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Diet of two coastal nototheniid fish from Terra Nova Bay, Ross Sea

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Abstract: An investigation into the feeding habits of two demersal nototheniids, *Trematomus bernacchii* and *T. centronotus*, showed that the most important prey were polychaetes, molluscs and euphausiids for *T. bernacchii* and polychaetes and amphipods for *T. centronotus*. Epifaunal (e.g. *Barrukia cristata*) and tube-dwelling polychaetes (*Amphicteis* cfr. *midas* and *Amythas membranifera*) were common in the diet of both species. Bivalvia including *Adamussium colbecki* were found in the diet of *T. bernacchii*. Epifaunal gastropods (Trochidae) were an occasional prey for *T. centronotus*. Amphipods (mainly Acanthonotozomatidae) and the euphausiid *Euphausia frigida* were the main crustacean food of *T. centronotus* and *T. bernacchii* respectively. Our data suggest a difference in the feeding behaviour of the two nototheniid species, although both appear capable of feeding on common epibenthic invertebrates.

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Key words: Antarctic, fish, feeding behaviour, diet

Introduction

Trematomus centronotus Regan, 1914 (recently synonymized by Balushkin & Tarakanov (1987) with *T. pennellii*) and *Trematomus bernacchii* Boulenger, 1902 have a circumantarctic distribution, living down to 700 m depth, although *T. bernacchii* is most common in the upper 200 m (DeWitt 1971, DeWitt *et al.* 1990). *T. centronotus* has recently been found in several localities along the Antarctic Peninsula (DeWitt *et al.* 1990).

Feeding habits of these fishes have been studied at the Antarctic Peninsula (Daniels 1982), the Weddell Sea (Schwarzbach 1988), the Cosmonaut Sea (Gosse 1961, Rakusa-Suszczewski & Piasek 1973, Naito & Iwami 1982, Pakhomov & Tseitlin 1991), the Adélie Coast (Arnaud & Hureau 1966, Hureau 1970) and the Ross Sea (Eastman 1985, Eastman & DeVries 1985). However, in most of these studies the prey identification was limited to a high taxonomic level which makes it difficult to deduce dietary differences between species. In this study we attempted to identify prey to a lower taxonomic level, allowing calculation of dietary similarity to evaluate the trophic overlap between species and the degree of food partitioning.

Material and methods

Fish were collected in a limited area (about 20 km of coast) off Terra Nova Bay, (74°41'42" S, 164°07'25" E), from January to February 1988 (Fig. 1). The specimens were caught by trammel net (length 108 m; height 1.8 m), gill net (length 123 m; height 6.4 m), bottom longline (98 hooks) and traps of zinc-plated wire (rectangular shape, side mesh size 20 mm). The sampling was carried out at six stations between 16 m and 300 m depth. Fishing was mainly during the day for a mean time of 4–5 h. Most fish were alive when landed and without scars attributable to scavenger organisms. The fish were frozen (-25 °C) or fixed in 10% neutralized formaldehyde. Overall, 11 species (1452 specimens) belonging to Nototheniidae, Bathydraconidae and Channichthyidae were collected. *T. bernacchii* and *T. centronotus* were selected for stomach contents analysis, being the most common. Fish weight was measured to the nearest lower gram and total length (TL) to the nearest lower millimeter. Stomach contents were weighed and examined by a stereoscope (50 x)before identification to family or species when possible. Prey were counted, dried at 60°C for 30 min and their wet weight recorded to the nearest milligram (including hard-structures).

The dietary analysis was conducted followed BIOMASS (Anon. 1981):

a) frequency of occurrence – number of stomachs containing a particular prey item as a percentage of the total number of stomachs examined. This describes the uniformity with which groups of fish select their diet (Bowen 1983).

b) mixed method (Hureau 1970) – the diet is expressed in terms of a dietary coefficient "Q", the product of the percentage by weight and the percentage by number of each prey type to reduce the bias of using weight or number alone. The prey are ranked as main food (Q > 200), secondary food (20 > Q < 200) and incidental food (Q < 20).

c) dietary diversity - either the number of taxa (P) present in the stomach contents of fish or a diversity index $H = -\Sigma i\, p_i \times 1n\, p_i$, where p_i is the percentage by number of the ith prey in the sample (Shannon & Weaver 1949).

d) dietary similarity – to evaluate trophic overlap between the species, we used the percentage diet similarity index $S = 100 \times (1 - ½\, i\, Px_i - Py_i)$ (Linton *et al.* 1981), where Px_i and Py_i are the proportions (by weight or by number) of the ith prey in the diet of the species x and y. The values range between 0 (no similarity) and 100 (total similarity).

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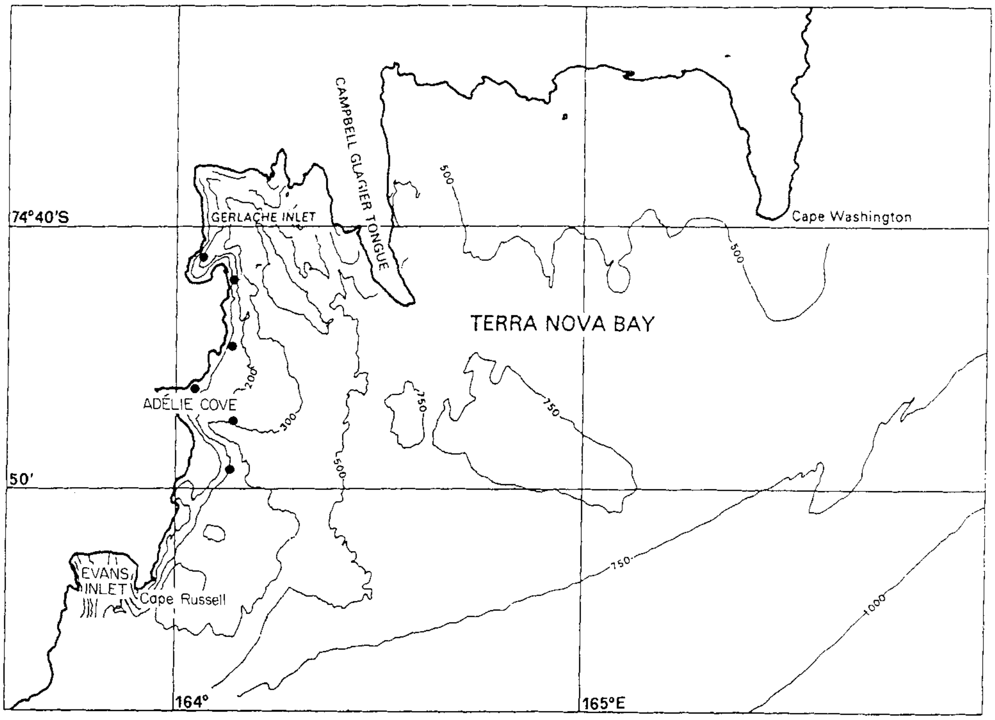

Fig. 1 Location of the sampling stations in the study area of Terra Nova Bay.

Table I. Diet of *Trematomus bernacchii* and *T. centronotus* showing the frequence of occurrence (F%), the percentage by number (N%) and by weight (W%) and the dietary coefficent (Q) of each prey taxon.

Prey taxon & habitat	*Trematomus bernacchii* F%	N%	W%	Q	*Trematomus centronotus* F%	N%	W%	Q
Polychaetes	33.3	35.5	11.8	418.9	72.9	28.3	47.1	1332.9
Epifaunal								
Prionospio patagonica					2.1	0.1	<0.1	<0.1
Prionospio sp.					2.1	0.1	<0.1	<0.1
Spiophanes soderstromi					4.2	0.7	0.2	0.1
Spionidae	0.9	0.6	<0.1	<0.1	4.2	1.5	0.4	0.6
Anaitides patagonica					4.2	0.3	0.2	0.1
Anaitides sp.					2.1	0.1	1.1	0.1
Phyllodocidae					4.2	0.3	0.8	0.2
Antinoella antartica	0.9	0.6	<0.1	<0.1				
Barrukia cristata	6.7	5.3	3.5	18.5	20.8	1.4	8.6	12.0
Eunoe sp.					2.1	0.1	0.3	<0.1
Eunoe anderssoni					2.1	0.1	0.4	<0.1
Harmotoe spinosa	0.9	0.6	0.1	0.1				
Harmotoe sp.	0.9	0.6	0.1	0.1	4.2	0.3	0.9	0.3
Polyeunoa laevis	0.9	1.2	0.6	0.7				
Polynoidae	5.7	3.5	1.6	5.6	16.7	1.2	7.0	8.4
Syllinae					2.1	0.1	0.2	<0.1
Euchone sp.	0.9	0.6	0.1	<0.1				
Fabricinae					4.2	0.3	0.1	<0.1
Tube-dwelling								
Ilyphagus wyvilleyi	1.9	1.2	<0.1	<0.1	14.6	1.0	1.3	1.3
Flabelligeridae	0.9	0.6	0.3	0.2				
Maldanidae	0.9	0.6	0.4	0.2	14.6	1.0	7.2	7.2
Amphicteis cfr. *midas*	5.7	8.9	1.9	16.9	16.7	1.4	2.1	2.9
Amythas membranifera	0.9	0.6	0.1	0.1	10.4	9.4	2.9	27.3
Ampharetidae	1.9	1.2	<0.1	0.1	10.4	0.8	0.3	0.2
Pista sp.	2.8	2.4	0.9	2.2				
Amphitritinae	3.8	2.4	1.5	3.6	2.1	0.1	0.1	<0.1
Terebellidae	1.9	1.2	0.2	0.2	20.8	1.4	6.2	8.7
Sabellidae					2.1	0.3	0.2	0.1

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Table I. continued.

Prey taxon & habitat	*Trematomus bernacchii* F%	N%	W%	Q	*Trematomus centronotus* F%	N%	W%	Q
Burrow dwelling								
Leitoscoloplos mawsoni	0.9	0.6	<0.1	<0.1	4.2	0.5	0.1	<0.1
Scoloplos marginatus					10.4	1.0	0.4	0.4
Orbiniidae	0.9	0.6	<0.1	<0.1	2.1	0.1	<0.1	<0.1
Tharyx cincinnatus					4.2	1.0	0.2	0.2
Paraonidae	0.9	0.6	<0.1	<0.1				
Cossura sp.					2.1	0.1	<0.1	<0.1
Ophelina gymnopige					8.3	2.1	0.8	1.7
Opheliidae	0.9	0.6	<0.1	<0.1				
Capitellidae					2.1	0.1	<0.1	<0.1
Pilargiidae	0.9	0.6	0.1	<0.1				
Aglaophamus ornatus					10.4	0.8	4.8	3.8
Glycera capitata					2.1	0.1	0.1	<0.1
Glyceridae					2.1	0.1	<0.1	<0.1
Gastropods					12.5	1.0	0.7	0.7
Falsimargarita iris					4.2	0.3	0.3	0.1
Trochidae					8.3	0.5	0.4	0.2
Lamellaria sp.					2.1	0.1	<0.1	<0.1
Bivalves	10.5	6.5	53.3	346.4	6.2	0.5	15.4	7.7
Adamussium colbecki	2.8	1.8	25.9	46.6				
Laternula elliptica					2.1	0.1	5.0	0.5
Bivalvia	7.6	4.7	27.4	128.8	6.2	0.4	10.4	4.2
Amphipods	9.5	9.5	3.1	29.4	35.4	51.2	12.0	614.4
Phoxocephalidae	0.9	0.6	<0.1	<0.1	4.2	0.3	<0.1	<0.1
Lysianassidae					4.2	0.4	<0.1	<0.1
Eusiridae	0.9	0.6	<0.1	<0.1	10.4	0.8	0.3	0.2
Oedicerotidae	0.9	0.6	<0.1	<0.1	10.4	0.7	0.6	0.4
Leueothoidae	0.9	0.6	<0.1	<0.1				
Stenothoidae	1.9	1.8	<0.1	<0.1	10.4	39.4	3.6	141.8
Acanthonotozomatidae	4.8	4.7	3.0	14.1	14.6	1.0	3.5	3.5
Ischyroceridae					8.3	6.4	3.5	22.4
Caprellidae					10.4	2.2	0.5	1.1
Hyperiidae	0.9	0.6	<0.1	<0.1				
Isopods	2.8	4.7	0.2	0.9	20.8	6.4	1.0	6.4
Cirolana sp. A					4.2	0.4	<0.1	<0.1
Cirolana sp. B	0.9	0.6	0.1	0.1				
Antarcturus sp. A	1.9	2.9	<0.1	0.1	8.3	3.0	0.2	0.6
Antarcturus sp. B					6.2	1.2	0.1	0.1
Antarcturus sp. C	0.9	1.2	<0.1	<0.1	10.4	1.5	0.7	1.0
Antarcturus sp. D					2.1	0.1	<0.1	<0.1
Euphausiids								
Euphausia frigida	3.8	26.0	14.4	374.4				
Euphausia sp.					6.2	0.4	5.3	2.1
Decapods								
Chorismus antarcticus					2.1	0.1	1.4	0.1
Pycnogonids					25.0	3.2	6.1	19.5
Nymphon sp.					6.2	1.2	4.2	5.0
Pentanymphon antarcticum					10.4	1.1	1.3	1.4
Pycnogonidae					10.4	0.8	0.6	0.5
Echinoids								
Echinoidea	1.9	1.8	8.9	16.0				
Fishes								
Notothenidae	12.4	10.6	8.3	88.0	2.1	0.1	4.1	0.4
Eggs	0.9	5.3	<0.1	0.1	2.1	8.7	6.6	57.4

Results

T. bernacchii was caught in the whole depth range sampled (0–300 m), and it was predominant between 50 and 150 m; *T. centronotus* was found from 50–150 m depth (87% of the specimens below 100 m). *T. bernacchii* and *T. centronotus* made up about 72% and 5% by number of the total catches. For stomach contents analysis 105 out of 1048 specimens of *T. bernacchii* and 48 out of 67 specimens of *T. centronotus* were selected by size stratification. The size and weight range of *T. bernacchii* were 17–29.5 cm and 79–408 g, those of *T. centronotus* were 16.5–25.5 cm and 52–239 g.

Out of the 105 *T. bernacchii* stomachs examined, only three were empty. In the diet of this fish we identified 37 prey taxa (Table I), of which 22 were polychaetes. The dietary diversity index was 2.87. Polychaetes, bivalves (*Adamussium colbecki*) and euphausiids (*Euphausia frigida*) were the main food of *T. bernacchii*. *Barrukia cristata* and *Amphicteis* cfr. *midas* were the most important polychaetes; the family Polynoidae was mainly important for its frequency of occurrence. Nototheniidae as well as amphipods appear to be a secondary food source. The latter were represented by several families, but *T. bernacchii* fed significantly only on Acanthonotozomatidae. Echinoids and isopods (*Cirolana* sp. and *Antarcturus* spp.) were accidental food items. Fish eggs were found only in one specimen.

Out of 48 *T. centronotus* examined, 46 contained prey (two empty) representing 56 taxa (Table I), 31 of which were polychaetes; the dietary diversity index was 2.60. The main prey were polychaetes, indicated by a high dietary coefficient (Q = 1333) and found in >70% of the specimens examined. The most common polychaete prey were *Amythas membranifera*, *Barrukia cristata* and *Aglaophamus ornatus*. Amphipods of the families Stenothoidae and Ischyroceridae were also a main food source. Fish eggs were a secondary food. Pycnogonids (mainly *Nymphon* sp.) were the most important accidental prey, that included bivalves and isopods (*Cirolana* sp. and *Antarcturus* spp.), euphausiids, gastropods (Trochidae), fishes (Nototheniidae) as well as decapods (*Chorismus antarcticus*). The diet similarity of the two species was 23% by number and 26% by weight.

Discussion

The polychaetes found in the diet of the two fishes have been subdivided into three groups in relation to their usual location in the substrate and their availability as potential prey. The first group comprised epifaunal polychaetes such as Polynoidae, which is the dominant family of the Antarctic polychaete fauna (Hartman 1964, 1968) and especially in Terra Nova Bay (Castelli 1991), and infaunal species such as small detritivores of the family Spionidae (Castelli & Prevedelli 1992). The second group consisted of sessile or sedentary tube-dwelling species which generally are exposed on the bottom. The third group comprised burrow dwelling polychaetes which were in limited communication with the substrate surface such as Orbiniidae, Opheliidae, Nephtydae, Glyceridae (Castelli & Prevedelli 1992). The predominance of polychaetes in the diets of the two species have been reported from many other localities, such as the Ross Sea (Eastman 1985, Eastman & DeVries 1985), the Cosmonaut Sea (Pakhomov & Tsietlin 1991), the Adélie coast (Hureau 1970). In Terra Nova Bay, the diet of *T. centronotus* was richer in polychaetes than that of *T. bernacchii*. This difference concerned the polychaetes in general as well as the three ecological groups described above.

In the diet of *T. bernacchii* there was a high occurrence of bivalves (*Adamussium colbecki* in small amounts), which were also found in its diet at Lützow-Holm Bay (Naito & Iwami 1982).

The importance of euphausiids in the diet of Antarctic fish is well known (Permitin 1970, Kock 1985, Williams 1985). In Terra Nova Bay *Euphausia frigida* was a main food item for *T. bernacchii*, although the frequence of occurrence of this prey was very low (3.8%). *T. centronotus* fed on euphausiids more frequently but in smaller amounts than *T. bernacchii*. It is probable that these species feed on euphausiids close to the bottom, as reported for Lützov-Holm Bay (Naito & Iwami 1982) and for other fish species at South Georgia (Targett 1981).

Gammarid amphipods (Stenothoidae) were a main prey of *T. centronotus*, while we found no hyperiids. In the Weddell Sea, amphipods made up >50% by number and by weight of the diet of *T. centronotus* (Schwarzbach 1988). In our study the amphipods were secondary food in the diet of *T. bernacchii*, but the importance of amphipods in the the diet of fish from the Antarctic Peninsula has been reported by Daniels (1982).

Nototheniid fishes were of secondary importance in the diet of *T. bernacchii*, as reported from McMurdo Sound (Eastman 1985). The other taxonomic groups of prey we found, such as isopods and echinoids for *T. bernacchii* and isopods, decapods and pycnogonids for *T. centronotus*, were not significant.

Very few studies (Rakusa-Suszczewski & Piasek 1973, Daniels 1982, Schwarzbach 1988) have been conducted on dietary overlap in Antarctic fish. In the Antarctic Peninsula, the dietary similarity between the two congeneric benthic species *T. bernacchii* and *T. scotti* was low (32% for the prey percentage by number and 34% by volume) (Daniels 1982). According to Schwarzbach (1988), in the Weddell Sea the dietary similarity between *T. centronotus* and other congeneric species was always <50%, except in the case of *T. scotti*. Our data showed that the dietary overlap between *T. bernacchii* and *T. centronotus* is around 20%, and therefore partioning of food resources between these species must occur.

Some animals are present in the stomachs of only one species, e.g. pycnogonids, gastropods (*T. centronotus*) and echinoids (*T. bernacchii*); other taxonomic groups, such as molluscs and amphipods, are only consumed in significant amounts by one species. Polychaetes are the main food of both species, but the burrow-dwelling polychaetes *Aglaophamus ornatus*, *Ophelina gymnopige* and *Scoloplos marginatus* were mainly fed upon by *T. centronotus*. Moreover, in the diet of *T. bernacchii* the presence of zooplanktonic and nektonic prey such as euphausiids and fishes is noteworthy, while *T. centronotus* consumed these organisms in small amounts.

We conclude that in Terra Nova Bay the two species are both carnivorous and consume a wide variety of organisms; however, trophic overlap is minimized by different feeding habits of the two species.

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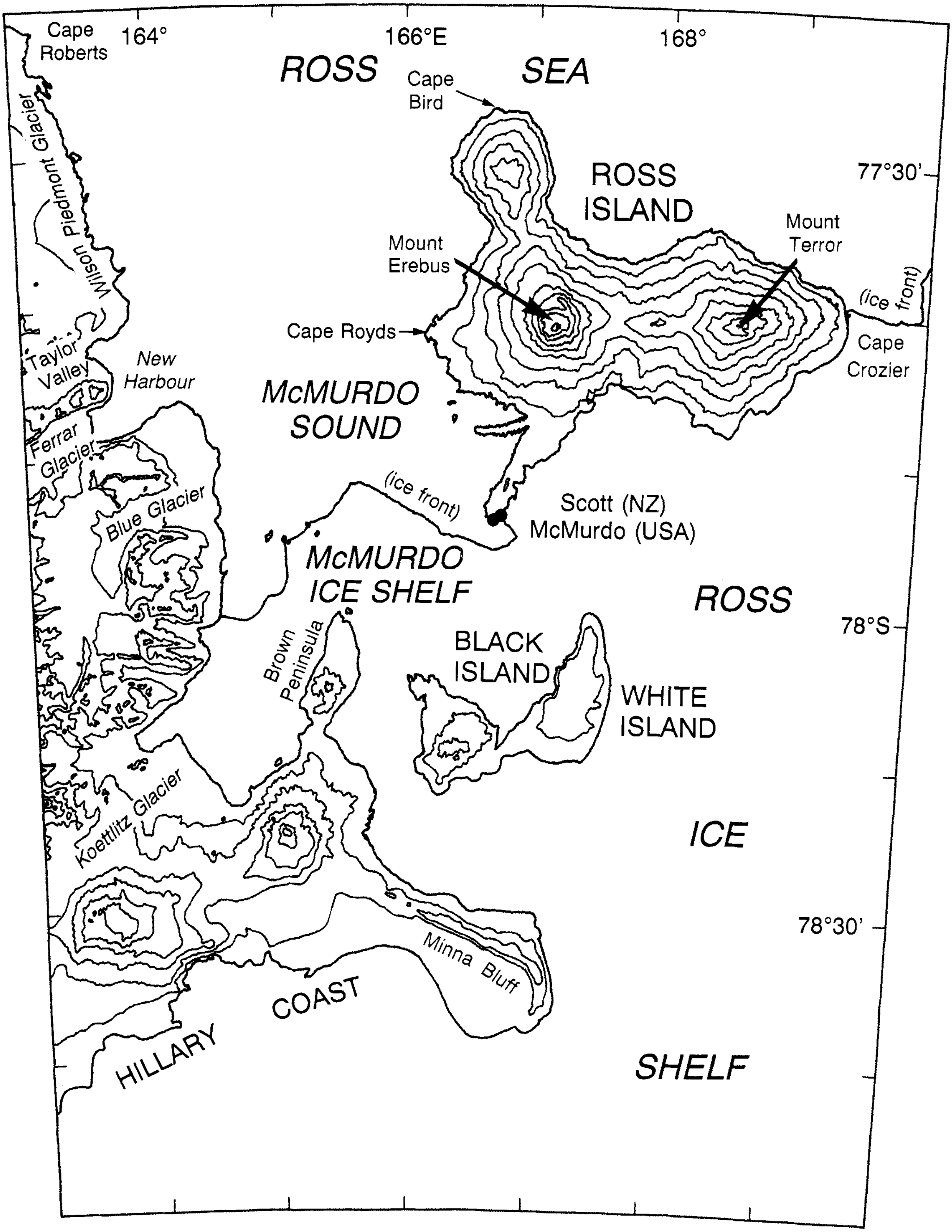
Antarctic Science **Handy Atlas Map No. 3.**

IMW Sheet No. ST57–60. McMurdo Sound-Ross Island area, 1:1 000 000 scale, contour interval 400m.



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