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Avalon and Miquelon Beached-bird Surveys from January 1984 to March 1985: I. Oil-related Seabird Mortality.

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Summary: Monthly beached-bird surveys were conducted at 24 beaches on the Avalon Peninsula of Newfoundland between St. John's and Placentia from January 1984 to March 1985, and at four beaches on Miquelon (France) from January to March 1984.

Of the 1470 seabird corpses found on Avalon surveys, 672 were complete enough to check for the presence of oil on their plumage, which was found on 23.9%. Only 148 of the 184 corpses found on Miquelon were classified, and 8.8% of there were oiled, a significantly lower proportion than on the Avalon.

The proportion of corpses with oiled plumage on the Avalon surveys was highest in cold months from October to March. The proportion oiled was greatest for highly aquatic birds such as the seaducks (35%), murres (48%) and other alcid species (23%). Coastal and highly aerial birds, such as herring gulls (0%), kittiwakes (11%) and shearwaters (0%) were much less likely to be oiled. These data are compared with the results of other surveys, and additional research requirements are discussed.

INTRODUCTION

Oil pollution is considered to be a major source of seabird mortality in eastern Canadian waters, although one of unknown magnitude (Brown 1980). Sources include both shipping accidents such as the sinking of the 'Kurdistan' off Cape Breton in 1979 (Brown and Johnson 1980), and chronic small spills of fuel oil and oily bilge water flushings. With the added risk of spills from the proposed exploitation of Canadian offshore oilfields such as Hibernia, it is important to document the sources and relative magnitude of present oil-related seabird mortality.

The regular monitoring of beaches, to record the presence of oil on seabird corpses found there, has been widely used to indicate the extent of mortality from oil pollution (e.g. Stowe 1982). The Canadian Wildlife Service conducted occasional beached-bird surveys in Newfoundland in the 1950's (Tuck 1961), and researchers from Memorial University conducted many more on the Avalon Peninsula from 1974 to 1982 (Threlfall and Piatt 1982).

In January 1984, the Canadian Wildlife Service developed guidelines for standard techniques to be used for all beached-bird surveys in Atlantic Canada (Appendix 1), and has conducted monthly surveys at 24 beaches on the southern Avalon Peninsula in conjunction with Memorial University since then. Surveys using these guidelines were also conducted from January to March 1984 by the Services de l'Agriculture de France on beaches of the island of Miquelon.

These regular surveys were designed to provide scientifically rigorous data on the occurrence of dead seabirds on beaches by species, and where possible by age and sex, as an indication of the relative rates of seabird mortality and the frequency of oiling. Beaches were monitored in areas where winds and currents are known to bring seabird corpses ashore, and where coastal shipping activity is expected to increase during the exploration and production phases of offshore oil exploitation. An evaluation of the results of the first four surveys in May 1984 confirmed that they had produced much useful information (Elliot 1984), and were important in providing data on present "background" levels of oil-related mortality.

This report briefly summarizes the data gathered in the first 15 Avalon surveys from January 1984 to March 1985, and the three Miquelon surveys, (i) to indicate the seasonal and inter-specific variation in oil-related mortality, and (ii) to identify areas where additional work is required to facilitate the accurate interpretation of results of this type.

METHODS

The 24 Avalon beaches surveyed included sequential series of shingle and pocket beaches along sections of the coast. These were usually separated by large rocky headlands where few corpses came ashore. They included most accessable beaches between Placentia and St. John's which appeared to have the greatest incidence of beached birds (Fig. 1a). Many of these beaches were included in previous surveys conducted by Memorial University. Beaches ranged from 50 m to 1900 m in length, with a total length of about 11.5 km. Additional surveys were conducted at four long sandy beaches on Miquelon, with a total length of 32 km, from January to March 1984 (Fig. 1b).

Most beaches were checked during the last ten days of the month using the techniques in Appendix 1. The conditions of the beach (presence of oil, heavy seaweed, and snow or ice) were recorded, as were weather conditions. All dead birds were collected and removed, and recorded on standard field survey forms, by sex and age (where possible), and by the relative amount of oil present (Appendix 2). Data were later coded and transferred to computer files for analysis. All whole alcid specimens were retained, and later measured in an attempt to age individuals based on the degree of skull ossification and the size of the bill (Gaston 1984).

RESULTS

1. Condition of the beaches

Although surveys were timed to avoid severe weather where possible, beaches were occasionally obscured by snow. This winter effect was most severe in March 1985 when almost all beaches were at least 60% ice or snow covered (Fig. 2a). The beaches were also sometimes partly obscured by dead seaweed carried ashore by storms, particularly during fall and winter months (Fig. 2b). These combined effects probably reduced the proportion of those corpses present on the beaches which were found during winter surveys, although the species composition and the proportion with oiled plumages were probably accurately determined.

No major spills or beachings of oil were recorded during the survey period in the study area. However, small patches of oil, generally less than one per 50 m of beach, were occasionally found, particularly from March to July 1984 (Fig. 2c). Most oil had coagulated on shingle or floating debris or driftwood. As discussed below, the proportion of oiled birds was greatest slightly before this peak in early 1984, and particularly in the winter of 1984 - 1985 when little oil was noticed on the beaches. Small oil patches present then may have been obscured by the winter snow and seaweed (compare Figs. 2a and b with Fig. 2c).

2. The seasonal distribution of oiled bird corpses

A total of 184 seabird corpses were found on the three Miquelon surveys, and 1470 were recorded on the 15 Avalon sruveys, with a peak in numbers in January and February 1984 (Fig. 3). However, as Figure 3 shows, this peak is composed largely of dovekies, of which a great number died in January 1984 in an area extending from St. Anthony to Sable Island, N.S. (C.W.S. files). Most died in an emaciated condition without encountering oil, probably due to the combined effects of starvation and poor weather conditions. Peaks of mortality for seabirds other than dovekies occurred during periods of extreme winter weather conditions, and during the summer breeding season.

Due to decomposition and the activities of scavengers, less then half the body (often only one or two wings) remained for 672 (45.7%) of the Avalon corpses, and 36 (19.6%) of those from Miquelon. These were not coded for the presence of oiled plumage, since slight or moderate oiling could easily have been overlooked.

Some oil was present on 191 (23.9%) of the remaining Avalon corpses, and on 13 (8.8%) of those from Miquelon. This proportion of birds with oiled plumage is significantly higher for the Avalon surveys ($\chi^2 = 19.13$, $P < 0.001$). The proportion of oiled Avalon corpses was highest in the colder months from October to March, and reached a peak of 85.7% in December 1984 (Fig. 4). The average amount of oil on the plumage was also highest in the cold months (Fig. 5), although the proportion of birds in the "heavily-oiled" categories (2 and 3) was not significantly greater from October to March, than from April to September ($\chi^2 = 1.92$, n.s.).

This survey period was unusual with only one incident of oiled birds reported (less than 25 oiled sea-ducks and alcids near Cappahayden in early March), as three or four reports are usually received each winter (C.W.S. files, J.F. Piatt pers. comm.).

3. The risk of oil-related mortality to different seabirds

The birds most likely to have oiled plumage were the highly aquatic alcids and sea-ducks (Table 1), and almost half the murres classified were oiled. The more coastal and aerial groups were less likely to encounter oil, with none recorded on the herring gulls (coastal), fulmars or shearwaters (aerial). Although almost all corpses found on the three winter surveys on Miquelon were from these highly aquatic birds (Table 2), the overall proportion with oiled plumage was still lower than on the Avalon surveys.

The apparent level of oiling of highly aquatic groups was probably reduced by the great number of dovekies present, particularly in January and February 1984 (Fig. 3). The proportion of oiled corpses for these groups rises from 27.7% to 38.0% when dovekies are omitted from the Avalon surveys, and from 9.6% to 20.9% for the Miquelon surveys.

All groups showed a similar seasonal pattern of encountering oil when the data were considered for the following "seasons", winter: January - March, spring: April - June, summer: July - September, and fall: October - December (Fig. 6). The highest proportion of oiled corpses on Avalon surveys was recorded outside the summer period for all groups of seabirds.

DISCUSSION

Caution must be used when interpreting these data, even as relative indices of mortality risk. Seaweed, snow and ice will have reduced the numbers of corpses actually found, and smaller species such as dovekies and guillemtos may be most easily overlooked. Species such as gulls are known to decompose faster than the compact-bodied loons and alcids (Hope Jones 1980), and overall decomposition rates are much slower in winter when many corpses are frozen.

Monthly checks such as these may encounter only 50 - 75% of the numbers found on weekly visits, since birds are eventually buried or removed from the beach by scavengers or wave-action (Stowe 1982). Belgian studies showed that most corpses only remained ten to 25 days on the beach (Kuyken 1978). This duration is likely to vary both geographically and seasonally. I have not compared the number of corpses found per kilometer of coastline with other studies conducted on long stretches of continuous beach, since the small pocket beaches surveyed here undoubtedly collect birds from farther away.

The proportion of birds found oiled is somewhat lower than the range of 40 - 80% found in this area in 1980 - 1982 by Threlfall and Piatt (1982). However, most of their surveys were conducted in the colder months (e.g. 65.9% were from October to March), and included beaches visited soon after known oiling incidents. The level is similar to that of 28.6% recorded over $8\frac{1}{2}$ years of winter surveys throughout Britain (Stowe 1982), but much lower than the 76.7% recorded on 15 annual February surveys in Belgium (Kuyken 1978). Although differences in timing and species composition make direct comparisons difficult, areas close to major shipping activity have the highest incidence of oiling (Stowe 1982).

The proportion of corpses that encountered oil at sea after the birds died from other causes is unknown. Kuyken and Zegers (1968) estimated that 5 - 7% of corpses found in Belgium were oiled this way,

although various corpse-drift experiments indicate that 10.9 - 52.3% may be oiled after death (summarized by Stowe 1982).

As in most other studies, including those in Newfoundland (Threlfall and Piatt 1982) and the eastern United States (M.M. Simons Jr., pers. comm.), the proportion of oiled birds was highest in colder months. Cold sea temperatures may slow the evaporation of volatile oil fractions, prolonging the time that floating oil remains a threat (Bourne and Bibby 1975). Alternatively, more oil may be discharged in winter, with more frequent balasting operations in rough weather, and greater opportunities to release unwanted oil under cover of darkness (Stowe and Underwood 1984). The types and sources of oil found on corpses on this survey are still unknown. However, since oiling rates were higher for the Avalon near the main shipping lanes off south-east Newfoundland than for Miquelon, ships seem to be the main source of oil.

The effect that species which spend most time on the water are at the greatest risk is apparent in many studies, both of specific spills (e.g. Brown and Johnson 1980), and from regular beach surveys (e.g. Table 3). Among these groups, the sea-ducks such as the common eider are also subject to heavy hunting pressure in Atlantic Canada (Métras 1984), and the Newfoundland breeding population seems to be at an all-time low. The two species most likely to be oiled, the common and thick-billed murres, are subject to additional heavy mortality by man, though losses in gill-nets near colonies (Piatt and Nettleship 1984) and by extensive winter hunting (Wendt and Couch 1984), respectively. These three species are also among those most commonly affected by major oil spills in eastern Canada (Brown 1980). Since they have low reproductive rates, and low natural mortality, this additional oil-related mortality is a cause for concern.

ADDITIONAL RESEARCH REQUIRED

The monthly surveys will be continued to document year-to-year variation, such as the effects of mild winters and periodic oil-spills, and to detect long-term trends. Additional work is needed to reduce the sources of error in interpreting the data discussed above. While published estimates of the magnitudes of some effects are available, they cannot be applied with confidence to the Newfoundland surveys with their unique characteristics.

Experiments should be conducted in the survey area to address the following questions:

i) Within a month, what proportion of birds once beached are either buried and thus not counted on surveys, or are subsequently removed from the beach, and either sink at sea or are beached at other sites where they may or may not be recorded? The fate of marked corpses on beaches, monitored over periods of 5 - 7 days as outlined by Maxwell et al (1981), would indicate the numbers missed on monthly surveys.

ii) What proportion of birds found on beaches with oiled plumage were oiled and dying from other causes, and can these be separated visually from those dying as a result of contact with oil? While some data was collected by Threlfall and Piatt (1982) using corpse-drift experiments, these procedures would be refined, and the experiments extended to cover additional areas, seasons and species.

iii) What proportion of birds dying at sea, both from oil pollution and other causes, eventually float ashore where they will be recorded on surveys? The presence of oil on corpses recovered during drift experiments designed to answer question (i) would indicate the local magnitudes of this effect, by location and by season.

Additional information can also be obtained from further analysis in the laboratory to answer the following:

iv) What are the types and sources of oil presently found on sea-bird corpses? Some preliminary samples of oil from beached birds are ~~possibly~~ being analyzed with chromatography by the Environmental Protection Service (Dartmouth) to see if sources can be identified.

v) Do some birds die from the effects of ingested oil, perhaps without signs of externally oiled plumage? Internal analysis of the alimentary canal, and other organs from beached birds, could clarify the relationship between oil ingestion and mortality.

ACKNOWLEDGMENTS

I am grateful to John Piatt, Bill Montevecchi and C.W.S. Seabird researchers for help in developing the guidelines for beached-bird surveys, and for arranging to have an honours student help in conducting the surveys. I thank all those who helped carry out the field work including Pierre Ryan, John Piatt and particularly Andrea MacCharles. Thanks are also due to Alain Desbrosse and his co-workers at the Services de l'Agriculture for conducting surveys on Miquelon. The financial assistance of Mobil Oil Canada is gratefully acknowledged.

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Table 1. The numbers of corpses found, numbers classified, and the proportion oiled for the major seabird groups on Avalon surveys.

Group of birds	Number found (classes 0-4)	Number classified for oiling (classes 0-3)	Percentage Oiled (classes 1-3)
I. Highly aquatic seabirds			
Sea-ducks	29	17	35.3%
Murres	194	125	48.0%
Dovekies	901	483	23.8%
Other alcids	97	42	9.5%
Total	1221	667	27.6%
II. Moderately acquatic seabirds			
Herring Gull	69	42	0.0%
Other gulls (ex. kittiwakes)	34	15	6.7%
Northern gannets	7	5	20.0%
Total	110	62	3.2%
III. Highly aerial seabirds			
Black-legged kittiwakes	34	25	0.0%
Fulmars and Shearwaters	91	36	11.1%
Total	125	61	6.6%

Table 2. The number of corpses found, numbers classified, and the proportion oiled for major seabird groups on Miquelon surveys.

Group of birds	Number found (classes 0-4)	Number classified for oiling (classes 0-3)	Percentage oiled (classes 1-3)
I. Highly aquatic seabirds			
Sea-ducks	5	3	33.3%
Murres	49	34	14.7%
Dovekies	103	93	3.2%
Other alcids	6	6	33.3%
Total	163	136	9.6%
II. Moderately aquatice seabirds			
Herring gulls	3	0	-
Other gulls (ex. kittiwakes)	5	1	-
Northern gannet	0	0	-
Total	8	1	-
III. Highly aerial seabirds			
Black-legged kittiwakes	8	6	0.0%
Fulmars and Shearwaters	0	0	-
Total	8	6	0.0%

Table 3. A comparision of the proportion of corpses of major seabird groups found oiled on four beached-bird survey projects.

	Percentage oiled			
	Avalon (this study)	Miquelon (this study)	Britain (Stowe 1982)	Belgium (Kuyken 1978)
I. Highly aquatic seabirds				
Loons and grebes			57.0	86.8
Sea-ducks	35.3	33.3	29.1	90.0
Murres	48.0	14.7	58.3	97.3
Dovekies	23.8	3.2	-	-
Other alcids	9.5	33.3	59.6	96.9
Overall	27.7	9.6	55.1	-
II. Moderately aquatic seabirds				
Herring gulls	0	-	8.9	-
Other *Larus* gulls	6.7	-	10.1	61.1
Northern gannets	20.0	-	29.1	-
Overall	3.2	-	10.7	-
III. Highly aerial seabirds				
Black-legged kittiwakes	11.1	0	18.1	76.0
Fulmars and shearwaters	0	-	13.3	-
	6.6	0	15.8	-

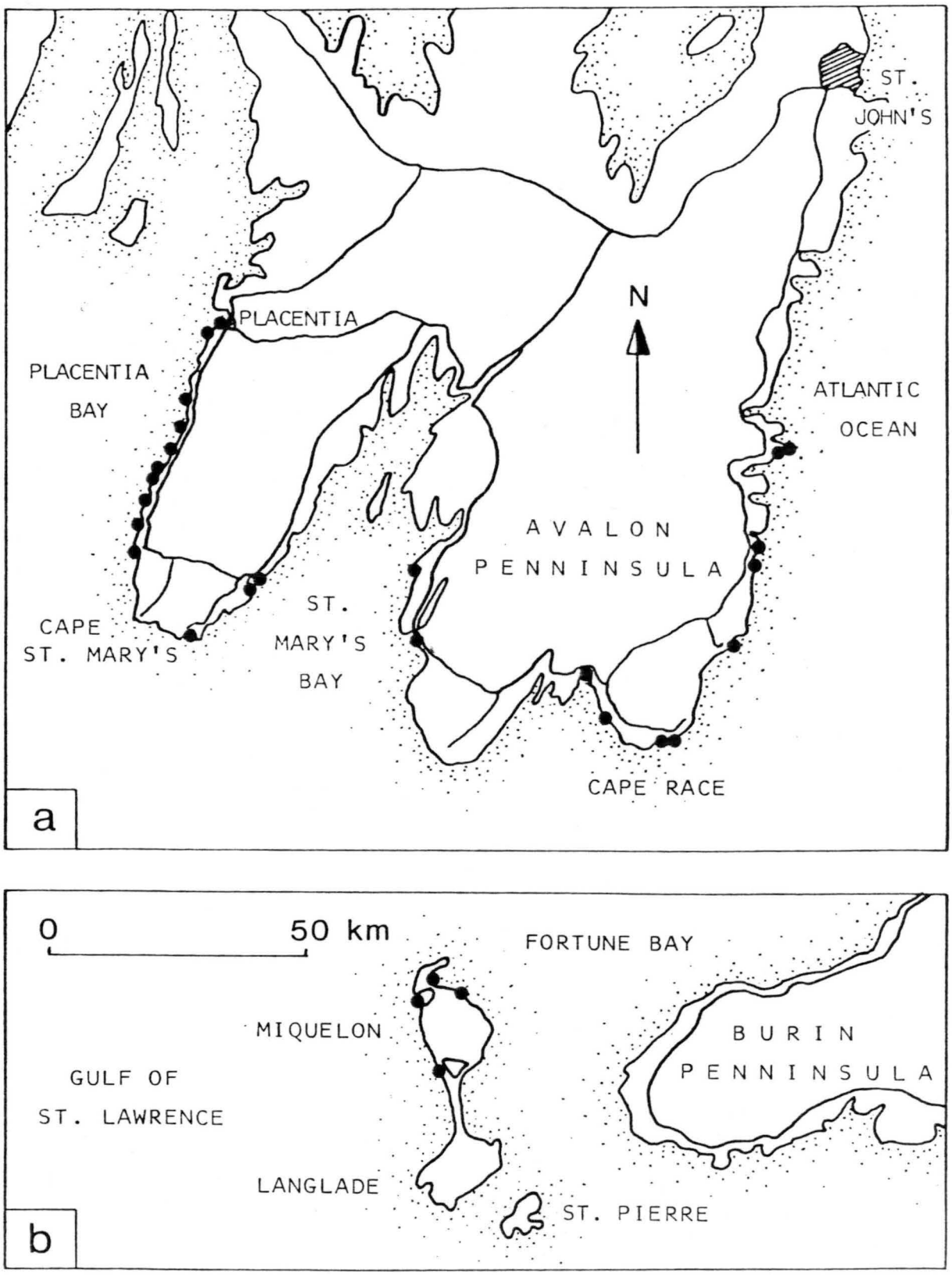

Fig. 1. The study areas on (a) the Avalon Penninsula, and (b) Ile de Miquelon, showing the beaches surveyed (●).

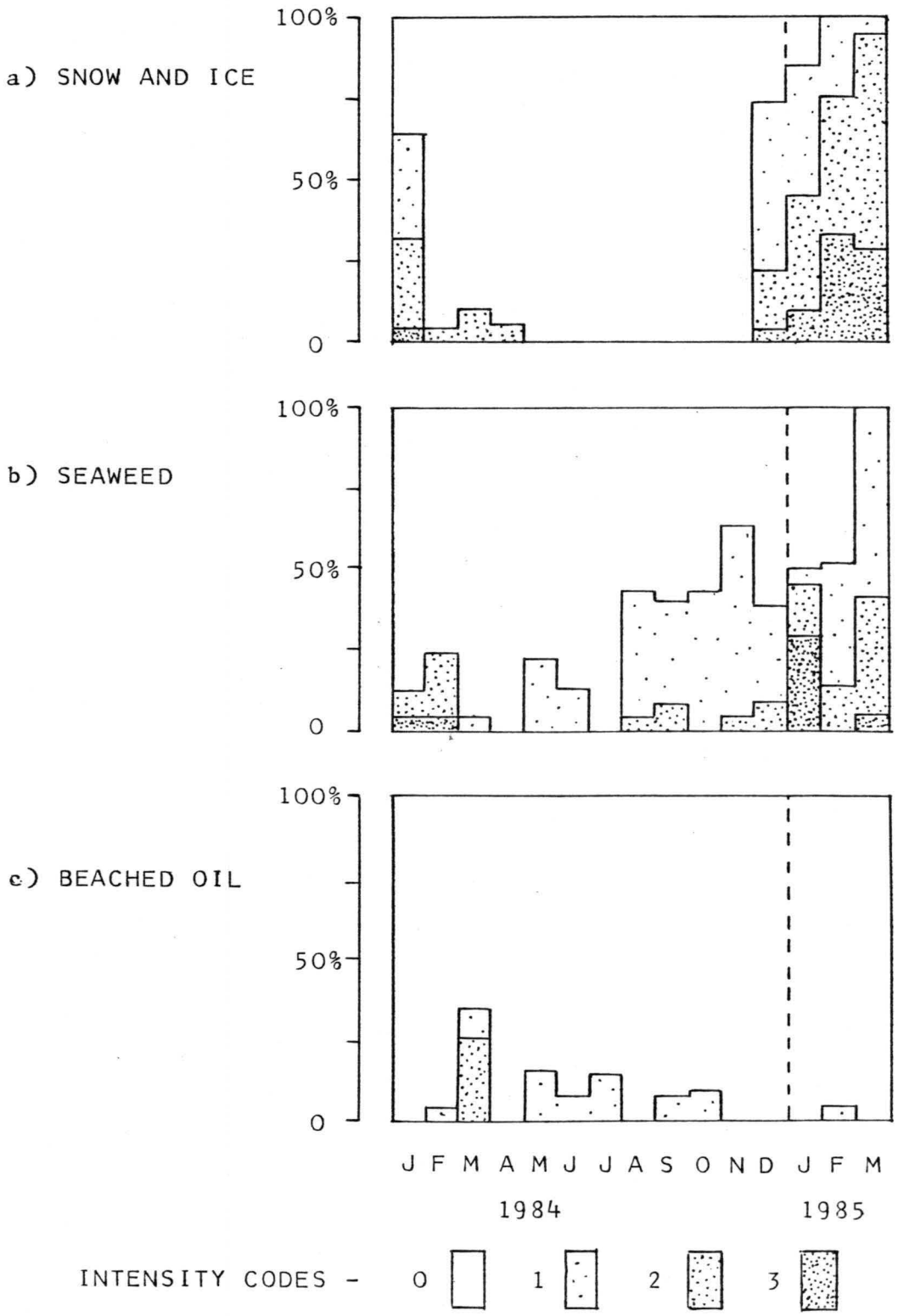

Fig. 2. The proportion of Avalon beaches on each survey within each surface cover code for (a) snow and ice, (b) seaweed, and (c) beached oil.

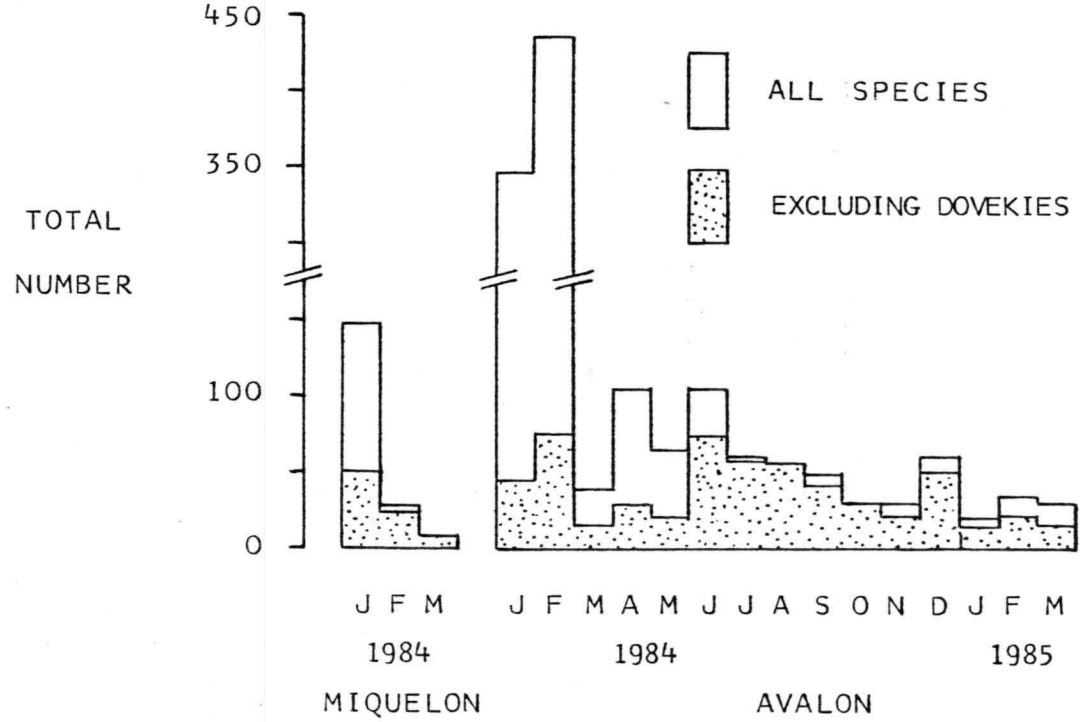

Fig. 3. The total numbers of beached birds, and the numbers with dovekies excluded, for all Miquelon and Avalon surveys.

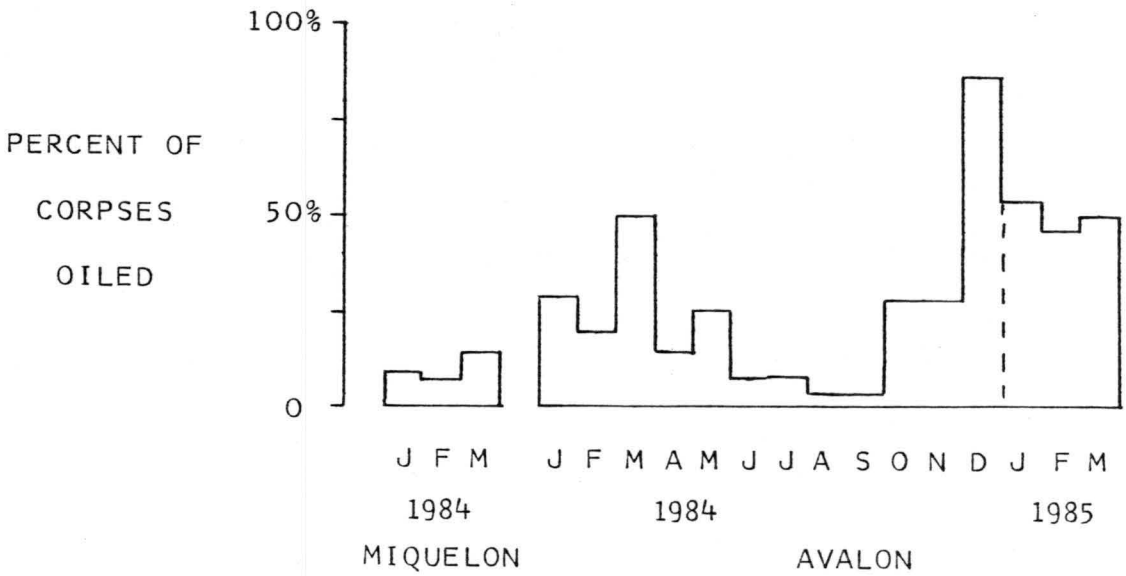

Fig. 4. The proportions of classified corpses on which oil was found, for all Miquelon and Avalon surveys.

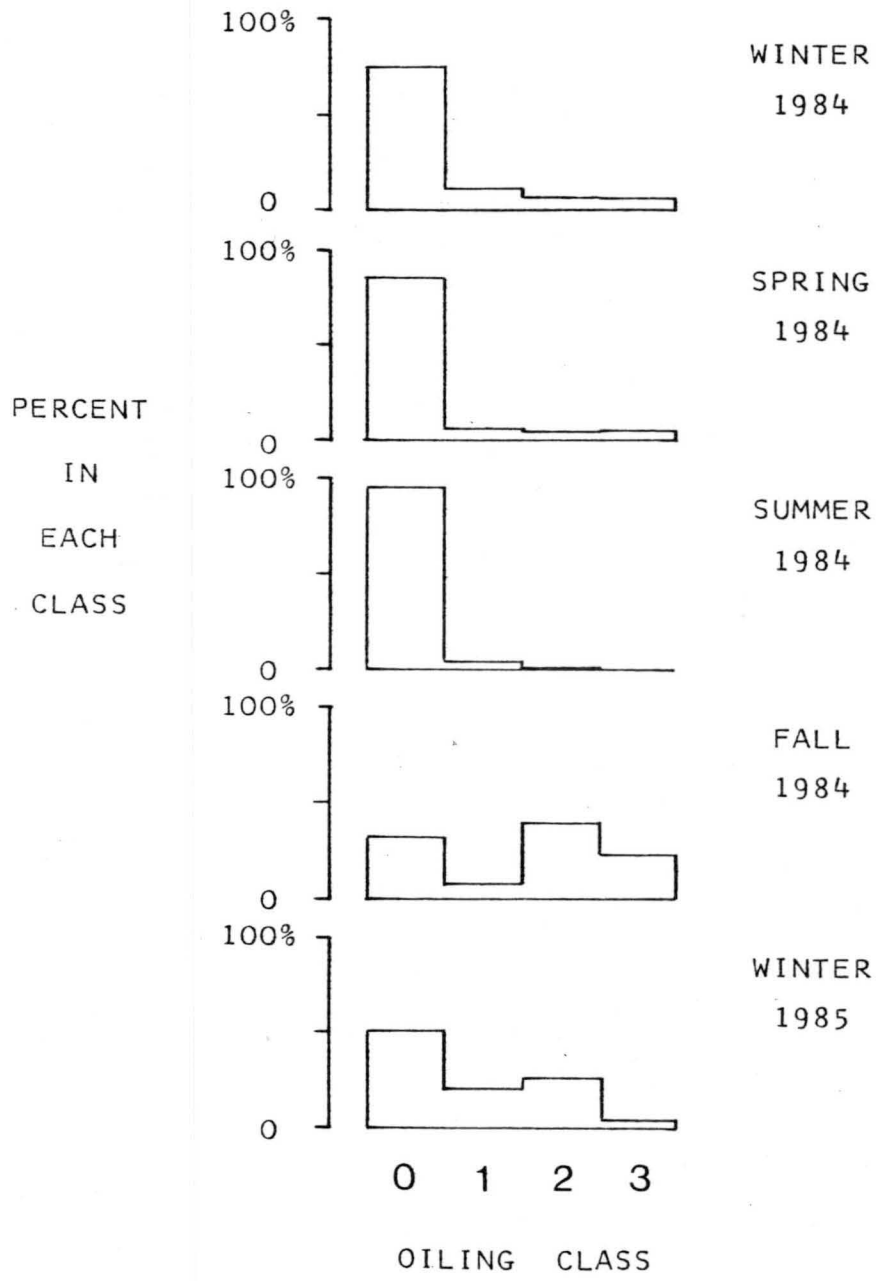

Fig. 5. The proportion of classified corpses assigned to each of the four classes of intensity of oiling, for each season of the Avalon surveys.

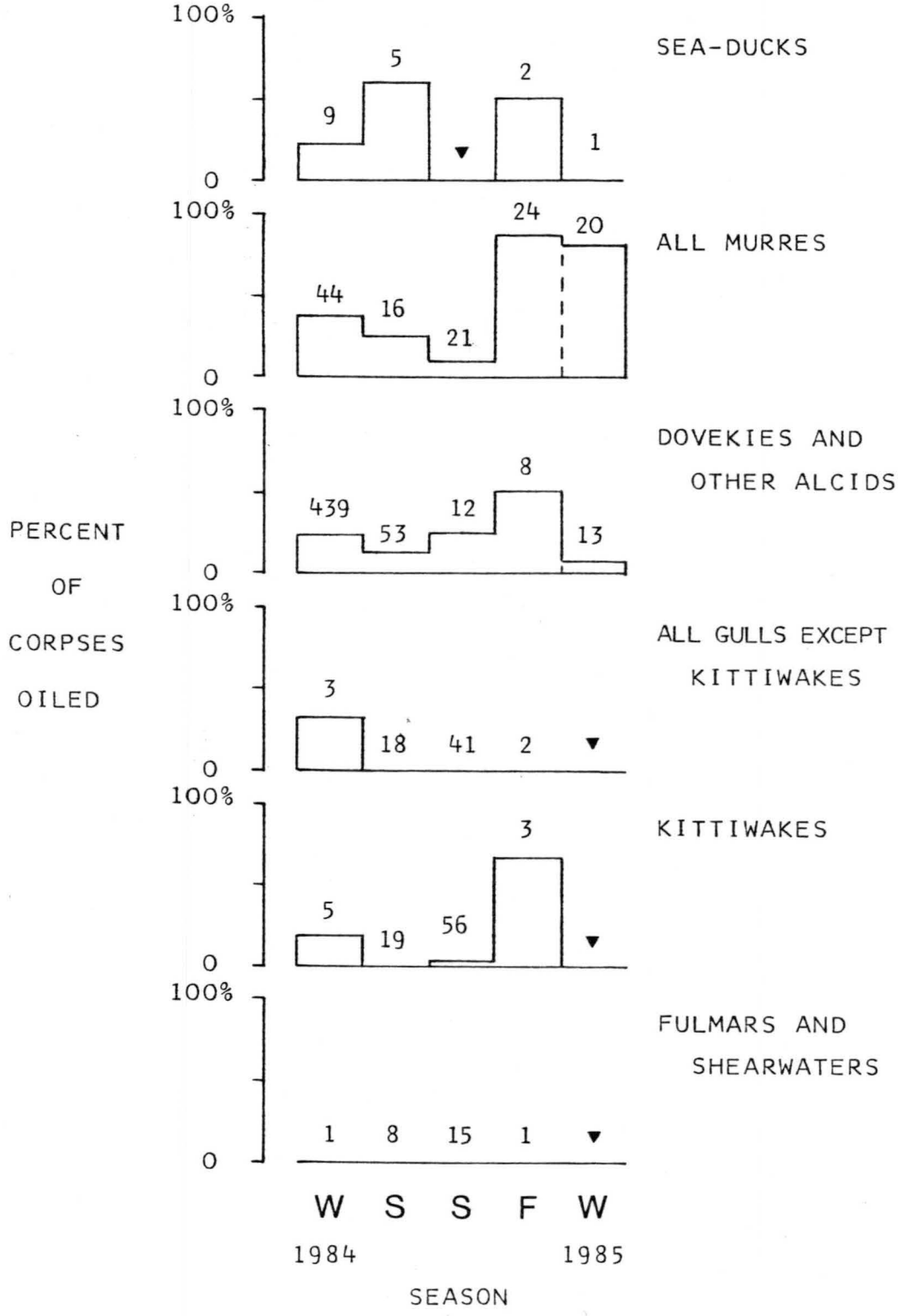

Fig. 6. The proportions of classified corpses of the major seabird groups which were found oiled in each season. Periods in which no birds were classified are shown by triangles (▼), and sample sizes are given for each season.

C.W.S. ATLANTIC BEACHED BIRD SURVEY

P.O. Box 9158, Stn. B, St. John's, Newfoundland A1A 2X9

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Survey Instructions

a) Select beaches for ease of year-round access, and high likelihood of finding dead birds. For initial visits, record the location (including grid references from topographic maps) with a sketch map to show the amount of beach checked, and the distance covered (km).

b) Surveys should be conducted once every month, on the same stretches of beach, preferably during the last ten days of each month.

c) All information for one beach should be recorded on one survey form (there are 2 forms per sheet), including the name of the beach, the survey period (the month and year), names of main observers and date. Record trips even when no dead birds are found.

d) Record brief weather details including approximate temperature (^{o}C), precipitation (e.g. heavy fog, flurries etc.), and approximate wind direction and speed (km/hr).

e) Record the relative amounts of oil, snow or ice, and heavy seaweed (thick enough to obscure corpses) on the area of the beaches where corpses would be expected, as follows:

Oil:
0) clean
1) few small patches or tar-balls (less than one per 50 m)
2) many large patches, or a few large ones, with flotsam speckled with oil
3) tide-line extensively covered, most flotsam oiled.

Note: Describe fully if level 2 or 3.

Snow/ice or weed:
0) covers 5% of beach or less
1) covers up to (and including) 30%
2) covers up to (and including) 60%
3) covers more than 60% of beach

f) Walk one way along the highest tide line, and return closer to the water to locate birds washed in more recently. Some wide beaches may require more tracks to cover the whole beach, but do not cover any section more than once.

g) Record the number of each species found dead, by age (immature or adult) or sex where easily determined. Record any sick or oiled live birds separately on the back of the forms.

h) Record the number of birds of each species in the following categories, based on the amount of oil on their plumage:

0) clean
1) slight oiling - smudges of oil that don't totally penetrate the breast feathers or coat the wings
2) moderate oiling - oil penetrates to base of feathers or saturates wings, less than 25% of body affected
3) heavy oiling - oil penetrates to base of feathers over more than 25% of body
4) unknown - less than half the body remains (often wings or head and neck only), and oil at levels (1) or (2) could thus be missed. Use this code even if oil is present. (Note: when single wings are found, use the minimum number of birds involved, not total wings.)

i) After examination, remove all birds from the beach completely in plastic bags.

j) Check all birds for bands or other markers. Send band numbers to the Banding Office, Canadian Wildlife Service, Ottawa, Ontario K1A 0E7, with details of when and where the bird was found, and the amount of oiling. When possible, please freeze the corpse and contact the nearest C.W.S. office collect (St. John's: 1-709-772-5585, or Dartmouth: 1-902-426-6052).

k) Count all live seabirds, gulls, waterfowl and other waterbirds on the beach, and on or over the water, that are close enough to be identified and counted easily with binoculars.

l) Record other specific data, or collect and freeze specimens, required for specific studies.

Additional Instructions - Newfoundland

a) Try to record age (immature or adult) and sex of birds of the following species:

Age:	Cormorants	Jaegars
	Gannets	Kittiwakes
	Common Eider	Other Gulls
	King Eider	Terns
	Other Waterfowl	
Sex:	Common Eider	Oldsquaw
	King Eider	Mergansers
	Scoters	Other Waterfowl

b) Keep heads (and bodies if not decomposed) of all Razorbills, Puffins, Murres and Dovekies for aging by bill, skull and wing measurements. Label each specimen with date and beach, and freeze in plastic bags.

C.W.S. ATLANTIC BEACHED BIRD SURVEY (additional remarks on back)

Survey No.	Period	Observers	Day	Mon.	Year
Beach					

NUMBER OF DEAD BIRDS ON BEACH

Code	Species	Age	Sex	Oiling Code 0	1	2	3	4

NO. OF LIVE SEABIRDS, GULLS AND WATERFOWL

Code	Species	No.

BEACH CONDITIONS		Oil	
Snow		Weed	

Temp.___ °C Precip.

Wind: Dir._____:_____km

Survey No.	Period	Observers	Day	Mon.	Year
Beach					

NUMBER OF DEAD BIRDS ON BEACH

Code	Species	Age	Sex	Oiling Code 0	1	2	3	4

NO. OF LIVE SEABIRDS, GULLS AND WATERFOWL

Code	Species	No.

BEACH CONDITIONS		Oil	
Snow		Weed	

Temp.___ °C Precip.

Wind: Dir._____:_____km

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