	100	5	13	11.00	135
38	DN048	7/31/90	005	410	439	1	100	0	0		80
39	DN049	8/04/90	008	405	449	4	100	5	27	11.00	51
40	DN050	8/04/90	010	405	449	4	100	0	0		77
41	DN051	8/07/90	002	408	456	1	100	5	36		64
42	DN052	8/08/90	007	400	459	1	100	5	45		40
43	DN053	8/09/90	001	405	501	4	100	5			30
44	DN054	8/11/90	001	400	506	2	100	0	0		51
45	DN055	8/13/90	005	400	511	0	0	0	0		19
46	DN056	8/15/90	022	410	516	1	100	0	0		5
47	DN057	8/18/90	002	440	523	4	100	0	0		9

Revised 11/29/90 KWG L

Appendix I

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

Study I.D. Number:	Conducted as part of NRDA Bird Study No. 11 and Restoration Feasibility Study No. 4 (Identification of Upland Habitats Used by Wildlife Affected by the EVOS)
Project Leader:	Dr. Samuel M. Patten
Assisted by:	Robert G. Hunter
Leading Agency:	Alaska Department of Fish and Game
Cooperating Agency:	U.S. Fish and Wildlife Service
Date of Report:	November 8, 1990

Table of Contents, List of Tables, Figures, Appendices

EXECUTIVE SUMMARY

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

A Harlequin Duck Restoration Feasibility Study was conducted by ADF&G in summer 1990 in Prince William Sound. The goals of this study were to locate Harlequin nesting streams, describe breeding habitats, and obtain productivity indices. Information gathered during the 1990 field season demonstrates the proposed restoration project is technically and logistically feasible.

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

The presence of Harlequin pairs at stream mouths suggests later breeding use of those streams. Mist-netting and radio-tagging female Harlequin Ducks at stream mouths and later radio-tracking along streams is the recommended method for locating nest sites.

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

OBJECTIVES

Objectives A-C specifically apply to both Harlequin Ducks and to Marbled Murrelets, the primary subjects of the 1990 Restoration Feasibility Study No. 4:

A. Develop and test methods for establishing the presence breeding birds.

B. Develop and test methods for locating nest sites.

C. Identify and characterize nest habitats and sites.

D. Define the parameters of and develop a proposal for a full-scale upland habitat feasibility study for marine birds, waterfowl, and other species.

E. Determine the costs of implementing a full-scale restoration project concerning upland habitats used by marine-dependent wildlife.

INTRODUCTION

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

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

Harlequin Ducks, because of their resident status and intertidal foraging habits, have been considered substantially at risk to effects of the <u>Exxon</u> <u>Valdez</u> Oil Spill (King and Sanger, 1979). Harlequin Ducks are dependent upon intertidal marine invertebrates (Vermeer and Bourne, 1982). Harlequins consume a wide variety of small mussels, clams, snails, chitons, limpets, and salmon eggs (Koehle, Rothe and Dirksen, 1982; Dzinbal and Jarvis, 1982). Bivalves, particularly blue mussels (<u>Mytilus</u>), and small clams (<u>Macoma</u>), are well-known for their ability to concentrate pollutants at high levels (Shaw et al, 1976). The crude oil spilled from the <u>Exxon</u> <u>Valdez</u> may cause severe damage to marine invertebrates that support Harlequin Ducks (Stekoll, Clement, and Shaw, 1980) and bioaccumulation in the food chain may result in uptake of petroleum hydrocarbons by Harlequin Ducks over a long period (Dzinbal and Jarvis, 1982; Sanger and Jones, 1982).

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

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

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

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

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

STUDY METHODOLOGY

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

1) an extensive regional survey to locate where Harlequins were concentrated in spring and summer (Objective A);
2) a description of stream sites where presumably breeding Harlequins were identified (Objective B);
3) an identification of general parameters of Harlequin breeding habitats (Objective C);
4) a collection of limited data on Harlequin productivity (brood size).
5) subsequent development and submission of a proposal, with budget submitted to OSRPO, Anchorage, in November 1990, for a full-scale Harlequin Duck Restoration Project (Objectives D & E).

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

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

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

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

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

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

STUDY RESULTS

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

Nine confirmed PWS Harlequin nesting streams were identified by observations of females with broods. These streams are listed in Table 1 by USGS name and standardized ADF&G Commercial Fisheries Division Anadromous Fish Stream Index Number.

Harlequin females are secretive, and nests are difficult to locate. Dzinbal (1982) was unable to locate any nests during his MS thesis research, even with intensive searching. He was unable to radio-tag females because the radio transmitters of the time were too large to be fitted on to the back of the bird.

No nests were located during this feasibility study. The technology of radio-telemetry has advanced, however, in the decade since Dzinbal's (1982) study. Radio transmitters are currently available of the size which will fit Harlequin Duck females. Battery life of this transmitter size is approximately three months, which should facilitate tracking of female Harlequin Ducks to nest sites.

The presence of Harlequin pairs in Spring at stream mouths suggests later breeding use of those streams. Harlequin Ducks will be mist-netted and radio-tagged at stream mouths in Prince William Sound in Spring 1991, and later tracked along streams to nesting sites. Clutch size, hatching success, and brood size (a productivity index) will be obtained from sample nest sites.

In general, Harlequin nesting streams are larger than the usual anadromous fish streams in PWS, with moderate gradients, and non-glacial waters averaging .3 - .5 m depth, used by spawning pink and chum salmon (Table 2). Substrates in these streams are large stone, rocks, and boulders, often creating turbulent flow patterns. The streams average 750 ft elevation at their onset, and are bordered by mature spruce-hemlock forest. These streams are typically 30 - 50 ft wide at the mouth to the estuary, have extensive intertidal areas, and are relatively short, 5 - 8 km in length (Table 2). The intertidal areas are used for feeding by breeding pairs, and later, by nesting females which fly to the intertidal to feed before the arrival of spawning salmon upstream. This behavior allows nesting females to be mist-netted at the mouths of their nesting streams.

Harlequin nests are generally located beginning at about .5 km from the stream mouths (Dzinbal, 1982). Nests are typically found within 2 to 20 m from the water (Bengston, 1966). Mean clutch size in the literature averages 5.5 eggs (Bengston, 1966). Observed brood size outside the PWS oil spill area in 1990 was 3.1 ducklings per brood, a relatively low productivity rate for a duck species.

Concentrations of molting and flightless males were noted inside the oil spill area of western Prince William Sound. Up to 70 individual ducks were observed in these concentrations. The largest of these aggregations was at Foul Bay, south of the entrance to Port Nellie Juan. An apparent characteristic of these molting sites was their location in extensive rocky intertidal zones in secluded bays. These sites appeared highly productive, were used by a variety of avian and mammal species, and may need protection as part of further restoration efforts. This topic is addressed in the proposed ADF&G Prince William Sound Harlequin Duck Restoration Project Description, submitted to the Oil Spill Restoration Planning Office in November 1990.

Table 1

Identified Harlequin Breeding Streams
in Prince William Sound

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

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. 0.5 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

CITATIONS

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Isleib, M.E. and B. Kessel. 1973. Birds of the North Gulf Coast - Prince William Sound Region, Alaska. Biol. Pap. Univ. Alaska 14.

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Koehl, P.S., T.C. Rothe, and D.V. Derksen. 1982. Winter food habits of Barrow's Goldeneyes in southeast Alaska. pp. 1 - 5 in Marine birds: their feeding ecology and commercial fisheries relationships. Nettleship, D. N., G.A. Sanger, and P.F. Springer, eds. Proc. Pacific Seabird Group Symp., Seattle, WA., 6-8 Jan. 1982. Can. Wildl. Serv. Spec. Publ.

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Shaw, D.G., A.J. Paul, L.M. Cheek, and H.M. Feder. 1976. Macoma balthica: an indicator of oil pollution. Mar. Poll. Bull. 7 (2): 29-31.

Stekoll, M.S., L.E. Clement, and D.G. Shaw. 1980. Sublethal effects of chronic oil exposure on the intertidal clam Macoma balthica. Mar. Biol. 57: 51-60.

Vermeer, K. and N. Bourne. 1982. The White-winged Scoter diet in British Columbia: resource partitioning with other scoters. pp. 30 - 38 in Marine birds: their feeding ecology and commercial fisheries relationships. Nettleship, D.A., G.A. Sanger, and P.F. Springer, eds. Proc. Pacific Seabird Group Symp., Seattle, WA., 6-8 Jan. 1982. Can. Wildl. Serv. Spec. Publ.

NWG
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RESTORATION FEASIBILITY STUDY NUMBER 4

Study Title: Identification of Upland Habitats Used by Wildlife Affected by the EVOS

Lead Agency: FWS

Cooperating Agency: ADF&G

INTRODUCTION

A variety of marine birds, waterfowl, and other bird and mammalian species were killed by the spill or injured by contamination of their prey and habitats. Many of these wildlife species are dependent on aquatic or intertidal habitats for such activities as feeding and resting, but they use upland habitats in forests, along streams, or above tree line to fulfill other life-history requirements (e.g., nesting, shelter). Through the public scoping process and technical workshop, many people have suggested that protection of upland wildlife habitats from further degradation may be an important way to help wildlife recover from the effects of EVOS. To explore this potential, it is necessary to learn more about the specific upland habitats upon which these species depend and how they use them. While such a feasibility study would be a large and complex undertaking, an initial study that primarily focuses on the marbled murrelet (Brachyrumphus marmoratus) and the harlequin duck (Histrionicus histrionicus) will be conducted in 1990. The results of this study will provide a basis for developing and evaluating a broader feasibility study proposal that will more fully explore the ecological relationship between marine-dependent wildlife and upland habitats.

OBJECTIVES

Objectives A-C specifically apply to both harlequin ducks and to marbled murrelets, the primary subjects of the 1990 study:

A. Develop and test methods for establishing the presence of breeding birds.

B. Develop and test methods for locating nest sites.

C. Identify and characterize nest habitats and sites.

D. Define the parameters of and develop a proposal for a full-scale upland habitat feasibility study for marine birds, waterfowl, and other species.

E. Determine the costs of implementing a full-scale restoration project concerning upland habitats used by marine-dependent wildlife.

Relationships with Other Studies:

This study relates directly to the results and field work of Bird Studies 2 and 11 and RF 5.

METHODS

Marbled murrelet: Naked Island in PWS will be the primary study site. The presence of breeding murrelets will be recorded by a stationary observer at dawn, at which times murrelets fly to inland nest sites. Murrelet altitude, behavioral, and other data will be recorded for each bird observed. Sites with high murrelet activity will be identified and then searched for nests. The efficacy of the dawn detection technique will be evaluated.

Harlequin duck: Streams in PWS will be selected for investigation based upon reported concentrations of ducks, survey data from NRDA projects, and interviews with knowledgeable field personnel. Once streams are identified as having a high potential for harlequin nests, there will be intensive ground searches for nests. As nests are located, the nest sites and habitats will be characterized by such parameters as distance from the stream and coast, topography, and vegetative cover.

BUDGET: FWS, ADF&G

Salaries	$13.3
Travel	1.0
Contractual Services	3.0
Supplies	2.5
Equipment	3.5
Total	23.3