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Observations on "turr" hunting in Newfoundland: age, body condition, and diet of Thick-billed Murres (*Uria lomvia*), and proportions of other seabirds, killed off Newfoundland in winter

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Introduction

The waters off Newfoundland are known to be the principal wintering area of Thick-billed Murres (*Uria lomvia*) in the Western Atlantic (Tuck 1961, Gaston 1980). Hunting is legal during September to March inclusive, and between 250 000 and 500 000 murres, including some Common Murres (*U. aalge*)—both are referred to as "turrs" in Newfoundland—are believed to be shot annually (J.S. Wendt and F.G. Cooch unpubl.).

Hunting is carried out from small boats, usually 5–6 m skiffs powered by 15–50 hp outboard motors. Most takes place within 5 to 10 km of the shore. Typically, two people hunt together, one steering while the other shoots. Hunting can be carried out only when the sea is fairly calm and not covered with pack ice. In most winters, suitable conditions occur on only about 10% of the days. In addition, the appearance of large numbers of murres in a particular area is erratic, according to many hunters. Sometimes they appear suddenly inshore, but are absent on other occasions at the same time of year. Consequently, hunting is very much determined by opportunity and, when birds are numerous, hunters tend to shoot as many as possible in case they do not get another chance that winter.

In this paper, we summarize the results of preliminary surveys carried out in Newfoundland to determine the methods used in murre-hunting and the characteristics of the hunted population. We had hoped to examine the species and age composition of the kill and collect data on the birds' ecology in winter, including overall body condition. In the event, using only a small number of samples taken when the opportunity presented itself, we were unable to make firm generalizations about the hunted population as a whole. However, the information that we obtained shows how much the shot samples vary between different months and localities, which should prove useful in planning more extensive future research.

Methods

To estimate the number of birds being shot and retrieved per boat, and their species composition, we waited at the dockside in several small harbours (Fig. 1) and recorded species and numbers as boats arrived back from the hunt. A few birds other than murres may have been concealed, but normally hunters toss the birds into the bottom of the boat or hang them by their necks from the thwarts, where they are clearly visible. Our presence in the area was unexpected and, in any case, those hunters who did have illegal birds apparently made no attempt to conceal them.

To examine the diet of murres wintering in Newfoundland coastal waters, we analysed the contents of the digestive tracts from three samples of birds collected. We also recorded their condition in terms of body weight, weight of pectoral muscles, and amount of visible fat present. We extracted lipids from some birds to ascertain the relationship between our estimates of visible fat and actual lipid content.

Most of the birds examined were shot by us, with the help of Todd and Terry Woodman and Wayne Waterman, all experienced murre hunters, who took us out in the same style and in the same boat that they would have used if they had been engaged in a normal hunt. Consequently, we believe that our samples were similar to those shot by ordinary hunters. We also obtained some murre heads from other hunters, which enabled us to determine the proportion of 1st-year birds. We examined the following samples:
(1) 246 murres shot on 19–20 February 1981 in Trinity Bay, of which 22 were examined for food remains;
(2) 277 murres from 340 seabirds shot in the Twillingate area of NE Newfoundland on 11–12 November 1981, with 22 examined for food remains;
(3) 160 murres shot in Trinity Bay on 3 February 1983, with 32 examined for food remains;
(4) additional heads without bodies from Trinity Bay in February 1981 (18) and December 1982 (36), and from Twillingate in November 1981 (6).

We classified most murres as either 1st-year or older age on the basis of the presence (older) or absence (1st-year) of ossified supra-orbital ridges or the degree of flexibility of the mandibles (Gaston in prep.).

For those dissected, we determined sexes by inspecting the gonads. Condition was assigned a score of 1 to 4 on the basis of visible fat according to the following criteria:
(1) no visible fat;
(2) light subcutaneous fat, bases of feathers still visible;
(3) moderate subcutaneous fat, covering the bases of the feathers;
(4) heavy subcutaneous fat and additional deposits on mesenteries and in the abdominal cavity.

For all birds dissected, we made linear measurements of wing length and of four bill dimensions—culmen, depth at gonys, length of white line (*U. lomvia* only), and length from distal edge of nostril to tip. The pectoral muscles were removed and weighed.

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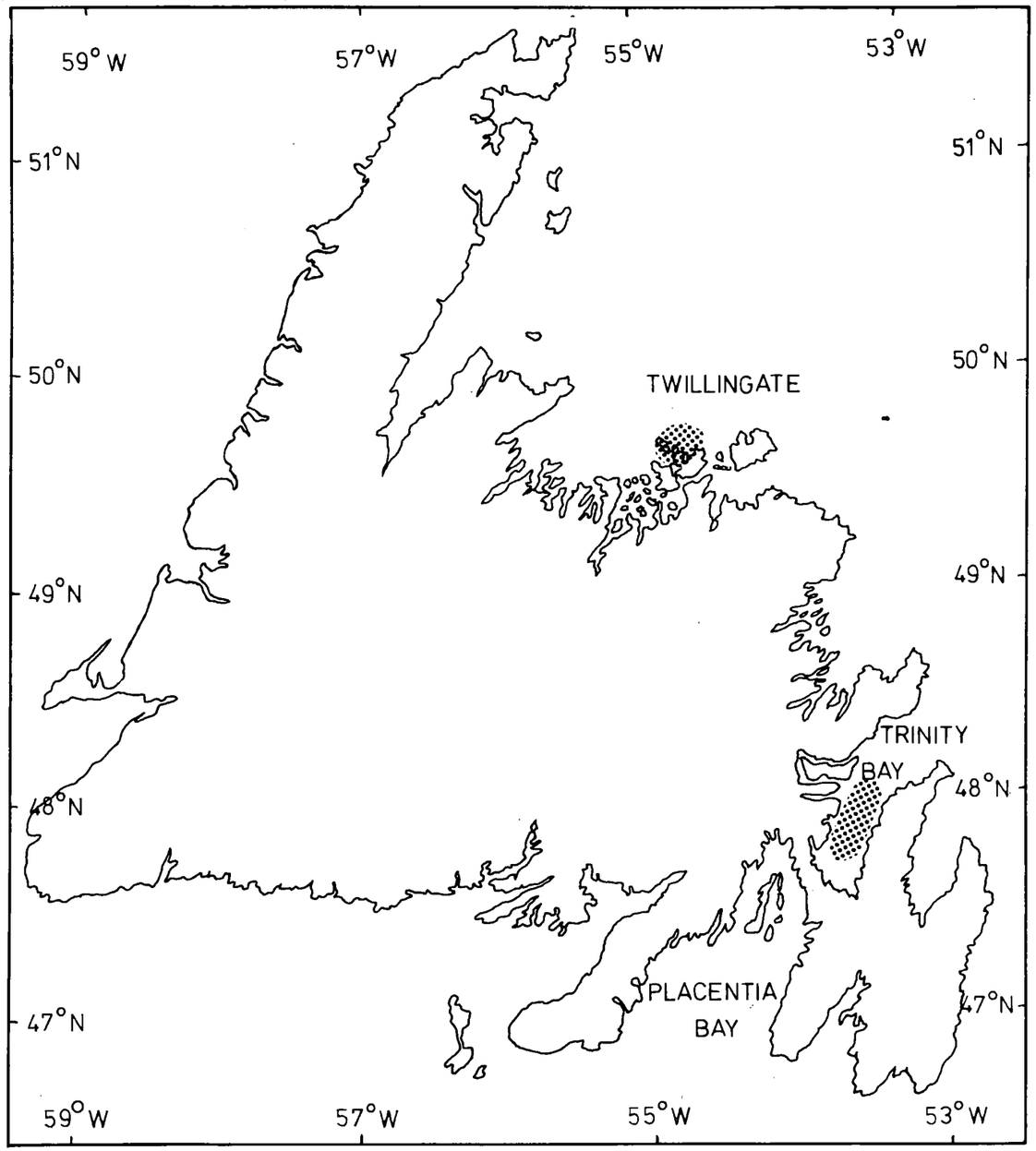
Figure 1
Localities in Newfoundland where birds were collected



We estimated the total lipid content of 20 Thick-billed Murres, using freeze-dried, powdered homogenate extracted with hexane. The sample included five oiled birds collected at Cape Race in February 1981, all of which had fat scores of 1. Those were the only birds assigned to that category. The remainder of those processed came from the February 1981 Trinity Bay sample.

We removed the proventriculus and stomach from the birds used for diet analysis and washed the contents out with 70% alcohol. We then separated the identifiable remains and counted them. Counts of fragmentary parts were used to establish the minimum number of individuals present: hence a stomach containing three heads and seven telsons of a particular species was assumed to represent seven individuals. Otoliths were paired by size, with each pair representing one fish, except where they differed in length by more than 5% of the smaller one, in which case we assumed that they represented different fish.

Results

Numbers shot per hunter

We obtained counts or estimates for the contents of 41 boats arriving back at the dock after a morning's hunt. They contained a total of 80 hunters bringing in 729 birds, or about nine birds each per trip (Table 1). The variations among and within days were very high. At Trinity Bay in 1981, success clearly declined from 18 to 20 February, perhaps because most of the birds present in the bay had been shot by the end of the period.

The boats inspected at Twillingate on 11–12 November 1981 were out on days universally acknowledged to be very poor for hunting. The numbers of birds brought in were probably about the minimum that most hunters would consider a worthwhile return for their efforts and costs. Most people interviewed claimed that on a good day 100 birds per boat was not unusual. However, even on poor days a few boats managed to get substantial numbers, probably reflecting a patchy distribution of the birds at sea.

Species composition of birds shot

No species other than murres were brought in at Trinity Bay despite the presence, from our own observations, of Dovekies (*Alle alle*), Black Guillemots (*Cepphus grylle*), and Black-legged Kittiwakes (*Rissa tridactyla*) in the same area. At Twillingate, 24 Dovekies and 23 Black-legged Kittiwakes were shot, as well as 11 Atlantic Puffins (*Fratercula arctica*), 4 Razorbills (*Alca torda*), and an Oldsquaw (*Clangula hyemalis*). Eleven out of 25 boats brought in species other than murres. Some of those, particularly Razorbills and Puffins, may have been shot in genuine error, but this could not have applied to the Black-legged Kittiwakes brought in by three boats, nor to the Dovekies in seven boats. The high proportion of illegally taken birds shot at Twillingate may reflect low numbers of murres present on that date.

The majority (79–100%) of murres shot on all days were Thick-billed Murres (Table 2). Their proportion was lower at Twillingate in November than in any of the Trinity Bay samples, all taken later in the year. That may reflect a southward movement of Common Murres in midwinter, or an arrival of Thick-billed Murres from further north.

Age composition

We have estimated the proportion of 1st-year to older birds for Thick-billed Murres (Table 3). In the November sample from Twillingate and the December sample from Trinity Bay, 1st-year birds predominated, whereas adults predominated in both of the February samples. That may reflect either a lower mortality of young birds during the early part of the hunting season, or a progressive change in the age composition of the population owing to the late arrival of adult birds from more northern waters. Possibly both effects were involved.

Diet

The 1981 sample from Trinity Bay, all Thick-billed Murres, included only eight birds with identifiable remains in their digestive tracts, other than parasitic nematodes. Three birds contained fish, including two with capelin (*Mallotus villosus*) otoliths. None of the crustacean material, found in seven birds, could be identified to the level of family.

In 1983, 30 Thick-billed Murres from Trinity Bay contained food remains, of which 77% included cod (*Gadus* sp.) otoliths, 67% Euphausiid crustacea (mainly *Thysannoëssa raschii*), and 53% amphipod crustacea (practically all *Parathemisto gaudichaudi*) (Table 4). Only two contained capelin otoliths.

Of 22 stomachs examined from birds collected near Twillingate in November 1981, 19 contained identifiable remains, including beaks and flesh of squid, which was by far the most numerous organism represented (Table 5). Twelve stomachs contained fish remains, of which the most common genus was *Gadus*, but only three stomachs contained crustacean fragments.

From such small samples, with so much regional variation, we find it hard to generalize about the winter diet of Thick-billed Murres off Newfoundland, but it is clear that Tuck's (1961) contention that murres depend mainly on capelin in winter is no longer true. From the evidence of our samples, young cod, squid, and Euphausiid and Hyperiid crustacea appear to be the most important prey organisms.

We examined only five Common Murres, three from Twillingate in November and two from Trinity Bay in February. All three Twillingate birds contained cod otoliths and squid remains, but nothing identifiable was found in the birds from Trinity Bay.

Weight and body condition

A good relationship was found between lipid content and visual fat score, ranging from 4% of dry weight for class 1 birds to 35% for class 4 (Fig. 2). With the

Table 1
Numbers of birds brought in per boat, excluding authors' boat

Sample	No. boats	No. birds/boat	$\bar{x}$	sd
Trinity Bay				
18 Feb. 1981	3	26, 40, 50	38.7	12.1
19 Feb. 1981	6	13, 15, 16, 16, 36, 44	23.2	13.2
20 Feb. 1981	5	3, 4, 7, 8, 25	9.4	9.6
16 Feb. 1983	2	50, 65	57.5	10.6
Twillingate				
11 Nov. 1981	4	1, 4, 9, 17	7.7	7.0
12 Nov. 1981	21	3, 3, 4, 5, 5, 6, 8, 9, 10, 11, 12, 15, 15, 16, 17, 18, 20, 23, 26, 27, 31	13.5	8.4
Total	41		17.9	14.9

Table 2
Species composition of shot samples examined. Percentages relate to total murres

	U. lomvia		*U. aalge*			
Sample	No.	%	No.	%	Other	Total
Trinity Bay						
Feb. 1981	231	94	15	6	0	236
Dec. 1982	32	89	4	11	0	36
Feb. 1983	45	100	0	0	0	45
Twillingate						
Nov. 1981	220	79	57	21	63	340
Total	528	87	76	13	63	667

Table 3
Proportion of 1st-year and older Thick-billed Murres in samples examined

	1st-year		Older			
Sample	%	No.	%	No.	Indeterminate	*n*
Trinity Bay						
Feb. 1981	30	38	70	89	5	132
Dec. 1982	84	27	16	5	0	32
Feb. 1983	0	0	100	45	0	45
Twillingate						
Nov. 1981	77	144	23	44	32*	220
Total	53	209	47	183	37	429

* Ageing performed by the criterion of bill flexibility only.

Table 4
Contents of stomach and proventriculus of 32 Thick-billed Murres collected in Trinity Bay, February 1983 (two stomachs were empty)

Taxon	No. stomachs	Total	$\bar{x}$ per stomach with food	$\bar{x}$ per stomach with taxon*
Gadus spp.	23	193	6.43	8.39
Boreogadus spp.	2	6	0.20	3.33
Mallotus villosus	2	2	0.07	1.00
Other	7	12	0.40	1.71
All fish	24	213	7.10	8.87
Euphausiidae	20	99	3.30	4.95
Hyperiidae	16	73	2.43	4.56
Harpactacoid copepoda	4	6	0.20	1.50
Isopoda	5	7	0.23	1.40
Decapoda	4	4	0.20	1.00
All crustacea	22	189	6.30	8.59
Squid	5	9	0.30	1.80
Polychaeta	1	1	0.03	1.00
All organisms	30	412	13.73	13.73

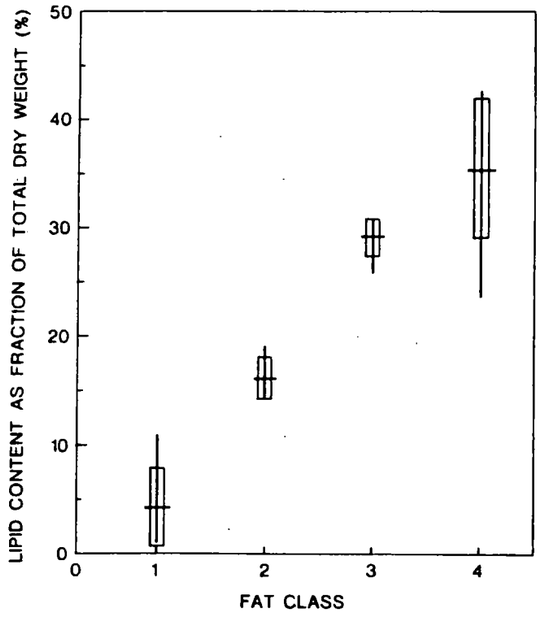
* Including only stomachs containing the taxon concerned.

Table 5
Contents of stomach and proventriculus of 22 Thick-billed Murres collected near Twillingate in November 1981 (six stomachs were empty)

Taxon	No. stomachs	Total	$\bar{x}$ per stomach with food	$\bar{x}$ per stomach with taxon*
Gadus spp.	9	19	1.19	2.11
Mallotus villosus	2	3	0.16	1.50
Ammodytes spp.	3	3	0.16	1.00
Other fish (unidentified)	5	9	0.56	1.80
All fish	12	34	2.12	2.83
Parathemisto spp.	3	10	0.53	3.33
Other crustacea (unidentified)	1	2	0.11	2.00
Squid	16	436	27.25	27.25
All organisms	16	482	30.12	30.12

* Including only stomachs containing the taxon concerned.

Figure 2
Comparison of visual fat classes with total lipid content determined by extraction



(exceptionally emaciated) oiled birds from the lipid-extracted sample omitted, total body weight showed significant positive correlations with all linear measurements and with pectoral muscle weights, but the correlation with the proportion of lipids, although positive, was not significant ($p > 0.1$). A stepwise multiple regression analysis, including all linear measurements, pectoral weight, and proportion of lipids, showed that the weight of the pectoral muscles alone explained 81% of the variation in body weight; lipid content contributed a further 7%, and the inner toe, culmen, and wing lengths a further 8% (Table 6).

To examine further the relationship of pectoral muscle weight, fat content, and linear measurements to weight, we combined data from all birds obtained in Trinity Bay in February and believed to be more than 1 year old. For this sample, the correlations between linear measurements and weight were rather poor, only wing length being significant ($p > 0.05$). A stepwise multiple regression analysis showed that 42% of variation in body weight was explained by the weight of the pectoral muscles, and a further 21% by wing length and fat score (Table 7). This suggests that most of the linear correlations for the lipid-extracted sample resulted from the presence of 1st-year birds that were lighter and smaller in all measurements than older birds. The mean pectoral muscle weights for that sample were 13% greater than those of 1st-year birds collected at the same time. The mean difference in total body weight was 15% (Table 8).

Fat scores for the sample shot at Trinity Bay in 1981 were slightly, though not significantly, lower than for the other two samples examined, but class 4 birds predominated in all three samples (Table 9). We found no significant difference between 1st-year and older birds in the fat scores assigned.

Conclusions

(1) Daily bags of murres fluctuated widely even among boats operating from the same base on the same day.

(2) Marine birds other than murres made up 18.5% of the birds shot around Twillingate, but none were taken in Trinity Bay.

(3) Common Murres constituted 21% of the murres shot at Twillingate, but only 0-11% of those shot in Trinity Bay.

(4) The proportion of 1st-year birds among Thick-billed Murres shot by hunters varied from 0 to 84%. The proportion probably declines between November and February.

(5) The diet of Thick-billed Murres in inshore waters in winter includes several species of fish and

Table 6
Results of stepwise linear multiple regression analysis for body weight in relation to weight of pectoral muscles, lipid content, and linear measurements of wing, bill, and feet (n = 12; three birds had missing measurements)

Variable*	Simple correl. coeff.	Multi. correl. coeff.	Cumul. proport. of var. explained	F val.
Pectoral wt.	0.898	0.898	0.806	24.46
Lipid content	0.435	0.936	0.877	9.02
Inner toe lgth.	0.807	0.966	0.933	7.56

* Additional variables did not add significantly to the amount of variation explained ($p > 0.05$).

Table 7
Results of stepwise linear multiple regression analysis for body weight in relation to weight of pectoral muscles, fat score, and linear measurements of wing, bill, and feet (n = 39)

Variable*	Simple correl. coeff.	Multi. correl. coeff.	Cumul. proport. of var. explained	F val.
Pectoral wt.	0.649	0.649	0.422	9.60
Wing lgth.	0.611	0.737	0.544	18.58
Fat score	0.205	0.798	0.636	8.91

* Additional variables did not add significantly to the amount of variation explained ($p > 0.05$).

Table 8
Comparisons of mean body weights, pectoral muscle weights, lipid content, and linear measurements for 52 Thick-billed Murres collected in Trinity Bay in February (some measurements missing for a few specimens owing to damage)

Variable	1st-years $\bar{x}$	1st-years sd	1st-years n	Older birds $\bar{x}$	Older birds sd	Older birds n	t
Body weight (g)	827.00	44.88	6	952.32	70.53	44	5.92*
Wing length (mm)	204.50	5.61	6	216.16	5.56	44	4.78*
Culmen (mm)	31.50	3.42	8	34.18	1.84	43	2.16†
Depth (mm)	11.11	0.89	7	13.03	0.54	42	5.51*
Nostril (mm)	25.62	2.93	8	28.70	1.06	43	2.93*
Pectoral muscles (g)	183.26	19.57	7	207.62	16.32	42	3.12*
Lipid content (% dry wt.)	24.53	10.51	6	32.84	5.67	9	1.84

* $p < 0.01$.
† $p < 0.05$.

a variety of marine invertebrates, of which cod, Euphausiid and Hyperiid crustacea, and squid appear to be the most important. The importance of different prey organisms probably varies widely from place to place and/or from year to year.

(6) Most birds shot in winter are carrying heavy subcutaneous fat, presumably indicating little energy stress. Although 1st-year birds are smaller than older birds in all weights and measurements, they do not differ significantly in the proportion of lipids present in body tissues, which suggests that their general body condition is similar to that of older birds.

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Table 9
Fat-scores of Thick-billed Murres examined from Newfoundland

Sample	Fat-score 1	2	3	4
Trinity Bay				
Feb. 1981	—	3	5	12
Feb. 1983	—	1	6	25
Twillingate				
Nov. 1981	—	—	2	17
Total	—	4	13	54