D. J. Tellyman

NEW ZEALAND MARINE DEPARTMENT
FISHERIES TECHNICAL REPORT
No. 9

Feeding Habits of the New Zealand Fur Seal

Arctocephalus Forsteri

R. J. STREET

WELLINGTON, NEW ZEALAND 1964

NEW ZEALAND MARINE DEPARTMENT

FISHERIES TECHNICAL REPORT

No. 9

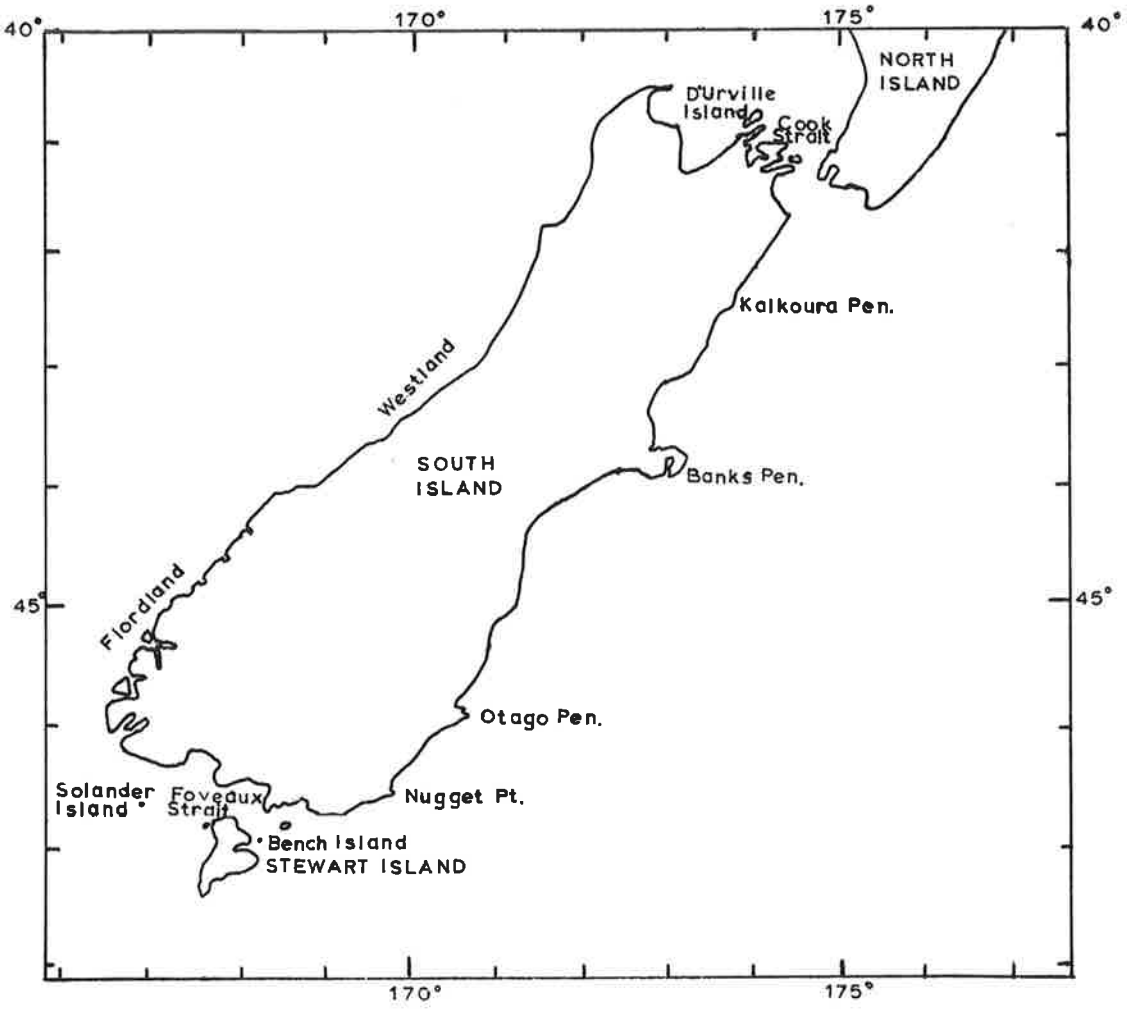
FEEDING HABITS OF THE NEW ZEALAND FUR SEAL (*Arctocephalus forsteri*)

R. J. STREET

WELLINGTON, NEW ZEALAND. 1964

CONTENTS

MAP 1.
Areas where investigations were made



FEEDING HABITS OF THE NEW ZEALAND FUR SEAL (*Arctocephalus forsteri*)

1. Introduction:

Fur seal rookeries are typically located on rocky exposed coastlines. Areas of greatest concentration occur on D'Urville Island, in Cook Strait, Kaikoura Peninsula, Banks Peninsula, Otago Peninsula, Nugget Point, Stewart Island and outlying islands, Solander Island, Fiordland, Westland and in the sub-antarctic islands.

It is often difficult to obtain an accurate count of the number of seals present in a rookery. They are usually scattered over an uneven rocky terrain, and are hard to locate against the background. The numbers ashore at different times also vary widely, which further make population estimates difficult. Approximate counts taken at the main rookeries in Canterbury and Otago showed on Kaikoura Peninsula from 150-270, on Otago Peninsula 650, and at Nugget Point 30. It was not possible to do any counts on Banks Peninsula, as the colonies were not accessible. There have been no censuses taken lately in the main rookeries in Southland, although general reports from fishermen state that the populations are heavy, with numbers increasing. In July 1958, counts of fur seals in Fiordland between Bligh Sound and Looking Glass Bay showed approximately 300 seals ashore. At Bench Island, in January 1961, there were approximately 150 seals ashore. Neither of these two counts was made in the areas of major concentration in Southland.

Fears have often been expressed by commercial fishermen that seals are having an adverse effect on fish

stocks. There is usually rough bottom adjacent to the rookeries, on which crayfishing, line fishing and sometimes set gill net fishing is carried out. Apart from the Cook Strait area, crayfishing is the most actively pursued of these methods of fishing. Investigations aimed at determining the feeding habits of fur seals and the relationship to commercial fisheries were carried out in Canterbury, Otago and Southland. Mr T.B.S. Gorman, now of the Fisheries and Wildlife Department, Victoria, conducted the investigations in Canterbury while employed by the Marine Department, and his results are incorporated in this report.

2. Methods:

Three methods were used to obtain information on the feeding habits of seals.

(a) Examination of gut contents;
(b) Surface observations of seals feeding;
(c) Examination of vomited food remains.

(a) The seals examined for gut content were all killed ashore, under special permit, with a rifle shot. In order to yield the most positive results, usually only seals seen coming out of the water, or those with moist coats were taken. This would indicate that the animals had recently been at sea, and hence there was some likelihood of finding food in the stomach. After shooting, the stomach of the seal was removed and the contents preserved in formalin. The oesophagus was also examined for possible food remains. The length and sex of the seal was noted. The contents were then shown to a person associated with the fishing industry; in most cases a commercial fisherman. The stomach contents were examined, the contents separated, counted, weighed and measured. Cephalopods could usually be designated as either octopus or squid, when only beaks remained. Fish remains were forwarded to

Mr J. Moreland, of the Dominion Museum, for identification.

(b) Within Otago and Southland, I have seldom seen seals feeding on the surface and most information has come from commercial fishermen. Such surface sightings refer to octopus and medium size or large fish. Surfacing is probably necessary for a seal to break up a large prey prior to ingestion.

(c) Remains of food, particularly indigestible items such as cephalopod beaks, fish bones and crustacean shells are sometimes found in the colony site. In addition to indigestible hard parts, body flesh was sometimes seen, and specific identification could be made.

3. **Sampling Areas**:

A total of 70 seals was shot; 64 showing remains of food in the stomach. Numbers taken in different areas were as follows: Kaikoura Peninsula 9; Banks Peninsula 2; Otago Peninsula (mainly Cape Saunders) 32; Nugget Point 14; Bench Island 13. Map 1 shows the location of these sampling areas. Commercial fishing, principally crayfishing, is carried out adjacent to all five areas where analyses of gut contents were made.

4. Stomach Contents:

(a) Food Items: In Table 1 results of the stomach analyses are shown, with food items expressed in terms of frequency of occurrence, percentage numerically, weight, and the percentage by weight. The numerical percentage does not give a very good picture, as the importance of small items is exaggerated. The weight of each food item expressed as a percentage gives a better picture.

	Squid	Octo-pus	Uniden-tified Cephal-opod (beaks)	Barra-couta	Juven-ile Gadi-dae (Red Cod family)	Whip-tail	Kaha-wai (Poss-ible)	Horse Macker-el	Butt-er-fish (Poss-ible)	Uniden-tified fish bones & flesh	Lamprey	Blind Eel	Crus-tacea
Frequency	231	53	11	29	48	3	1	4	1	19	2	1	2
Number of seals occurring in	32	17	3	20	2	3	1	2	1	14	2	1	2
Percent-age of item numeri-cally	57.3	13.3	2.5	7.2	11.9	.8	.2	1.0	.2	4.6	.4	.2	.4
Weight in ounces	512	615	-	817	16	48	Bones only	26	Bones only	106	6	Teeth only	Shells only
Percent-age by weight	23.9	28.8	-	38.1	.7	2.2	-	1.2	-	4.8	.3	-	-

TABLE I

Cephalopod (squid and octopus) .... 52.7% by weight
Fish ..... 47.3% by weight

Stomach contents of fur seals.
Number and weight of food items.

Barracouta, octopus and squid are the main food items occurring. Higher numbers of squid and octopus than barracouta occur, but in many cases only their beaks remained, and they would have represented an accumulation from several meals. Medium size octopuses are about the same weight as large barracouta, but medium size squid are considerably less. A higher intake of squid is therefore necessary to give an equivalent weight. The crustacea remains were the shell of a natant decapod, and part of a crab leg. Figure I shows the proportions by weight of the food items found in the stomach.

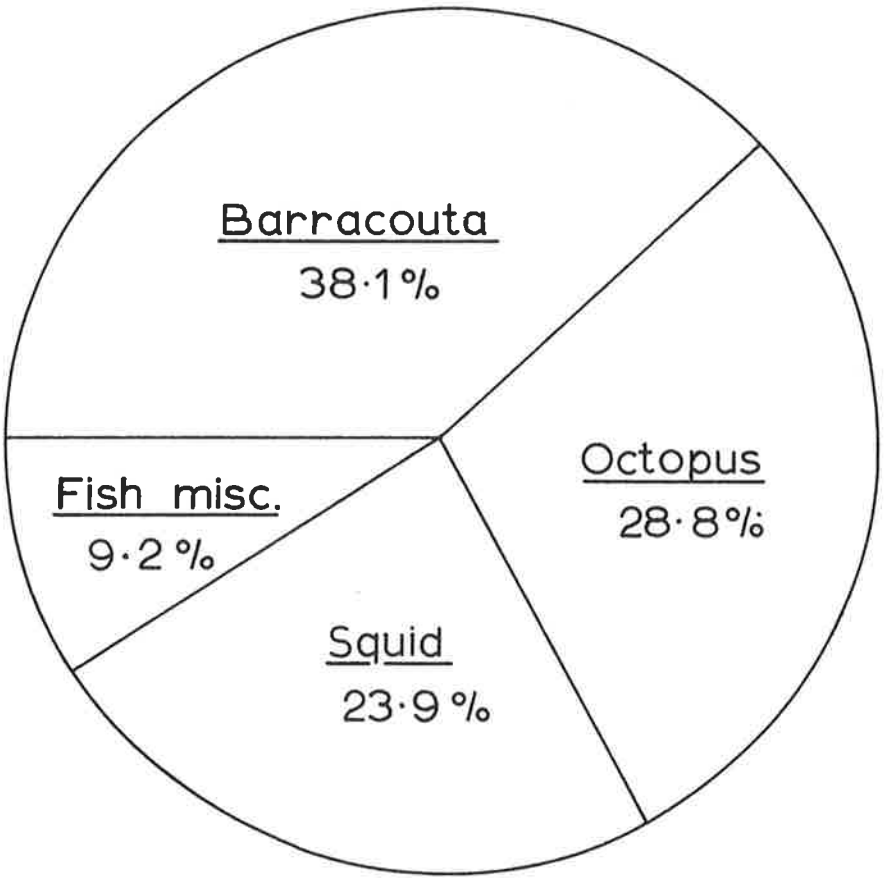
In addition to food remains, many stomachs contained numbers of pebbles, and nematode worms were nearly always present.

One disadvantage in expressing the food items as a percentage by weight is that fish could be digested at a different rate than octopus and squid, e.g. if squid and octopus were digested more quickly, the proportion of fish remains would be exaggerated. It was not possible to express all items as an original total weight, e.g. with unidentified fish, and where cephalopod beaks remained with no body parts. Where sufficient flesh, either cephalopod or fish was present, associated with hard parts, then it was possible to calculate approximately the original total weight. Such remains would also represent a recent meal. Table 2 shows the stomach contents from 31 seals where the food remains could be expressed as an original total weight. Food items are shown as a calculated original whole weight, and a percentage of the total whole weight.

Squid comprises a greater proportion of the stomach content when recent food remains are converted to original weight. These conversions figures are approximate,

FIGURE 1.

Stomach contents of fur seals.



	Squid	Octopus	Barracouta	Juvenile Gadidae (red cod family)	Whiptail	Horse Mackerel	Lamprey
Frequency	102	12	23	48	2	3	2
Number of seals occurring in	20	11	17	2	2	1	2
Calculated original weight in ounces	1530	1536	1814	24	128	48	8
Percentage	30.0	30.2	35.6	.5	2.5	1.0	.2

Cephalopod (squid and octopus) 60.2% by weight

Fish 39.8% by weight

Table 2 Stomach contents of Fur Seals.
Number and weight of recent food items.

but indicate that squid remains had undergone more digestion, and were either taken earlier in the feeding period than other food items or were digested faster. This is discussed further under feeding periods.

Table 3 shows the five areas where gut analyses were made, and the weight and proportion of the main food items. Only a few barracouta bones were present in one of the two seals from Banks Peninsula. Barracouta and squid were major items in all the other four areas, although the proportions differ. No octopus occurred at Kaikoura Peninsula, and the proportion of miscellaneous fish was higher. This included whiptail, and fish remains that could not be positively identified. The number of gut analyses made in the different areas was relatively small, and more extensive sampling could indicate whether or not these small regional differences in food taken are significant. The basic feeding pattern is the same in all areas.

(b) Quantity of food taken in one feeding period: Seals do not necessarily feed every day, and it is usual for individuals in a colony to spend considerable periods ashore. A few seals ashore with dry coats and obviously out of the water for a while were shot, and they all showed either empty stomachs, or only cephalopod beaks or well digested bones. It is difficult therefore to assess the daily food requirements. However, an estimate can be obtained of the quantity of food taken in one feeding period.

Figure 2 shows the weight of stomach contents in 1 lb units from the 38 seals showing recent food remains. The average weight of stomach contents was approximately 4 lb. The greatest amount of stomach contents was from a 6 ft male, which

Area	No. of Seals	Total weight of food	Stomach Content							
			Squid		Octopus		Barracouta		Fish Miscellaneous	
			weight	%	weight	%	weight	%	weight	%
Otago Peninsula	32	56 lb. 10 oz.	11 lb. 8 oz.	20.3	16 lb. 4 oz.	28.7	21 lb. 8 oz.	38	7 lb. 6 oz.	13
Nugget Point	14	26 lb. 13 oz.	10 oz.	2.3	11 lb. 1 oz.	41.3	14 lb. 6 oz.	53.6	12 oz.	2.8
Bench Island	13	39 lb. 13 oz.	17 lb. 13 oz.	44.6	11 lb. 2 oz.	27.9	10 lb. 11 oz.	26.9	4 oz.	.6
Kaikoura Peninsula	9	10 lb. 13 oz.	2 lb. 1 oz.	19.2	-	-	4 lb. 8 oz.	41.5	4 lb. 4 oz.	39.3
Banks Peninsula	2						Bones only			

Table 3 Food items occurring in the different areas.

FIGURE. 2.

Weight of food in stomachs

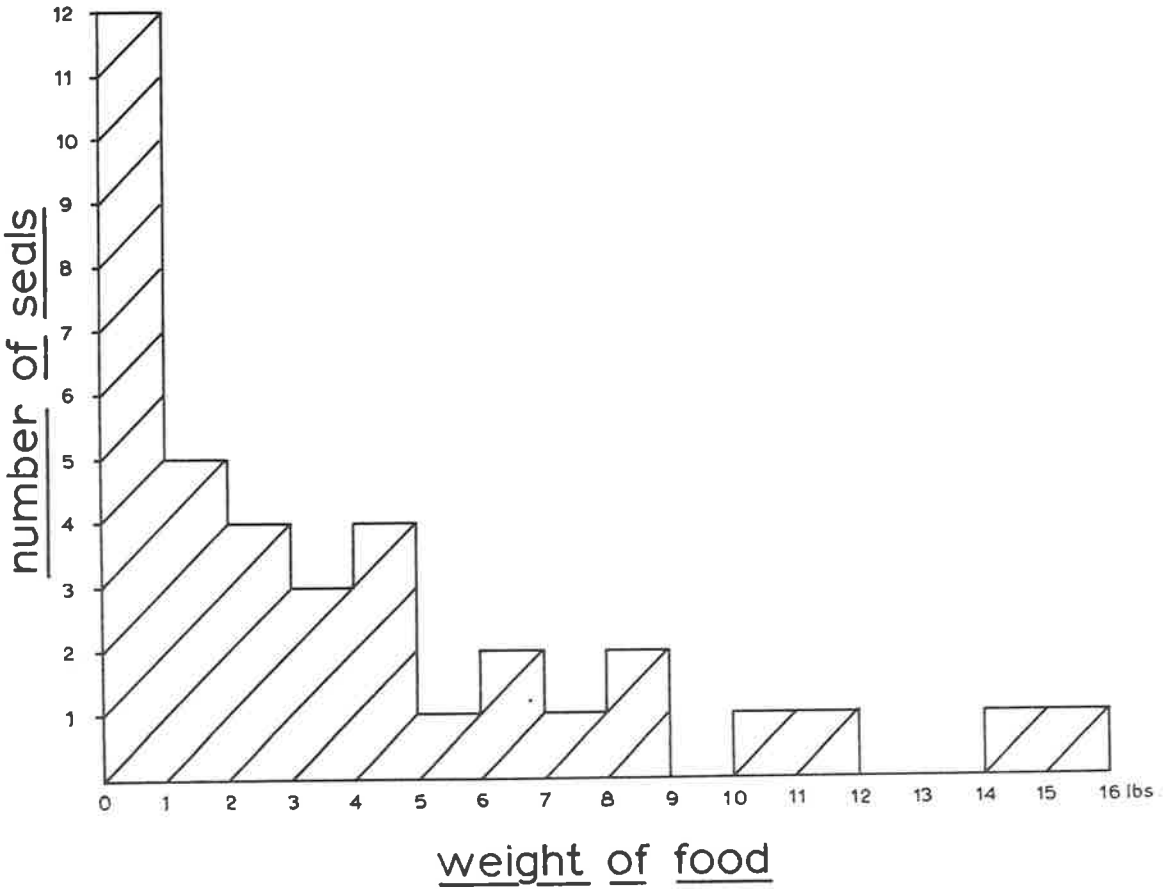
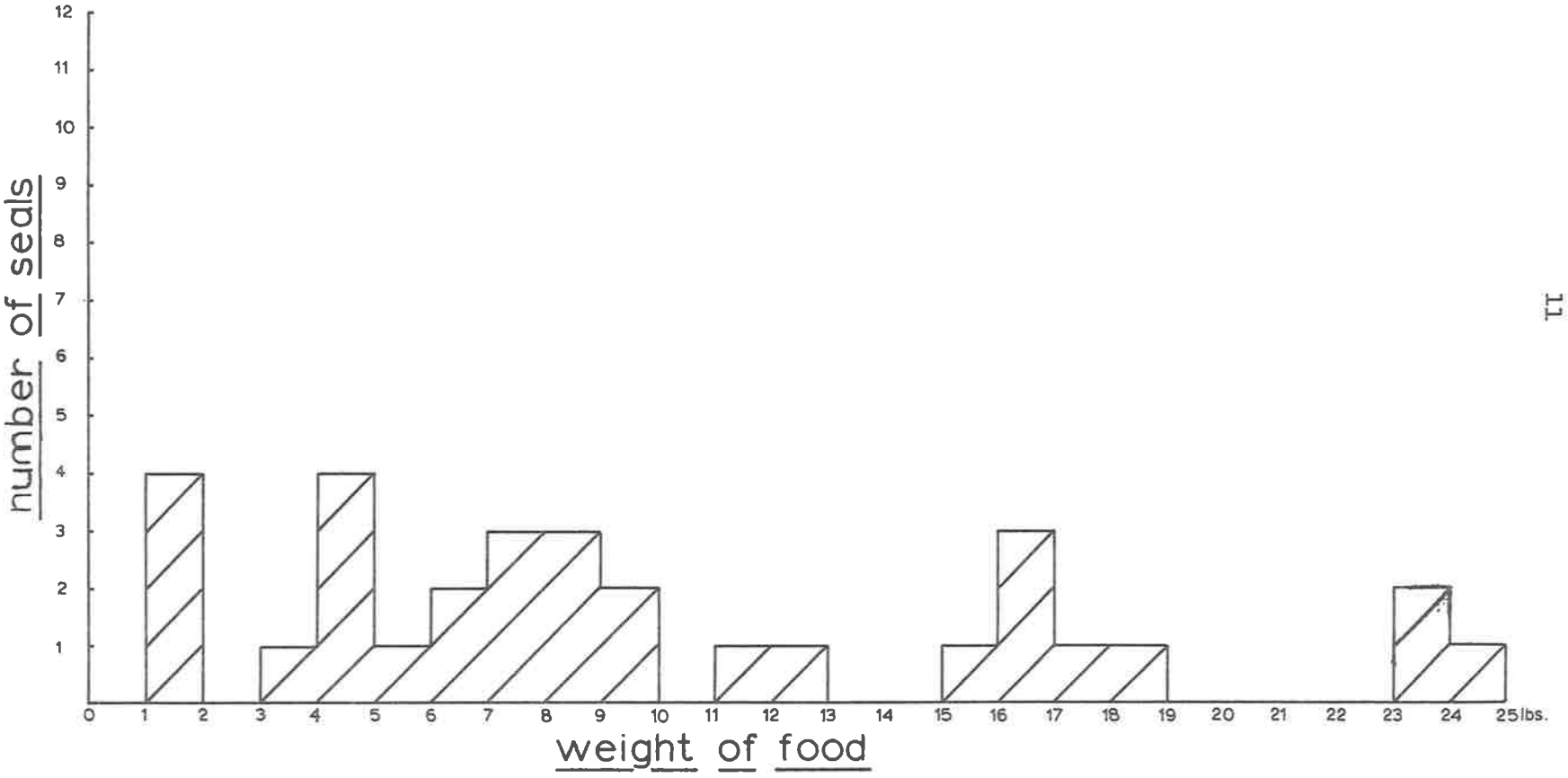


FIGURE. 3.

Original weight of food in stomachs



Period	No. of Seals	SQUID No. of bodies	Weight	Average weight	No. of sets of beaks only	OCTOPUS No. of bodies	Weight	Average weight	No. of sets of beaks only	BARRACOUTA No. of bodies	Weight	Average weight	No. of fish with bones only
6 a.m.- 9 a.m.	25	35	12 lb 8 oz.	5.7oz.	9	1	4 lb 5 oz.	4 lb 5 oz.	3	11	24 lb 4 oz	2 lb 3 oz.	4
9 a.m. - 12 noon	31	61	19 lb 7 oz.	5.1oz.	44	7	27 lb 6 oz	3 lb 14 oz.	34	11	26 lb 7 oz	2 lb 6 oz	1
12 noon - 3 p.m.	5	-	-	-	56	-	-	-	1	-	-	-	-
3 p.m. - 6 p.m.	9	6	14 oz	2 oz	20	4	6 lb 12 oz	1 lb 11 oz	3	1	14 oz	14 oz	1

Table 4 Feeding Periods

contained four octopuses weighing 15 lb.

The 38 stomach contents had undergone varying rates of digestion. In 31 seals, it was possible to convert the stomach contents to an approximate original whole weight. Figure 3 shows the weight of stomach contents prior to digestion in 1 lb. units. It appears that an adult seal is capable of consuming at least 24 lb. of food a meal, but the average amount is much less. The average for the data in Figure 3 is 9-10 lb.

(c) Feeding Period: Table 4 shows the three main food items occurring and the state of digestion at different times of the day. Stomachs examined during the early morning showed a higher proportion of squid bodies to beaks only than those examined later in the day. Squid remains seen in the afternoon were further digested than those in the morning. The higher proportion of beaks only in the afternoon suggested that many would be from squid taken the previous night. Indications were that squid were obtained mainly at night.

There was a higher proportion of octopus beaks only during the morning than in the afternoon, but the average weight of bodies during the morning was higher. There were only 12 octopus bodies in the stomach contents, and the data give no clear indication of any preference in feeding period. One seal shot just after coming ashore at 11 a.m. at Bench Island, contained 11 lb. 2 oz. of very fresh octopus, and this would have been obtained within a short time. Surface observations of seals feeding on octopus have been reported both at night and during the day.

Most seals containing barracouta were shot during

the morning, and hence there is little data for comparing feeding periods. However, barracouta were usually associated with squid in the gut content, and it would be expected that seals were feeding on both concurrently. This would involve mainly night feeding. Seals have been reported on the surface with barracouta during the day.

(d) Seasonal Feeding: Table 5 shows the type of food taken seasonally in the 64 seals with food in the stomach.

The main food items have been taken at all seasons, although there are differences in the proportions. Eleven of the Bench Island seals were examined within three days in January, and these showed a particularly high proportion of squid, and account for the high proportion of squid in January. One seal examined in September contained 19 sets of octopus beaks; obviously an accumulation from several meals. This one seal has accounted for the very high proportion during this month. There were however 44 octopus in 16 seals taken in August and September, as against 9 in 48 seals in the other months. This suggested that octopus is more readily available to seals during the months of August and September.

5. Surface Observations of Seals Feeding:

Only two personal observations have been made of seals with food items on the surface. At the north end of D'Urville Island seals have been seen on the surface with butterfish (greenbone). Set gill nets were in the vicinity, and it is possible that fish were removed from the nets. On another occasion a seal has been seen with a red cod off Otago Peninsula.

Fishermen witnessing seals with food on the surface usually mention either octopus, barracouta, ling, blue cod

TABLE 5

Number of food items occurring seasonally

	No. of seals	Squid	Unidenti-fied Cephalopod	Octopus	Barracouta	Fish Misc.	Crustacea remains	
January	19	168	1		14	14		
February	5	11	2	3	1	5		
March								
April	1	13			1			
May	4	1			2	5		
June	2							
July	4			4		1	1	
August	8	7		14	3	39	1	
September	8	4		30	3			
October	3	1			1	1		
November	4	11	8	1	2	2		
December	6	15		1	2	1		

or butterfish (greenbone). Octopus and barracouta are the two items that have been reported most frequently. Both of these figured prominently in the stomach contents examined. Fishermen have seen seals with octopuses in 30 fathoms off Cape Saunders. Octopuses are usually bottom living, although they have been reported swimming in surface waters. Fishermen have reported seals with ling on the surface in 75 fathoms off Cape Saunders. It is stated that the belly portion of the fish is torn out, leaving the rest of the body. It cannot be said with certainty at what depth the fish were taken, although seals are possibly capable of diving to a depth of 75 fathoms. One fisherman reported catching a fur seal in a trawl net brought up from 60 fathoms. The body was well chafed, indicating that it had been caught near the bottom, and been in the net for some time.

6. Vomited Food remains:

Examination of the colony site often revealed vomited food remains. The items most frequently encountered were squid and octopus beaks. Barracouta and horse mackerel remains were less frequently noted, and there were also single observations of lamprey and casts of the common rock crab.

These observations confirmed that octopus, squid and barracouta are major food items.

7. Discussion:

The principal species, excluding oysters, landed in Canterbury, Otago and Southland, are crayfish, blue cod, tarakihi, elephant fish, gurnard, lemon sole, English sole, groper, flounder, pioke (rig) and ling. Stomach analyses of fur seals did not show any of these. The above species are obtained by the use of set pots, lines and by trawling. Surface

fish such as barracouta are not exploited to any great extent. In Canterbury, Otago and Southland, set gill netting for species such as butterfish and moki is not pursued to any extent.

The investigation indicated that the main diet of fur seals does not involve commercial species. Three items, barracouta, octopus and squid comprised 90.8% by weight of the food remains in the stomachs. From their known distribution, barracouta and squid would be obtained in surface or near surface waters. The state of digestion of food in the stomachs suggested mainly night feeding when in surface waters. Rand (1959) states that the bulk of the prey of the Cape fur seal Arctocephalus pusillus is made up of surface fish.

The state of digestion of octopus remains suggested that they are taken at any time of the day, with no predominance of night feeding as in barracouta and squid. This indicated a different pattern of feeding than when obtaining squid and barracouta, and it is probable that seals obtain octopuses from the bottom. Octopuses are often seen during underwater swimming, and are very easily captured, making little effort to escape. They would represent a sizeable and an easily caught food item for a seal. There may also be a liking for the flesh, in preference to bottom living fish and crayfish. Octopuses are recognised predators on crayfish, and much direct loss is caused to fishermen by octopuses eating crayfish in the pots, and once in, deterring the entry of others. Underwater observations, and examination of octopus stomachs have confirmed that they are important predators on crayfish. Fur seals could achieve some beneficial balance in keeping down the octopus population.

Sorensen's work on the New Zealand fur seal at Campbell Island (Bailey and Sorensen 1962) indicated that the main diet in these waters was penguins and squid. Penguins are not so plentiful around the New Zealand mainland, and surface fish are more abundant than in sub-antarctic waters. It is to be expected

then that fish will assume greater importance in the diet in waters around New Zealand.

From surface observations there is no doubt that seals do sometimes eat commercial fish, but these sightings are fairly infrequent and could easily give a false impression. The main pattern of feeding is on surface or near surface organisms which are of very minor commercial significance in New Zealand.

8. Appendix:

Scientific names of Fish and other Organisms referred to

Common Name	Scientific Name
Octopus	Octopus maorum (mainly)
Arrow Squid	Notodarus sloanii (mainly)
Broad Squid	Sepioteuthis bilineata
Rock crab	Hemigrapsus sexdentatus
Lamprey	Geotria australis
Blind eel	Eptatretus cirrhatus
Barracouta	Thyrsites atun
Blue cod	Parapercis colias
Butterfish (greenbone)	Coridodax pullus
Elephant fish	Callorhynchus millii
Flounder (dab)	Rhombosolea plebeia
Hapuka (groper)	Polyprion oxygeneios
Ling	Genypterus blacodes
Horse mackerel	Trachurus sp.
Moki	Latridopsis ciliaris
Pioke (rig)	Mustelus antarcticus (mainly)
Red cod	Physiculus bachus
Sole (lemon)	Pelotretis flavilatus

Common Name	Scientific Name
Sole (English)	Peltorhamphus novaezealandiae
Tarakihi	Cheilodactylus macropterus
Trumpeter	Latris lineata
Whiptail	Macruronus novaezealandiae

9. Summary:

1. Stomach contents of 70 fur seals from Kaikoura Peninsula, Banks Peninsula, Otago Peninsula, Nugget Point and Bench Island were examined. Food consisted mainly of barracouta, octopus and squid, these three items comprising 90.8% of the food remains by weight.

2. Fur seals feed principally in near surface waters, although octopus are probably taken on the bottom. Surface feeding takes place mainly at night.

3. The largest amount of food found in a stomach was 15 lb., representing four octopuses. The original weight of the octopuses would have been approximately 24 lbs. The average weight of food taken a meal was 9-10 lb.

4. No fish of significant commercial importance were found, and seals would not appear to compete to any extent with fishermen. Barracouta were a major item in the stomach content. They are not fished commercially to any extent. Reports from fishermen give accounts of seals sometimes feeding on medium size of large commercial fish, but these items are incidental to the main diet of fur seals.

5. An important predator-prey relationship exists between seals, octopuses and crayfish. Octopuses are predators on

crayfish, and seals are predators on octopuses.

10. Acknowledgments:

I wish to thank Mr K.R. Allen, Director of Research, and Mr J.H. Sorensen, Assistant Director of Fisheries, for their direction and helpful criticisms of the results and text. My thanks are also extended to Mr J. Moreland for identifying fish species when only bones remained; to Mr T.B.S. Gorman for allowing me to use the results he obtained in Canterbury, and to the many fishermen who supplied boat transport to seal colonies that were not accessible from shore.

11. References:

Bailey A.M. and Sorensen J.H. (1962) — Sub-antarctic Campbell Island. Proc. Denver Museum of Natural History, No. 10.

New Zealand Marine Department (1961) — N.Z. Marine Department Annual Report, Wellington, N.Z.

Rand R.W. (1959) — The Cape Fur Seal (Arctocephalus pussilus) distribution, abundance and feeding habits off the S.W. Coast of the Cape Province. Div. of Fish.Invest.Report No. 34.

R. E. OWEN, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1964

D. J. Tellyman

NEW ZEALAND MARINE DEPARTMENT
FISHERIES TECHNICAL REPORT
No. 9

Feeding Habits of the New Zealand Fur Seal

Arctocephalus Forsteri

R. J. STREET

WELLINGTON, NEW ZEALAND 1964