COMPOSITION OF BEACHED MARINE BIRDS FROM AN OILING EVENT IN SOUTHEASTERN NEWFOUNDLAND AND LABRADOR, NOVEMBER 2004

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SUMMARY

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The waters off Newfoundland and Labrador, Canada, have one of the worst chronic oiling problems in the world. Although the species generally affected by chronic oiling is known, details on the sex, age and condition of birds killed are not well understood. In late November 2004, oiled seabirds began arriving on the beaches of eastern Placentia Bay. Over the next week, 409 oiled marine birds were collected, with Thick-billed Murres *Uria lomvia* (67%) and Dovekies *Alle alle* (23%) constituting the majority. Adult birds comprised 80% (n = 253) of Thick-billed Murres, 61% (n = 84) of Dovekies and only 38% (n = 16) of Common Murres *Uria aalge.* Sex ratios were close to unity (48.2% male, n = 189) for Thick-billed Murres, but male-biased for Dovekies (60.5%, n = 76) and Common Murres (85.7%, n = 14). Most Dovekies and Thick-billed Murres were found dead (83%), with the highest proportion found alive three and four days, respectively, after the first birds arrived. In spite of additional mass from the oil, body masses of Thick-billed Murres were low (mean: 742 g; range: 520–986 g; versus an expected 950 g for wintering birds). This study confirms previous assumptions that chronic oil pollution in Newfoundland affects all ages of Thick-billed Murres equally, because the age distribution among recovered birds was similar to that expected in the population at large.

Key words: Age, *Alle alle,* Dovekie, Newfoundland, oil pollution, sex, Thick-billed Murre, *Uria lomvia*

INTRODUCTION

The waters off Newfoundland and Labrador, Canada, have one of the highest incidences in the world of oiled birds washing ashore (Wiese & Ryan 2003). The preponderance of these oiling events are attributed to illegal discharges of oily bilge waters, because the type of oil found on the birds tends to be a mixture of heavy fuel oils and lubricating oils.

Recently, Wiese & Robertson (2004) estimated that approximately 300 000 seabirds—largely Thick-billed *Uria lomvia* and Common Murres *U. aalge* and Dovekies *Alle alle,* die annually in Newfoundland and Labrador waters because of chronic oil pollution. Using population models, Wiese *et al.* (2004) went on to demonstrate that oiling was having a significant impact on population growth of Thick-billed Murre populations in the Northwest Atlantic. However, a key assumption of the model by Wiese *et al.* was that mortality of seabirds from oiling would affect all age classes according to their abundance. This assumption is important, because in long-lived seabirds, adult individuals contribute much more to population growth than juveniles do (Weimerskirch 2002).

In late November 2004, an oiling incident occurred in southern Newfoundland and Labrador in which substantial numbers of oiled seabirds began coming to shore. Although oiled seabirds are found regularly beached along this shore, generally only one or a few are found at any visit, and often these carcasses have been scavenged. Incidents in which significant numbers of birds are found on beaches in one day are relatively rare. As a result, we focused on collecting carcasses of seabirds every day and bringing them back to the laboratory for detailed assessment of species, age, sex and biometrics, as suggested by Heubeck *et al.* (2003). The purpose of the present paper is to report detailed information on the sex, age, species and body condition of oiled seabird carcasses collected during this incident. Further, the assumption that oiling affects seabird age classes according to their abundance was evaluated.

METHODS

On 28 November 2004, reports were received from the public by the Canadian Wildlife Service and Environmental Protection Branch of Environment Canada and by the Canadian Coast Guard (Department of Fisheries and Oceans) that oiled seabirds were coming ashore along the Cape Shore of the Avalon Peninsula in southeastern Newfoundland and Labrador (Fig. 1). The previous week, on 21 November 2004, the *Terra Nova* FPSO (floating production, storage and offloading) vessel released an estimated 1000 barrels of crude into the ocean, 445 km east of where birds were coming to shore. However, chemical analyses revealed that the oil on 19 birds and four samples collected from beaches was consistent with ship-source oil and not *Terra Nova* crude (G. Thomas, Environment Canada, pers. comm.). The overall geographic extent of birds coming ashore was determined by

- reports from the public (considerable media coverage was associated with this spill and the public were highly sensitized to oiling issues at the time),
- reports from ground teams sent to beaches adjacent to, but outside of, the areas reported by the public as having oiled birds, and

- helicopter surveys on 28 November and 1 December 2004 (these surveys involved examining inaccessible beaches with low-level passes; such surveys have proven effective in the past in determining the extent of oiled birds).

Once the extent was determined, from 29 November to 4 December 2004, one to three teams of two to three people were deployed to collect all oiled bird carcasses, and in the case of Coast Guard personnel, also to clean oiled debris off the beaches. Arrangements were also made with local individuals having an interest in seabirds to ensure that any birds picked up by the public and other agencies (i.e. provincial parks) were included in the study. After 4 December, pulses of birds were no longer reported by the public and teams concluded their field work, although it is likely that a few more birds subsequently came ashore.

Beaches where birds were coming to shore were searched on a daily basis. As it turned out, these beaches were the same beaches surveyed to monitor continuing oil pollution in Newfoundland and Labrador (Wiese & Ryan 2003). All birds found were labelled (usually on a plastic bag containing the bird or birds) with the date found, whether the bird was found alive or dead, and the location. Birds obtained from the public were not always accompanied by all the required information, but in general, the date, location and whether the bird was found alive or dead could be ascertained. At the end of each day, oiled birds were brought back to the Canadian Wildlife Service office near St. John's, and the birds were placed in freezers.

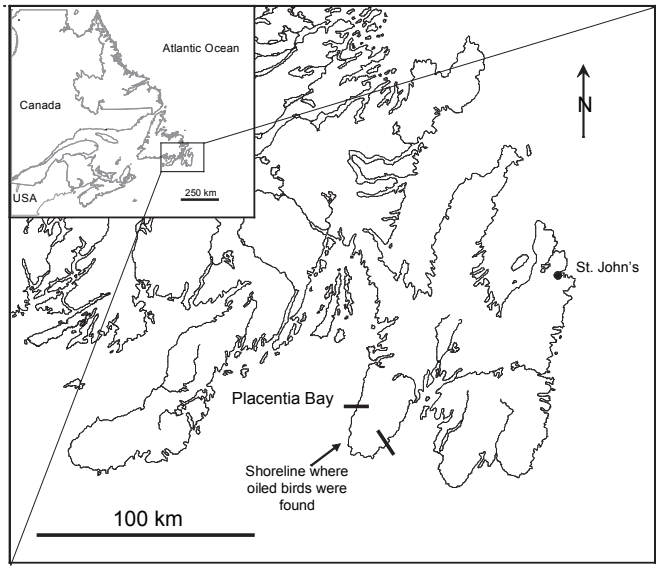

Fig. 1. Location where oiled marine birds were found, 28 November–4 December 2004, in southeastern Newfoundland and Labrador.

After the incident, the birds were thawed and processed in the laboratory. A variety of information was collected from each carcass, but because of heavy oiling or scavenging, not all specimens had complete data records. Where possible, birds were identified to species, sex and age. Species identification was often easily assessed, but in a few heavily scavenged carcasses, differentiation between Common and Thick-billed Murres was not possible. External plumage characters were used to age ducks and gulls, but in murres and Dovekies, which made up the bulk of the sample, age was assessed by examining the supraorbital ridge, and birds were classed as juveniles, second year, or adults (Gaston 1984, Nevins & Carter 2003, Soldaat 2006). For murres, assessment of age was further validated by examining wing feather characters [specifically, colour and wear of greater secondary coverts (Camphuysen 1995)]. Sex was determined by internal examination of the gonads where possible, and gonadal development was also used to validate the age assigned to the bird. The aging of juvenile and adult birds, especially when intact, is likely to be very accurate; assignment of the second-year class was more subjective, and some error in assignment may have occurred.

Morphometrics were taken on all intact specimens. The measurements taken were specific to each species group, but in general, all intact carcasses were weighed (to the nearest gram) and were measured at wing chord (to the nearest millimetre), culmen midline, head–bill length, total tarsus and tarsus bone (to the nearest tenth of a millimetre). Only tarsus bone was analysed. For auks and gulls, gonys depth was also measured, and for Common Eiders *Somateria mollissima,* additional measurements of the bill used in subspecific identification were recorded (Mendall 1986).

Carcasses were assessed on their level of oiling, which included six ordinal categories:

- slight oiling (<25% and no penetration to the skin surface)
- <25%
- 25%–50%

TABLE 1
Species, sex, and age composition of oiled marine birds found in southeastern Newfoundland, 28 November – 4 December 2004

	Juvenile			Second-year			Adult			Unknown			Total [n (%)]
	M	F	U	M	F	U	M	F	U	M	F	U	
Thick-billed Murre	14	19	3	5	10	1	72	69	60	2		20	275 (67.2)
Dovekie	14	7	1	5	4	2	28	18	5			12	96 (23.5)
Common Murre	8	1	1				4	1	1			1	17 (4.2)
Unspecified murre									2	1		10	13 (3.2)
Atlantic Puffin											2	1	3 (0.7)
Common Eider		1		1			1						3 (0.7)
Black Guillemot									1				1 (0.2)
Great Black-backed Gull				1									1 (0.2)

[a]M = male; F = female; U = unknown.

- 50%–75%
- 75%–100%
- 100% of the body covered in oil

Degree of scavenging was also assessed on an ordinal scale as intact (0), punctured (1), breast taken out (2), head and skeleton remaining, most soft tissue removed (3), or only single body parts (usually wings or a head) remaining (4).

We used log-likelihood ratio tests to compare proportions and the Mantel–Haenszel χ^2 to assess whether linear trends were present when comparing two ordinal variables. We used analysis of variance to compare measurements across age and sex classes. We used a critical value of 0.05 and two-tailed tests throughout.

RESULTS

Species, sex and age

In total, 409 oiled marine birds were collected from 28 November to 4 December 2004 along 65 km of coast on 12 beaches in southeastern Newfoundland and Labrador. Most of the birds were found on two beaches, Point Lance and Branch. All but four of the birds found were auks, and most were murres and Dovekies (98%). Thick-billed Murres constituted a preponderance of the sample (67%), with Dovekies (23%) the next most common (Table 1). The three Common Eiders found were of the northern (*S. m. borealis*) type.

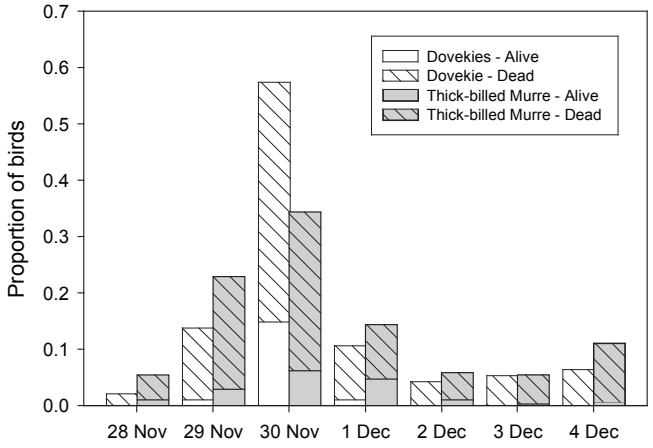

Fig. 2. Date recovered and status of oiled Thick-billed Murres and Dovekies found in southeastern Newfoundland and Labrador, 28 November–4 December 2004.

Of the Thick-billed Murres that could be aged (n = 189), 80% were adults, 6% were in their second winter and 14% were juveniles. We found an 11-year-old Thick-billed Murre, banded as a chick in the Canadian High Arctic (Coburg Island) in 1993. Among the Dovekies (n = 84), 61% were adults, 13% were in their second year and 26% were juveniles; these age ratios were different between the two species ($G = 11.1$, $df = 2$, $P = 0.004$). Of the small number of Common Murres that could be aged (n = 16), 10 (62%) were juveniles and only six were adults (38%).

The sex ratio for Thick-billed Murres was not detectably different from unity (48.7% male, n = 191, $G = 0.13$, $P = 0.72$), and not different across age classes ($G = 2.26$, $df = 2$, $P = 0.32$). However, Dovekies showed weak evidence of a male bias (60.5% male, n = 76, $G = 3.39$, $P = 0.065$) that was not detectably different across age classes ($G = 1.29$, $df = 2$, $P = 0.53$). Of 14 Common Murres, the 12 that were sexed were males (86%).

Alive or dead, degree of oiling and scavenging

Of the entire sample, where recorded (n = 407), 83.3% of birds were found dead. This proportion was similar for Thick-billed Murres (82.4%, n = 274) and Dovekies (83.2%, n = 95). The highest daily proportion of live birds was found four and three days, respectively, after the first Thick-billed Murres and Dovekies were reported (Fig. 2).

Most Thick-billed Murres (58%, n = 206) were found with less than 50% of the body coated with oil; in Dovekies (n = 81), 69% of specimens had more than 50% of the body coated with oil (Fig. 3). Overall, the degree of oiling was heavier on Dovekies than on murres ($G = 34.8$, $df = 5$, $P = 0.0001$). We observed no trend in the degree of oiling over time for Thick-billed Murres (Mantel–Haenszel $\chi^2 = 1.09$, $df = 1$, $P = 0.30$) or Dovekies (Mantel–Haenszel $\chi^2 = 0.91$, $df = 1$, $P = 0.34$). Not surprisingly, the degree of oiling was lighter

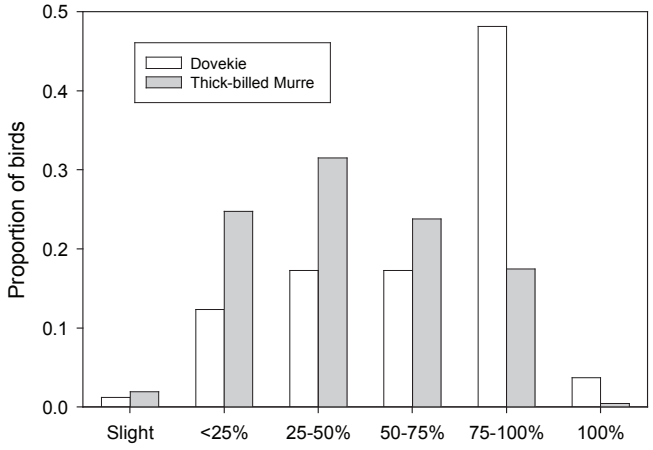

Fig. 3. Degree of oiling of Thick-billed Murres and Dovekies found in southeastern Newfoundland and Labrador, 28 November–4 December 2004.

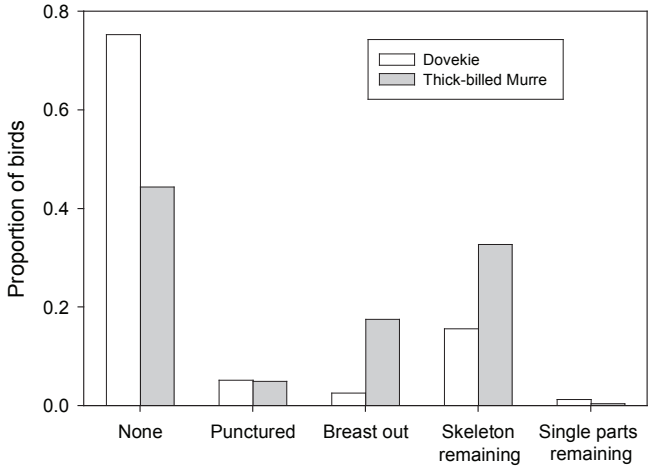

Fig. 4. Degree of scavenging of oiled Thick-billed Murres and Dovekies found in southeastern Newfoundland and Labrador, 28 November–4 December 2004.

on birds found alive than on those found dead (Thick-billed Murre: Mantel–Haenszel $\chi^2 = 31.6$, $df = 1$, $P = 0.0001$; Dovekie: Mantel–Haenszel $\chi^2 = 17.0$, $df = 1$, $P = 0.0001$).

Fewer Dovekies than Thick-billed Murres found dead were scavenged (25%, n = 77 vs. 56%, n = 223; $G = 23.2$, $df = 1$, $P = 0.0001$; Fig. 4). The degree of scavenging increased over time for Thick-billed Murres (Mantel–Haenszel $\chi^2 = 9.6$, $df = 1$, $P = 0.002$), but did not detectably change for Dovekies (Mantel–Haenszel $\chi^2 = 0.09$, $df = 1$, $P = 0.76$).

Body mass and morphometrics

No differences in body mass were found across the sexes and age classes of Thick-billed Murres ($F_{5,140} = 0.92$, $P = 0.47$) or Dovekies ($F_{5,63} = 1.52$, $P = 0.20$; Table 2). However, because oil was not removed before weighing, body mass measurements were influenced by the amount of oil on the carcasses. Indeed, body mass increased linearly with degree of oiling in both Thick-billed Murres ($F_{1,144} = 8.56$, $P = 0.004$) and Dovekies ($F_{1,70} = 18.2$, $P = 0.001$).

In Thick-billed Murres, we observed significant interaction between sex and age in head length ($F_{2,133} = 3.22$, $P = 0.043$), but for the rest of the measurements, analyses based only on main effects are presented. Differences in wing length were noted across age classes ($F_{2,139} = 5.64$, $P = 0.004$), but not between sexes ($F_{1,139} = 1.66$, $P = 0.85$). For culmen length, we observed differences between sexes ($F_{1, 139} = 5.89$, $P = 0.017$), but not across age classes ($F_{2,139} = 2.71$, $P = 0.07$). For nostril and bill depth, differences between sexes (nostril: $F_{1,139} = 4.63$, $P = 0.033$; bill depth: $F_{1,138} = 4.76$, $P = 0.031$) and across ages were noted (nostril: $F_{2,139} = 8.37$, $P = 0.001$; bill depth: $F_{1,138} = 24.1$, $P = 0.001$). No detectable differences in tarsus length were seen between sexes ($F_{1,139} = 0.01$, $P = 0.95$) or across age classes ($F_{2,139} = 1.04$, $P = 0.36$).

TABLE 2
Body mass and morphometrics of oiled Thick-billed Murres and Dovekies found in southeastern Newfoundland, 28 November – 4 December 2004[a]

		Mass (g)	Wing (mm)	Culmen (0.1 mm)	Nostril (0.1 mm)	Bill depth (0.1 mm)	Head length (0.1 mm)	Tarsus (0.1 mm)
Thick-billed Murres								
Females								
	Juvenile (n=17)	755±73	216±5	34.7±2.3	26.4±2.0	11.1±0.9	99.0±2.8 (n=15)	37.1±2.0
	Second-year (n=8)	722±126	216±7	35.1±1.1	26.9±1.2	11.5±1.0	97.3±2.3	37.6±3.8 (n=7)
	Adult (n=54)	722±102	219±4 (n=52)	35.6±2.0 (n=53)	27.5±1.4 (n=53)	12.3±0.5 (n=53)	98.8±3.0 (n=53)	36.2±2.1 (n=53)
Males								
	Juvenile (n=12)	770±76	213±5	35.3±1.9	26.4±2.1	11.6±1.7 (n=11)	98.8±3.1 (n=10)	37.4±3.8
	Second-year (n=5)	764±73	220±1	37.1±1.8	28.8±1.0	11.9±0.2	102.0±1.4	36.5±0.4
	Adult (n=50)	747±84	218±7 (n=51)	36.4±2.1	27.5±1.4	12.6±0.5	100.5±2.4 (n=48)	36.9±2.4 (n=51)
Dovekies								
Females								
	Juvenile (n=7)	155±15	119±3	14.5±0.4	10.2±0.5	6.4±0.4 (n=6)	52.0±0.9	20.4±1.8
	Second-year (n=5)	178±64	120±3 (n=4)	14.9±1.0	10.2±0.8	6.2±0.8	52.3±1.6	23.3±2.1 (n=4)
	Adult (n=17)	162±21	123±3	15.0±1.0	10.6±0.5	6.6±0.7	52.1±1.3	21.2±2.8
Males								
	Juvenile (n=12)	149±21	118±2	15.1±0.7	10.5±0.8	6.1±0.7	53.2±1.0 (n=11)	20.9±1.9
	Second-year (n=4)	145±18	119±2	15.0±0.2	10.5±0.6	6.5±0.4	53.3±0.8	22.6±2.8
	Adult (n=24)	165±20	121±4	15.5±0.8 (n=23)	11.0±0.6 (n=23)	7.1±0.5 (n=23)	53.1±1.4 (n=23)	21.8±2.4

[a] Data are presented as mean ± 1 standard deviation. Sample sizes that differ from the main sample are noted in cases where certain measurements could not be taken on all birds.

In Dovekies, we observed no significant interactions between sex and age, and therefore main effects are presented for all measurements. We found differences in wing length across age classes ($F_{2,62} = 9.43$, $P = 0.001$), but not between sexes ($F_{1,62} = 1.30$, $P = 0.94$). No detectable differences were noted in nostril and bill depth between sexes (nostril: $F_{1,62} = 2.44$, $P = 0.12$; bill depth: $F_{1,61} = 0.86$, $P = 0.36$), but differences across ages were seen (nostril: $F_{2,62} = 4.01$, $P = 0.023$; bill depth: $F_{1,61} = 6.47$, $P = 0.003$). For head length, we observed differences between the sexes ($F_{1,61} = 7.98$, $P = 0.006$), but not across age classes ($F_{2,61} = 0.06$, $P = 0.95$). We observed no detectable differences in culmen or tarsus between the sexes (culmen: $F_{1,62} = 2.44$, $P = 0.12$; tarsus: $F_{1,62} = 0.03$, $P = 0.85$) or across age classes (culmen: $F_{2,62} = 2.32$, $P = 0.11$; tarsus: $F_{2,62} = 2.57$, $P = 0.08$).

DISCUSSION

The species composition of oiled seabirds collected during this incident was similar to that of carcasses collected in the same area in the winters of 1984–1999, with murres being the most common, followed by Dovekies and low numbers of gulls, sea ducks and other auks (Wiese & Ryan 2003). Birds killed in this particular incident likely reflected the species, age and sex composition of birds being chronically oiled along this shore.

Age ratios indicated a predominance of older age classes in both murres and Dovekies. Because of high adult survival rates, seabird populations are expected to consist mostly of adult birds. Based on population modeling, Wiese *et al.* (2004) calculated that 81% of Thick-billed Murres should be adults, a figure that closely matches the value of 80% in this incident. Wiese *et al.* (2004) assumed that mortality from oil pollution affects all age classes equally, and although our results are based on only one incident, they support that assumption. Oil pollution has the potential to affect populations more heavily than hunting does, because hunting mortality is largely focused on the younger age classes (Elliot 1991). The age structure of the recovered Dovekies was also weighted toward adults (61%), but not to the same degree as murres. The difference may be attributable to younger birds being more vulnerable to oil pollution (either generally or in this particular incident), or it may be an indication that Dovekie populations have an age structure that is different from that of murre populations. A lower adult survival rate, which would be expected in the smaller Dovekie, would explain the lower proportion of adults in the oiled sample. Unfortunately, the survival rate of Dovekies has not been measured (Montevecchi & Stenhouse 2002).

The sex ratio of the Thick-billed Murres collected was 1:1, and this ratio was consistent across age classes, further suggesting that this incident killed a representative sample of the population at large. The Dovekies showed some evidence of a male bias, but a larger sample would be required to make inferences.

The species, sex and age composition of oiled seabird carcasses has the potential to provide meaningful information on the population segments affected in a spill event (Heubeck *et al.* 2003, Nevins & Carter 2003, Camphuysen & Leopold 2004). The incident documented here appears to have primarily affected the offshore species wintering on the Grand Banks. The scarcity of sea ducks and other coastal birds in the sample suggests that the oiling itself occurred offshore. Had the incident occurred at a different time or closer to shore, other seabird population segments would have been at risk.

Although most beaches were searched daily, most birds were found dead. The peak of birds arriving alive occurred three to four days after the first carcasses were seen. No live Dovekies were found after the fourth day, while live Thick-billed Murres were found until day seven. Body masses of the Thick-billed Murres, despite being measured while the birds were still coated with oil to varying degrees, were considerably lower than those of unoiled birds (unoiled birds: first year, 827 g; adults, 952 g; Gaston *et al.* 1983). Again, these results indicate that oiling occurred offshore and, furthermore, that a number of days elapsed between the birds being oiled and arriving onshore. Oka & Okuyama (2000) estimated that, at 620 g, Rhinoceros Auklets (*Cerorhinca monocerata*) could survive one to two days after oiling. Based on this information, murres, which are larger, may be able to survive another day or two, but Dovekies, because of their much smaller size, probably succumb soon after they are oiled. Many Dovekies were found heavily oiled, indicating that once oiled, they may have had difficulty leaving the slick area. Body masses of Dovekies were confounded because of oil on their plumages. Data on wintering Dovekies are not available, but lightly oiled Dovekies in our sample (146 g, n = 10) were only slightly lighter than breeding birds (147–175 g; Montevecchi & Stenhouse 2002). One interpretation is that Dovekies do not deplete their body reserves, as the murres do, but are killed quickly by poisoning or drowning. Further work on this matter is clearly warranted, because it has implications for rehabilitation efforts for this species.

Most birds were found before they were scavenged, especially Dovekies. Because most scavengers could take away or consume a whole Dovekie, it may be expected that they are found scavenged only rarely. Additionally, scavenged Dovekies may be especially difficult to find, because they are small and are quickly buried on beaches. Further, because Dovekies tended to be found heavily oiled, they may not have been appealing to scavengers. The higher level of scavenging seen in murres may have arisen because most scavengers consumed murres where they were found. In Newfoundland and Labrador, only 0.79–0.88 of seabird carcasses are detected on any given beach survey (Wiese & Robertson 2004), which would give scavengers an extra day to find and scavenge carcasses that were missed.

In Thick-billed Murres and Dovekies, males and adults were larger than females and juveniles in some, but not all, measurements, and fewer differences were noted in Dovekies. Others have noted similar patterns for these species (Gaston *et al.* 1983, 1984; Gaston & Jones 1998; Montevecchi & Stenhouse 2002; Gaston & Hipfner 2000). In terms of geographic variation, Thick-billed Murres breeding in the Northwest Atlantic (eastern Canadian Arctic and Greenland) tend to be smaller than those from the Northeastern Atlantic (Svalbard and northern Russia) (Gaston & Jones 1998). Measurements from birds collected in this incident were generally small and consistent with Northwest Atlantic breeding populations. That finding coupled with the recovery of a band from Coburg Island and the known migration routes of these species, suggests that the birds killed in this incident, and by extension, most of the birds oiled in Newfoundland and Labrador waters, are from populations that breed in the Northwest Atlantic. There are two subspecies of Dovekies: the smaller *Alle a. alle* which breeds from Greenland east to Svalbard, and the larger *Alle a. polaris,* which breeds on the northern islands of western Russia (Stempniewicz *et al.* 1996). Within *Alle a. alle,* birds breeding in Greenland may be smaller than birds in Norway (Roby *et al.* 1981, Stempniewicz *et al.* 1996, Montevecchi & Stenhouse

2002). Based on the wing lengths of Dovekies found in this study, the birds were more likely to be Greenlandic breeding birds, although differences were slight (Greenland wing: 122–123 mm; Norwegian wing: 125 mm; present study: 121–123 mm; Roby *et al.* 1981, Stempniewicz *et al.* 1996).

We support the recommendation by Heubeck *et al.* (2003) to spend the time and effort to perform detailed analyses of corpses found after an oiling incident. Valuable information on the impact of the event can be collected. We were able to test a previously untested assumption that oiling events in Newfoundland and Labrador indiscriminately affect all age classes. The composition of the kill also provided an indication of the location and possibly the timing of the kill, because mostly pelagic species were affected and, at least among the murres, birds came ashore highly emaciated. For Thick-billed Murres and Dovekies of known age and sex, we also obtained morphometric data that can be used for reference in future incidents. Although such an effort adds an extra level of complexity to any oil spill response, examination of oiled seabird carcasses collected during oiling events in Newfoundland and Labrador should become a standard operating procedure when feasible.

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