

## RESEARCH ON THE ALASKA FUR SEAL HERD, 1948

Victor B. Scheffer and Karl W. Kenyon, Biologists  
Seattle, Washington, 20 January 1949

This report describes briefly the activities under Project 80 in 1948. Generally speaking, the biologists 1. photographed the seal beaches from the air, 2. counted dead seal pups, 3. studied the human error in measuring seals on the killing field, 4. tagged 19,532 seal pups, 5. studied the growth rate of seals of known age, 6. collected liver samples for vitamin A analysis, 7. counted seals at sea during the fall migration, 8. made a critical study of the present method of computing the seal population, and 9. engaged in research of lesser importance. The following men were employed in Seattle and in the field:

### Victor B. Scheffer, Project Leader

21-22 May	Washington coast
12 June-19 August	Pribilof Islands
3 September-3 October	Pribilof Islands
2 November-20 December	Bering Sea and North Pacific

### Karl W. Kenyon, Biologist

21-22 May	Washington coast
1 July-17 October	Pribilof Islands

2 November-20 December      Bering Sea and North  
Pacific

David H. Wiltsie, Collaborator

12 June-9 August              Pribilof Islands

The chapter headings below are arranged alphabetically, in agreement with the categories in the Seattle research file of notes, correspondence, and photographs. (In certain categories there is nothing to report for the 1948 season.)

#### ANATOMY, MISCELLANEOUS

##### Serum samples

For the Rutgers University Serological Museum, blood samples of fur seal and sea-lion were collected. The blood was found to clot very quickly. This is an evolutionary advantage because, in both species, 1. the males fight fiercely and bloodily and 2. the pups at birth break the umbilical cord by pulling on it, whereas in most mammals the mother crushes the cord with her teeth and retards the flow of blood.

##### Blood types

Dr. William S. Laughlin of the Peabody Museum, Harvard, a visitor to the Pribilofs, blood-typed 27 fur seals. He believes that it might be possible to show blood group kinship between seals of the eastern and the western sides of the north Pacific Ocean.

### Skeleton of the fur seal

A yearling seal (BDM 290) accidentally killed during pup tagging operations was carried to Seattle in frozen state and was X-rayed on the 27th of October through courtesy of the Standard X-ray Sales Company. The purpose was to enable study of the skeletal relations with a view to selecting the best place for applying metal identification tags.

### Photographs of anatomical features

For no immediate reason except to explore the fur seal, detailed photographs were taken of various parts of the body in fresh condition. They included pancreas (Fig.1), spleen, heart, brain, kidney, tongue, lungs, pituitary, pelt, and teeth.

## BEHAVIOR IN CAPTIVITY

### Birth

A male fur seal was born in the Balboa Park Zoo, San Diego, California, after a gestation period of at least 372 days. The mother was captured on St. Paul Island on the 1st of August 1947. The Zoo has kept a record of the behavior of this pup, - how it learned to swim, how it was weaned, and so on.

### Albinos captured

Two pups with abnormal pelage were captured on St. Paul Island on the 5th of October and shipped to Juneau, where they

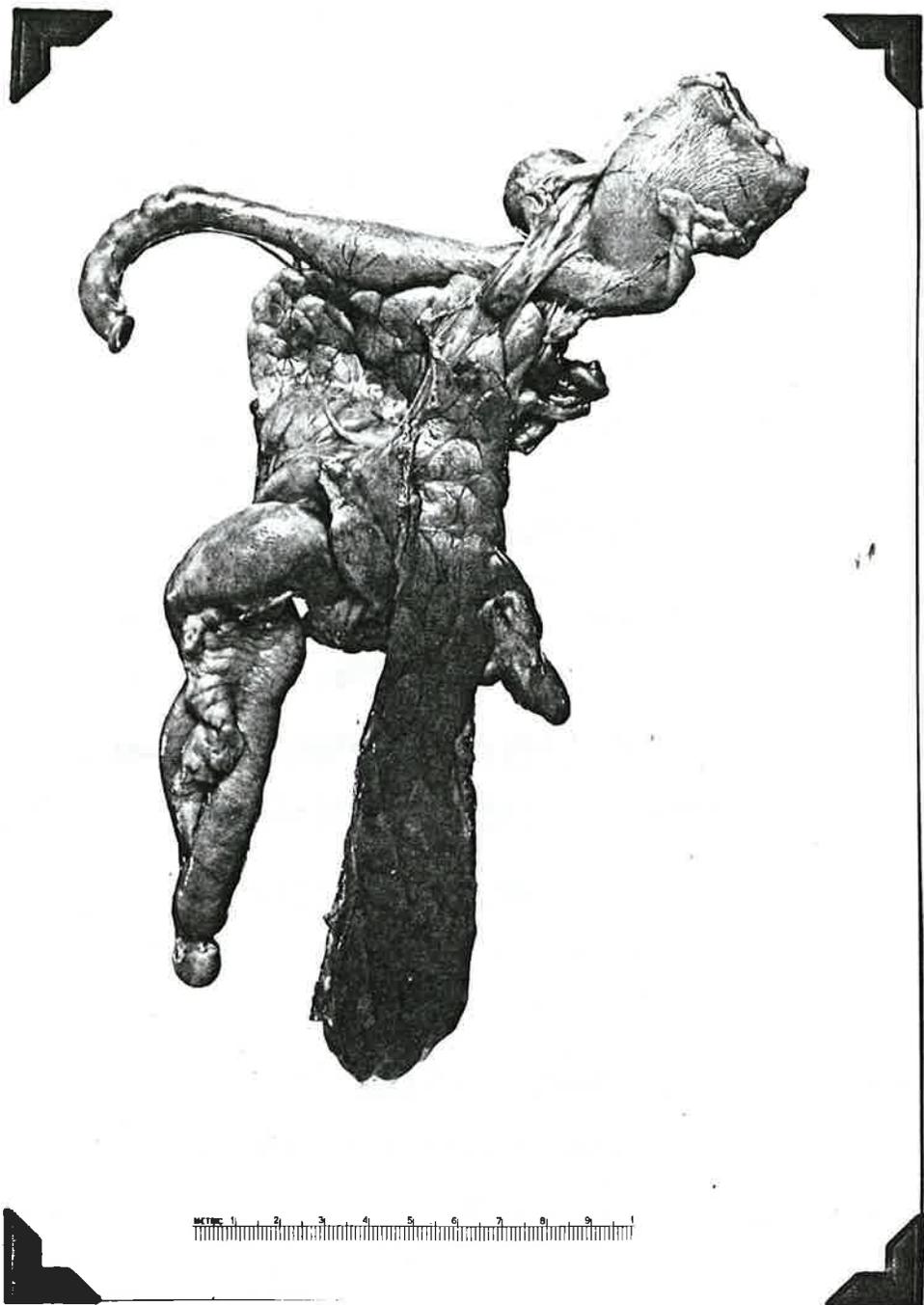


Fig. 1 Pancreas of a male fur seal about 3 years old,  
St. Paul Island, Alaska, 7 July 1948, weight 131 grams. (Photo 2382)

were transferred to a commercial airliner and forwarded to the Balboa Park Zoo. This is the first time that a fur seal has been flown, and the method was satisfactory. One of the pups was a female albino and the other was a male "partial albino," that is, it had white underfur and brown overhair. The pair arrived in San Diego on the 17th or 18th of October. Observations will be made of the molt of the pelage.

### General

Dr. Arthur Kelly, veterinarian of the Balboa Park Zoo, submitted on the 24th of November a report on the health, food consumption, and increase in weight of the six fur seals in his care. So far as is known, these are the only Callorhinus ursinus in captivity in the world.

## BEHAVIOR IN THE WILD, MISCELLANEOUS

### Electrocardiograms

Dr. Fred Alexander, cardiologist from the Massachusetts General Hospital, spent a week on St. Paul Island studying the temporary employees of Aleut stock. He made electrocardiograms of a pup and a bachelor fur seal.

## BYPRODUCTS

### Vitamin A

Studies were continued in cooperation with F. Bruce

Sanford of the Seattle Technological Laboratory, of the vitamin A potency of seal liver. The biologists collected 51 livers and shipped them to Seattle. Since the 1947 research had shown that the pale livers have a higher potency than the maroon-colored ones, the 1948 samples were selected on the basis of paleness. Out of each row of ten carcasses laid out on the killing field, the palest liver was selected. Laboratory analyses in the fall of 1948 revealed the following data (in part):

Year	Sample	N	Mean "spec" units per gram of oil
1947	bachelors, unselected	95	57,430
1948	bachelors with pale livers	51	137,310

The range in potency of the pale livers was 4,170 to 634,000 units per gram of oil. Of the 51 livers, 16 had potencies exceeding 100,000 units per gram of oil. The reason for the high potency of the pale livers as compared with that of the normal, maroon-colored ones, is unknown. Whether studies of vitamin A in seal liver will be pursued in 1949 has not yet been decided.

#### Native uses of byproducts

An article entitled "Use of Fur-Seal Carcasses by Natives of the Pribilof Islands, Alaska," by Scheffer, appeared in the Pacific Northwest Quarterly (39:131-132 and plate, April 1948).

## COOPERATION WITH FOREIGN BIOLOGISTS

Canada

Dr. Georges Prefontaine, representing the Fisheries Research Board of Canada, was on St. Paul Island from the 13th to the 16th of July. He arrived and departed on the FWS photographic airplane.

England

Dr. G. C. L. Bertram, former naturalist on the Falkland Islands and member of the Discovery Committee, applied to the Washington office in November for permission to visit the Pribilof Islands in 1949. He has studied, and published accounts of, the southern fur seal, elephant seal, and sea-lion.

## ECOLOGY: OCEANOGRAPHY AND WEATHER

Seawater temperatures

A plan which has long been considered, to install a recording thermometer in the sea at St. Paul Village, was recently abandoned. Agent Dan Benson and the biologists reexamined the beaches and noted the damage done by ice during the previous winter. The thermometer, which had been borrowed from the Weather Bureau in Washington, D.C., was returned to the local WB station on St. Paul Island.

On the 25th of September the biologists collected samples of marine molluscs and seawater for Dr. Heinz A. Lowenstam,

University of Chicago. Dr. Lowenstam is "collaborating with Dr. Harold C. Urey of the Institute of Nuclear Studies in establishing a palaeo-temperature scale by means of the isotopic composition of recent marine shells."

#### ECOLOGY: PHYSIOGRAPHY

##### Geology of the Pribilof Islands

Dr. Tom Barth of the University of Chicago and Mr. Ray Arnett of Stanford University spent about two weeks on the Pribilofs preparing a geological map. The biologists helped by providing transportation, photographs, and local information. The Pribilofs, it seems, are not of kindred origin with the Aleutian Islands, and are of rather complex formation. When the geological report is completed, it may shed light on the problem: "Why do the fur seals visit the Pribilof Islands, and how long have they been doing so?"

#### FOOD HABITS: STOMACH CONTENTS

##### From California

A small adult female seal was shot on the 12th of December about 10 miles SSW of Farallon Island. Her stomach was well filled with small, smelt-like fish and squid. The contents were sent to the Denver food habits laboratory of the FWS. The food habits of fur seals in California waters are known from the examination of only two stomachs. The biologists regret

that they were unable to collect a goodly number of samples there. During the Black Douglas cruise, ten or a dozen seals were shot at, three or four were wounded, but only one was recovered.

## GROWTH AND MEASUREMENTS

### Annuli on teeth

In certain fishes, the presence of growth rings or annuli on the scales and otoliths is evidence of the age of the individual. Various parts of the body of the fur seal have been examined from time to time with a view to discovering a similar clue to age. In 1948 it was found that the roots of the canine teeth of seals up to seven years of age show definite annuli (Fig.2). (There are at the present time no tagged seals older than seven years.) The annuli appear as a series of ridges and depressions encircling the tooth. Each ridge probably represents dentine laid down in winter when the seals are feeding and each depression represents dentine laid down in summer when the seals are resting on land. Both sexes show the annuli, in spite of the current belief that the summer feeding habits of the mature males and the mature females are different. In very old bulls the annuli are absorbed or are buried, - at any rate they are not distinct. A study should be made of growth rings using the known-age specimens from one to seven years old now stored in the Seattle lab. If the age of a seal can be determined by this simple means, it may obviate to a certain extent the necessity of tagging pups in order to obtain known-age specimens.

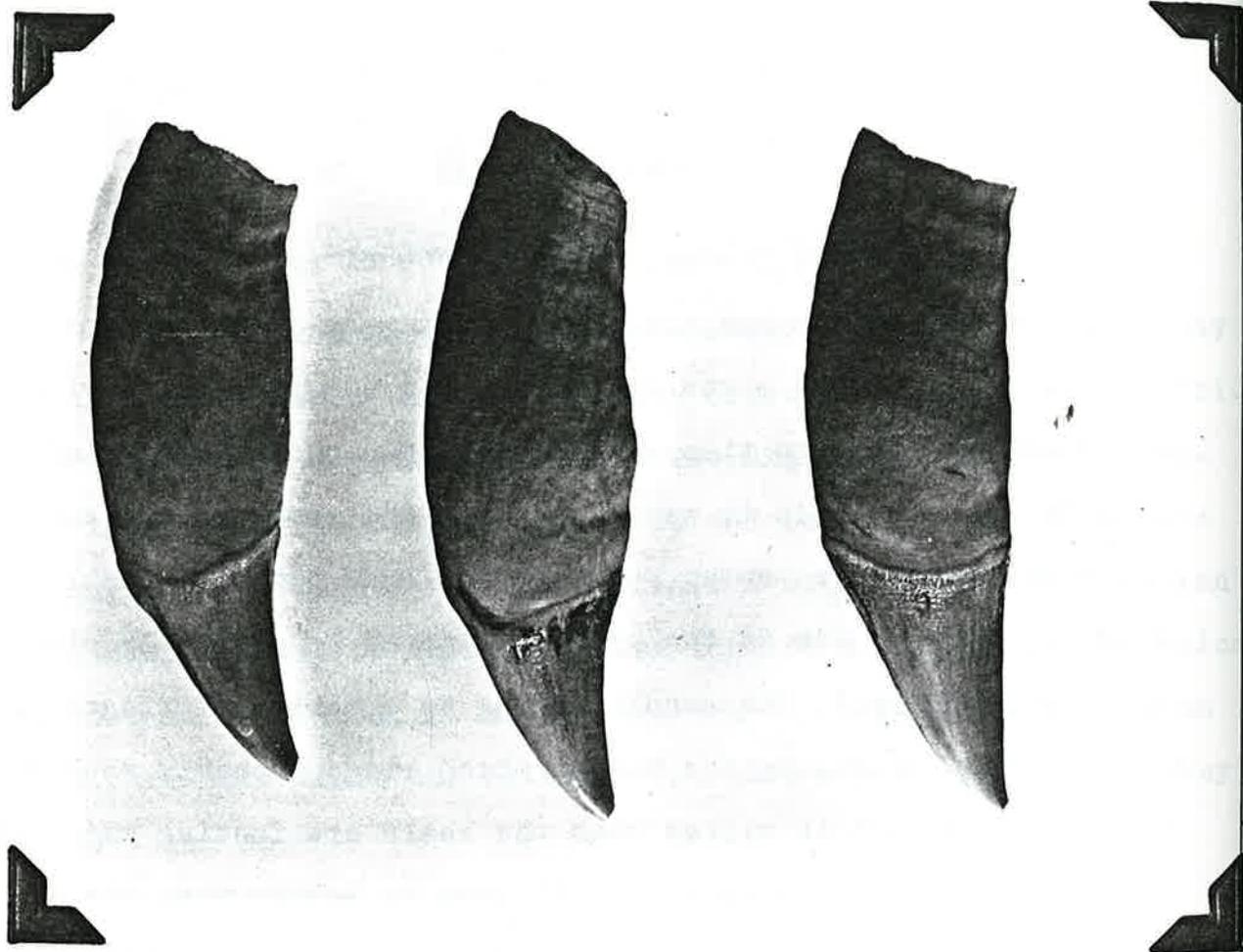


Fig.2 Annuli on fur seal teeth, upper right canines, X2.  
The left and the middle teeth are from known-age seven-year males,  
the right tooth is from a male of unknown age. (Photo 2411)

Known-age specimens

Continuing a project started in 1941, the skins and/or skulls of ten marked, known-age seals were collected in 1948, as follows: 2 one-year males, 1 three-year female, 6 seven-year males, and 2 seven-year females. In addition, 8 newborn, or full-term fetal, pups were collected. It will soon be possible to state rather definitely the average size of the newborn seal pup. At present, there are recorded the weights of 6 males (mean 11.9 pounds) and 3 females (mean 9.4 pounds).

Of the 973 pups tagged in 1945, 43 were killed in 1948 on St. Paul Island and 3 on St. George Island. The mean length of the body as measured in the usual way on the killing field was 42.27 inches and the range was 40 to 45 inches. The official age-length standard for three-year males is 41 to 45 inches. The specimens fall nicely into this group, which is not surprising since they were hand picked by the clubbers on the basis of size.

Another group of tagged seals recovered in 1948 included 6 seven-year olds; mean length 60.33 inches, range 57 to 70 inches. There is no age-length standard for seven-year males; the nearest being that for six-year olds, 58 to 63 inches.

(Please see under "Reproduction: Anatomy" a discussion of measurements of testes and bacula.)

## JAPANESE HERD

Collaboration with Ford Wilke

Ford Wilke arrived in Tokyo in the fall of 1948 to investigate Japanese sealing records, sealing methods, etc. He is planning to work at sea in early 1949 on a sealing expedition outfitted by the Japanese Marine Animal Company. Scheffer wrote to Wilke on the 19th of November suggesting that the latter collect bull seal skulls for taxonomic comparison with skulls from the Pribilof Islands.

The Japanese lost their only seal breeding grounds, on Robben Island, off southern Sakhalin Island, when the Soviet took possession during World War II. Numerous seals feed in Japanese waters, however, during the winter and spring months.

#### MARKING SEALS

##### 1948 series

Seal pups were tagged on St. Paul Island to provide marked animals for study, in the future, of migration, growth rate, and other phenomena. The salient features of the 1948 tagging program are:

Dates, 13th to 22nd of September, or 7-1/2 working days

Crew, 10 to 12 natives and 2 biologists

Number of seals tagged, 19,532

Number of tags which failed and were discarded, 231

Number of tags unused at end of season, 237(1)

- 
1. Operations halted by a snowstorm.

Specifications of tags, monel metal, sheep-hog size  
as used in 1947, numbered B-1 to B-20,000,  
applied to left fore arm pit

Number of seals killed by handling, 35 or 0.17 per cent

Best day's work, seals tagged, 3,190

The tagging was much easier in 1948 than in 1947, for the following reasons: 1. Since the operation was completed 18 days earlier, the pups were smaller and easier to handle. 2. The National Band and Tag Company provided applicators (pliers) improved in having restraining flanges on the lower jaw. 3. In 1947, a hole was punched in the hind flipper as a double check on the tag in the fore flipper. In 1948, however, it was considered unnecessary to punch a hole, since the purpose of the tagging operation was different. Thus, in 1948, the work went faster. 4. Tagging was done only on the rookeries best adapted by slope and smoothness for easy driving of pups. No tagging was done on Zapadni, Northeast Point, Tolstoi, and Lukanin-Kitovi.

Embarrassing features of the 1948 season were: 1. The tags provided were the same mediocre ones tried out in 1947. While only 231 tags were logged as complete failures in 1948, there were several thousand that clinched poorly. It is felt that a better tag can, and should be, provided. 2. The tags arrived late in the season. Scheffer was obliged to fly to Seattle and fly back with the tags, at a needless cost to the Government of perhaps \$500. Future tagging operations should be started on the first of September and they should be planned on a modest scale, say on 5,000 pups, until an effective tag has been developed

through test and observation.

The success of the 1945 operation, when a 2-hole tag was used, indicates the possibilities in this direction.

Record of pup tagging, 1948

September	Rookery	Tags handled, B-Series	Seals effectively tagged
13	Polovina	1 - 2,700	2,653
14	Polovina	2,701 - 5,500	2,753
16	Polovina Cliffs	5,501 - 8,100	2,534
17	Polovina Cliffs Little Polovina	8,101 - 11,000 and 11,720 - 11,800	3,076
18	Little Polovina	11,101 - 12,300 (except 11,720 - 11,800)	1,116
20	Gorbach	12,301 - 15,500	3,190
21	Gorbach	15,501 - 18,000	2,477
22	Gorbach and Reef	18,001 - 19,000	979
22	Little Zapadni	19,001 - 20,000 (except 19,103 - 19,125; 19,201 - 19,214; 19,301 - 19,500)	754
		Total	19,532

Recoveries in 1948

Four tagged yearling seals were taken on the Northwest coast. These represent the first marked seals reported from the

American coast out of the 30,000 tagged since 1941.

15 February	Tokeland, Washington	Sex?	Tag A-11833
19 March	Nootka Sound, B.C.	Sex?	/Tag A-18721
26 March	Gearhart, Oregon	Sex?	Tag A-6281
20 April	Neah Bay, Washington	Male	Tag A-14,302

Mention has been made of the 46 tagged three-year males killed in routine sealing operations on the Pribilof Islands in 1948, and of the few tagged animals taken as scientific specimens.

#### Rubber collars on seals

What seems to be a likely answer to the "mystery of the rubber collars" was recently provided by Col. H. M. McCoy, Chief of Intelligence, U. S. Air Force. From 1944 to 1948, ten seals wearing rubber collars were killed on St. Paul Island. The collars were identical and were unlike any of the other objects that have been found occasionally on the necks of seals. In letter of the 7th of June 1948, to Frank G. Ashbrook, Col. McCoy stated:

"Personal Equipment personnel suggest that the rings are possibly fragments of rubber bags used by the Japanese for aerial delivery of food and water. It is known that such bags were used in the latter years of the war; however the known bags were manufactured of synthetic rubber similar to neoprene."

MIGRATION: ARRIVAL AND DEPARTURE

#### The hauling-out pattern

The return of bachelor seals (as reflected by the kill of three-year olds) is erratic from day to day. The mean return calculated over a ten or fifteen year period, however, follows rather closely the "normal curve" of the statistician. The curve has a peak between the 10th and 15th of July. In 1948, the return of bachelor seals was strongly influenced by stormy weather which caused a slump in the kill near the 20th of July (Fig.3).

Fifty-three tagged males known to be three-year olds were killed on St. Paul Island in the course of the regular sealing season. Their frequency distribution was, as follows:

Five-day round with mid date	Number of tagged 3-year males killed during round
20 June	0
25 June	0
30 June	3
5 July	4
10 July	12
15 July	14
20 July	6
25 July	<u>14</u>
Season	53

While these figures are similar to the ones plotted in Figure 3, they are derived from true three-year olds and they reflect the hauling out pattern of true three-year olds.

It will be interesting to plot, in a similar way, the frequency of recoveries of the three-year olds which will be killed in 1950 and 1951. It is estimated that about 1,000 will be recovered each year. The estimate is based on the fact that the 1948 recoveries were from an original stock of 973 tagged

thousands  
of seals

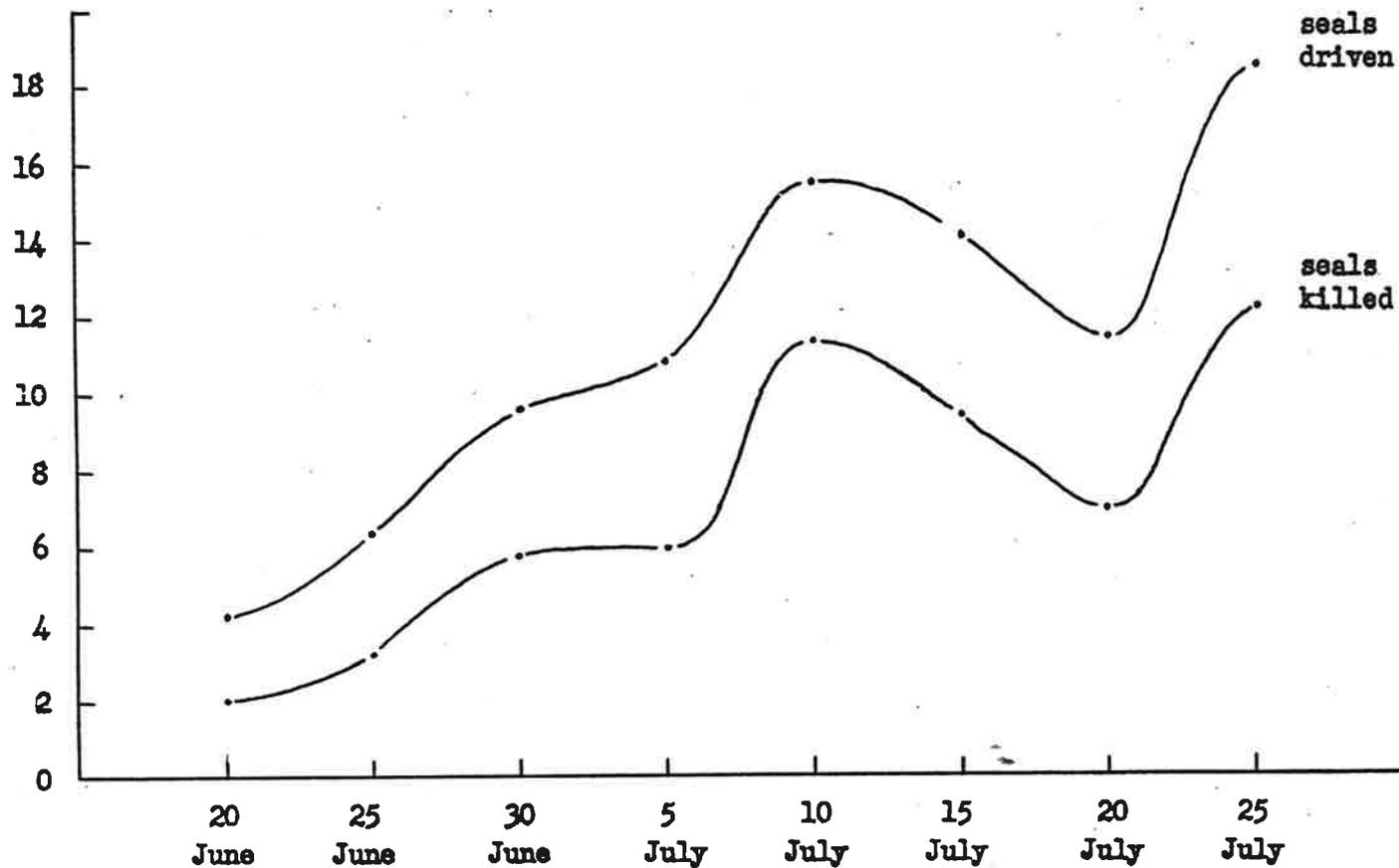


FIG.3 FUR SEALS KILLED AND DRIVEN ON ST. PAUL ISLAND, ALASKA, IN 1948

pups, while the 1950 and 1951 recoveries will be from original stocks of 19,183 and 19,532, respectively.

### Total kill

From the commercial point of view the bachelor seals hauled out in satisfactory numbers in 1948. The Pribilof kill for the past ten years has been, as follows:

<u>1939</u>	60,473	<u>1944</u>	47,654
<u>1940</u>	65,263	<u>1945</u>	76,964
<u>1941</u>	95,013(1)	<u>1946</u>	64,523
<u>1942</u>	145(2)	<u>1947</u>	61,447
<u>1943</u>	117,164(3)	<u>1948</u>	70,142

### Greatest single day's kill

Peculiar weather conditions on St. Paul Island were responsible for the greatest single day's kill in the present century. A storm at Northeast Point on the 22nd of July held many seals in the water, and the kill here was only 1,108. When the field was revisited on the next round, five days later the kill was 4,027.

### Seals on land in November

The biologists were afforded an opportunity to see the

- 
1. Not a normal season. An effort was made to take 30,000 extra skins.
  2. Operations limited by war.
  3. Not a normal season. An effort was made to recoup the losses of 1942.

seal beaches quite late in the season when they visited St. Paul Island on the 24th of November. The weather was freezing, the sky overcast, and the rookeries partly coated with frozen sea spray. On Tolstoi and Tolstoi Sands there were about 5,000 seals, or five per cent of the number present in mid-summer. On Lukanin and Kitovi there were not over 25 seals on land. The seals at this season were pups, yearlings, and a few cows and bulls. A semblance of harem structure could be seen here and there.

#### MIGRATION: AT SEA

#### Itinerary of the Black Douglas, 1948

In October and November 1947 biologists on the Black Douglas counted fur seals in waters along the coast of Alaska from Dixon Entrance to Attu Island. In November and December 1948 they repeated part of the journey, that is, from Dixon Entrance to the Pribilof Islands. They then struck southeast and ran a 2,000 mile course across the open Pacific from Dutch Harbor to San Francisco. They spent several days in southern waters and then headed for Seattle, running at various distances offshore. During daylight hours a biologist was on watch in the wheel house to observe and record all seals encountered. Details of the journey are, as follows:

2 November Left Seattle with biologists V. B. Scheffer and Karl W. Kenyon, Capt. Clyde I. Dell, and crew of eleven. Because of the maritime strike which had held up shipping since August, the ship carried a heavy load of FWS cargo for Alaskan ports.

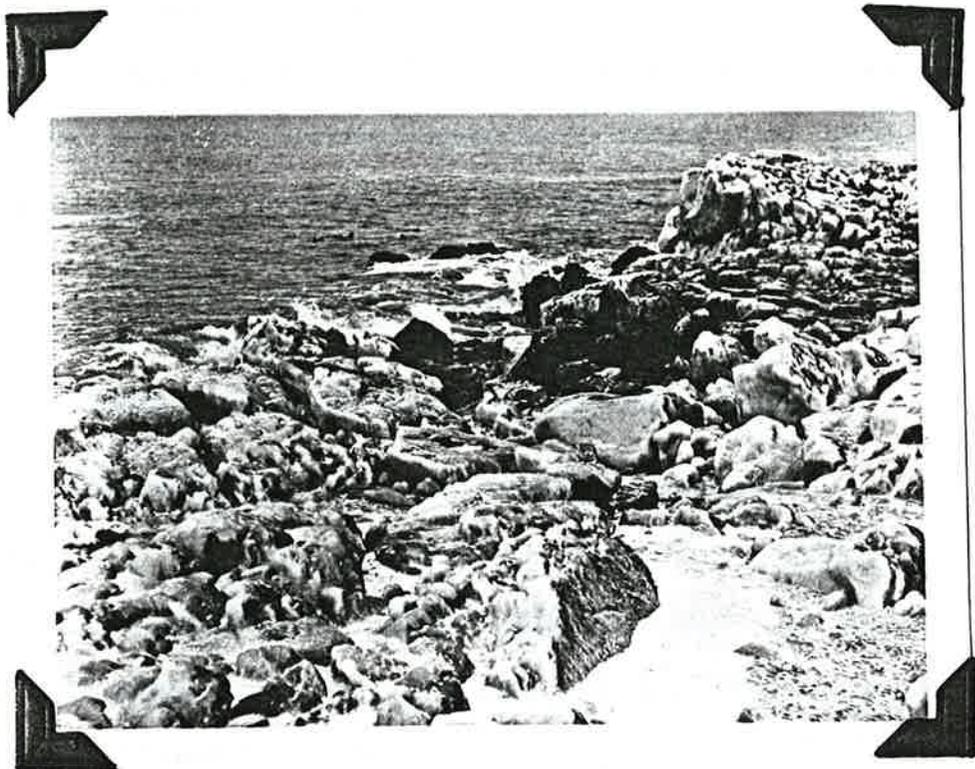


Fig.4 Winter on a fur seal rookery; a few seals on land and a few in the water; Kitovi, St. Paul Island, Alaska, 24 November 1948. (Photo 2454)

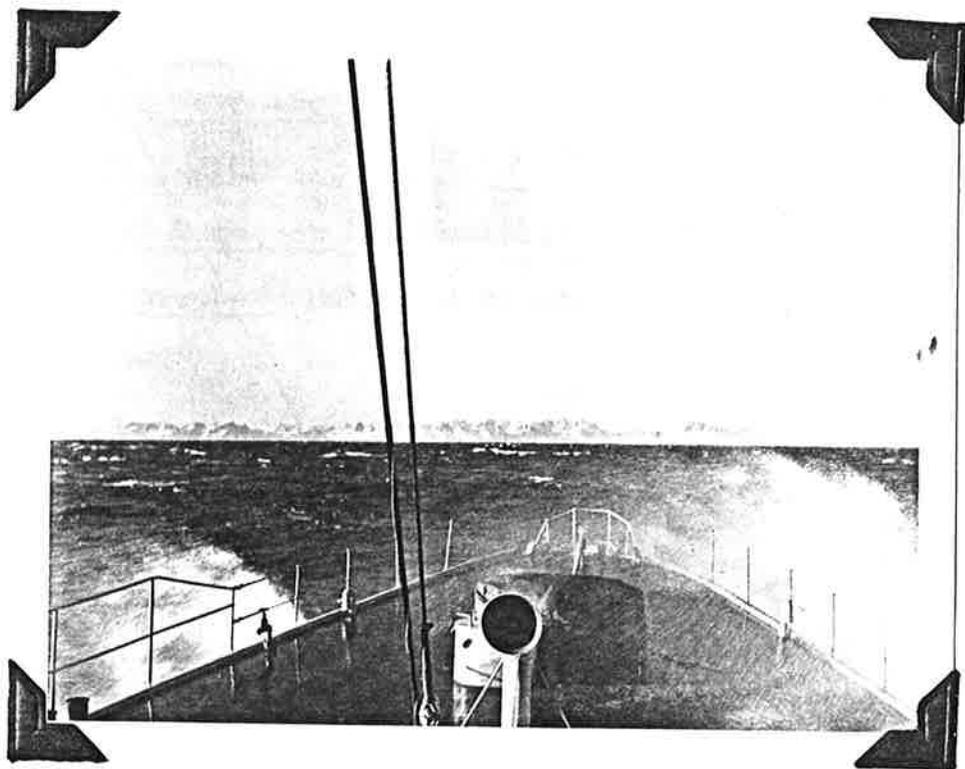
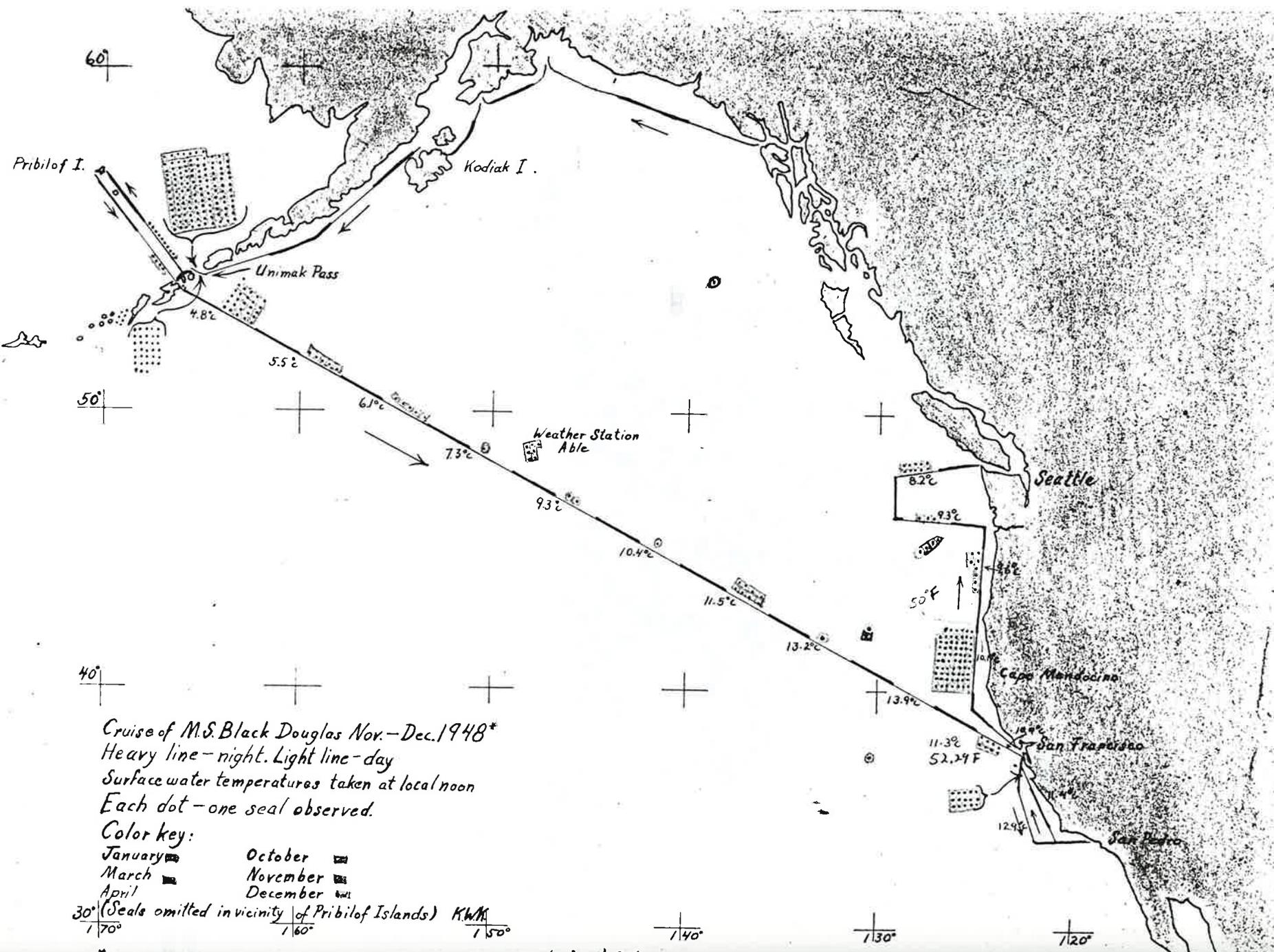


Fig.5 USFWS Black Douglas on seal patrol near the Semidi Islands, Alaska, 18 November 1948. (Photo 2451)



6-11 November Unloaded cargo at Ketchikan, Wrangell, Petersburg, and Juneau.

13 November Unloaded at Cordova.

14 November Docked at Whittier.

15 November Unloaded at Seward.

16-17 November Unloaded at Kodiak, loaded Pribilof mail, repaired radio.

19-23 November At Unalaska in a gale.

24 November Unloaded at St. Paul Island. Observed and photographed seals on land.

26 November Departed Akutan Pass.

7 December Arrived San Francisco for mail and for conference with FWS officials to whom the ship will be transferred in the spring of 1949.

9 December Arrived San Pedro to take oil and water.

10-11 December Cruised in vicinity of Channel Islands.

12 December Anchored at San Francisco in a storm to work on specimens.

17-18 December Ran 200 miles west of the Washington coast and returned.

19 December Anchored at Neah Bay, Washington, to talk with native sealers.

20 December Arrived Seattle.

Nautical miles cruised 7,406

#### Results of the cruise

While the cruise of the Black Douglas was rather

uneventful, certain biological data were obtained. These are listed below in approximate order of importance. (Please see also the chart, Figure 6). Along with the observations of the Black Douglas biologists are included certain brief but important notes made by U. S. Coast Guard officers during 1948.

1. Seals are widely dispersed in the north Pacific.--

During the ten-day run of the ship from the Aleutian Islands to California, seals were seen daily in the path of visibility, 150 to 200 yards on either side of the ship. Considering that the path of the ship was extremely narrow, relative to the spread of the north Pacific, it is reasonable to assume that the total number of seals present in the north Pacific was large.

Coast Guard Commander Midtlyng reported that he saw seven seals at Weather Station Able in October (Lat. 49°N., Long. 148°W.). This suggests that some seals leave the Pribilofs early in the fall and are far at sea by October.

2. Seals concentrate along the coast.-- It may be concluded tentatively that in early winter more seals feed along the west coast of America than in mid-ocean. The heaviest concentration (except of seals traveling through Unimak Pass) was found on the 15th of December about 40 miles off the coast of northern California.

3. Seals head southeast after leaving the Pribilofs.-- By reference to Figure 6 you will note that large numbers of seals were seen in Unimak Pass and, again, a day's run southeast of the Pass, while none at all were seen along the Alaska Peninsula

and in the Gulf of Alaska. This is evidence that certain classes of seals head rather directly for deep water after leaving the breeding grounds. The classes included seem to be the adult females and the <sup>sub-adults</sup> bachelors of both sexes.

Seals also concentrate in Unimak Pass in April, according to a report from Lt. R. B. Moore of the Coast Guard Cutter Unalga. During the 22nd and 24th of April he counted a total of 33 seals there and found them "numerous" on the 28th of April. Perhaps some seals feed in the Pass all winter. More likely, some seals feed in the Pacific and return to the Bering Sea early in the spring.

4. The southern limit of distribution.-- Fifteen seals were counted on the 12th of December off Monterey, California. No seals were seen south of here, although the ship went on to San Pedro and returned.

While headed from San Francisco for Weather Station Fox, which lies on the course to Honolulu, Commander Midtlyng saw no seals in December farther south than the one spotted in Figure 6. This seal was 400 miles west of San Francisco.

5. Seals tend to travel alone.-- While on land the seals are strongly gregarious. At sea they travel alone or in very small groups. The largest group seen was of eight individuals. (These were milling around in a feeding area occupied by sea birds and white-sided dolphins<sup>off Monterey, Calif.</sup>.) Groups of seals were observed, as follows:

Number in group	Frequency
1	136
2	52
3	13
4	2
5	1
6	1
7	0
8	1

It is important to note that, with rare exceptions, when two seals were seen together they were of similar size and were obviously not mother and pup. The question of whether the pup accompanies its mother during the first winter can be answered in the negative.

6. Age and size groups.-- The biologists were able to classify the seals observed as small, medium, or large, but could not identify accurately the sex of most animals. Occasionally the white whiskers of the mature cow were plainly visible. Most of the seals were adult cows or medium sized animals, presumably subadults of both sexes. During the entire cruise only two bulls were seen, one in Unimak Pass and one off north central Oregon. Eight pups were seen in Unimak Pass and one 120 miles off Cape Flattery, Washington.

7. Behavior of the seals.-- For the most part the seals were lying quietly on the surface of the water or writhing about, rubbing their bodies with their fore flippers. Off the California coast, where calm water was encountered, most of the seals were sleeping on the surface with the flippers of the right or left side projecting above the water like periscopes. The only seals,

other than those frightened by the ship, which were definitely traveling were the 127 seen in Unimak Pass on the 19th of November. Seals frequently jumped clear of the water while heading into the breaking seas.

8. Conclusions.-- Judging from the limited data at hand, the cows and subadults of both sexes drift away singly from the Pribilof Islands and head for the Pacific Ocean via Unimak Pass. They encounter the North Pacific Drift which moves slowly eastward and splits against the Oregon coast. The seals accumulate near this coast in winter, then follow the counterclockwise current up the coast to Alaska in the spring. It is quite possible, too, that some seals feed in the winter in the north Pacific and return to Unimak Pass without approaching the American shore. Little is known of the migration of the bulls, the silver pups, and seals in general in the western half of the north Pacific.

#### MORTALITY ON PRIBILOF ISLANDS

##### Hookworms Disease

Uncinariasis on St. Paul Island was the most severe on record since the days of pelagic sealing. (In those days, it was difficult to distinguish between starving orphan pups and those succumbing from hookworm.) The biologists and a crew of four natives counted 21,600 seal pup carcasses at Northeast Point on the 10th and 11th of August 1948 (Figs. 7 and 8). Of this number, about 19,000 were actually tallied and the remainder were estimated in areas where, to attempt a count would cause living seals to



Fig.7 Fur seal pups dead as a result of hookworms,  
Northeast Point, St. Paul Island, Alaska, 11 August 1948. (Photo 244)

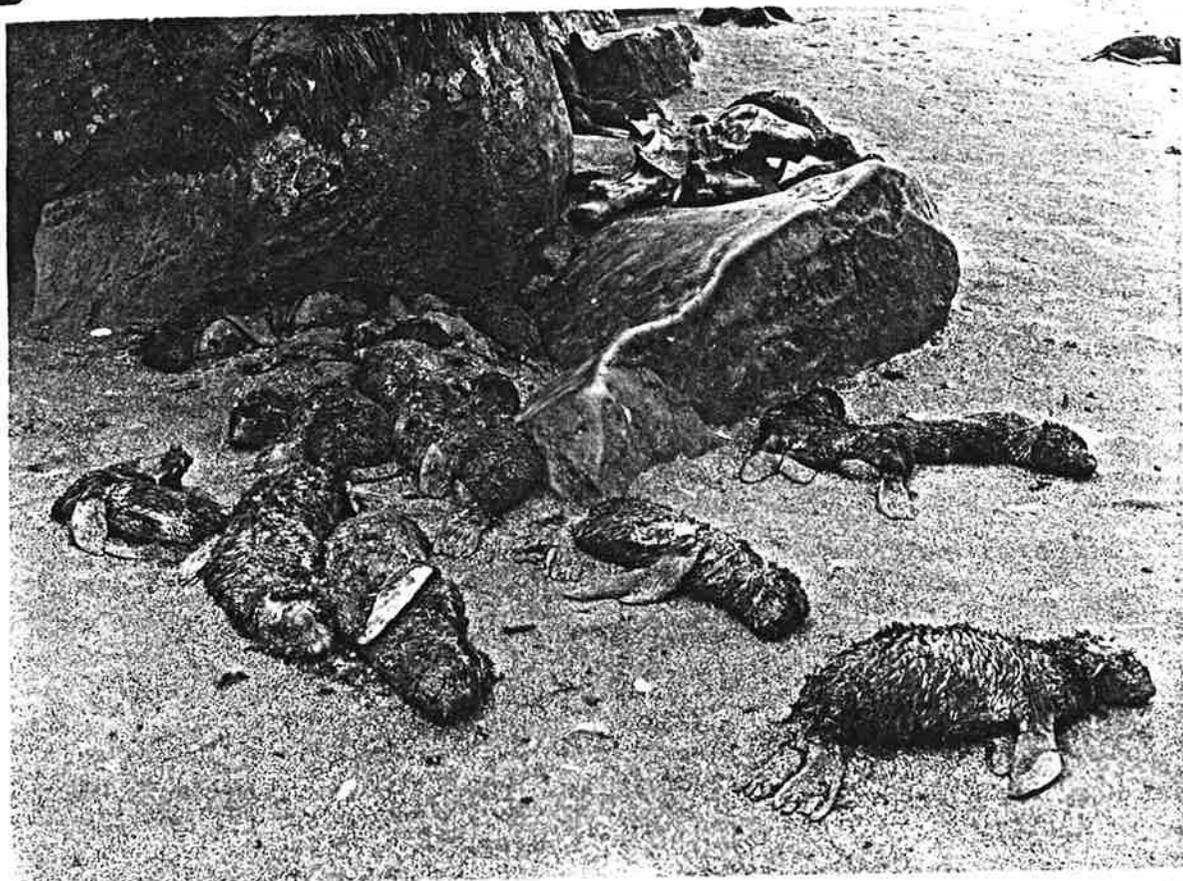


Fig.8 Fur seal pups dead as a result of hookworms, Northeast Point, St. Paul Islands, Alaska, 11 August 1948. (Photo 2442)

stampede and smother.

Ten fresh carcasses, seven females and three males, were selected at random and were dissected. All had Uncinaria and bloody mucus in the small intestine. Five were fat, five were poor; none was emaciated. The stomachs of four contained curdled milk. There was no observable correlation between concentration of carcasses and kind or exposure of beach although the carcasses, as well as the living seals, were more abundant near the edge of the water. The flat and beach extending over five acres below Hutchinson Hill seemed to have the greatest number of carcasses. Moderate to heavy mortality has been observed here since 1944.

At the time of the count, the biologists saw not more than a hundred pups that were thought to be dying, and some of these may have been starving orphans. The peak of the epidemic was estimated to have passed in the last week of July, judging from the stage of decomposition of the carcasses.

Other rookeries were examined for pup mortality. On the 13th and 14th of August the biologists traversed the catwalks on Reef, Gorbach, and Tolstoi. There were many carcasses, -- in places as many as below Hutchinson Hill. At Tolstoi on the 14th the warm, fresh carcass of a pup was found. Its stomach was bulging with milk and milk was running from its mouth. Hookworms were present in the intestine. To a certain extent, at least, well-nourished pups succumb suddenly to the parasite.

On the 11th of August, Scheffer gathered a pint of white shell sand below Hutchinson Hill. He shook the sand with a gallon of water and examined the turbid supernatant liquid under a

microscope. Small worms similar in shape to Uncinaria but only one-tenth the size were observed. Were they larval hookworms? A parasitologist should be sent to the Pribilof Islands for a summer to plan and direct research on the various worm parasites of the fur seal.

From past years there are two references with which the dead pup count of 1948 may be compared: On the 2nd of September 1938 the Agent estimated that there were 2,500 to 3,000 dead pups at Northeast Point and he believed that this number was lower than usual (St. Paul Island Log). On the 8th and 9th of September 1941, biologists Wilke and Banner counted 8,641 dead pups at Northeast Point.

#### Tapeworms

In July 1945 Scheffer collected tapeworms from the fur seal and sea-lion on St. Paul Island and forwarded them for study to Dr. Horace W. Stunkard, New York University. A rather detailed report has recently appeared: "Pseudophyllidean Cestodes from Alaskan Pinnipeds," Journal of Parasitology 34:211-228, June 1948. Dr. Stunkard found two species of tapeworm in the fur seal, a third in the sea-lion, and a fourth in the bearded seal.

#### Dermoid cyst

A native sealer in cutting open the belly of a bachelor seal found a large roundish object the size of a grapefruit; weight 1-1/4 pounds. The object was located in the postabdomen. The biologists dissected it and found that it was a dermoid

(fetal) cyst containing bone, cartilage, hair, and assorted tissues in disorderly arrangement. It was the first such recorded from the fur seal.

#### PELAGE

Under this heading, the only important research in 1948 was the grading of study skins, collected in 1947, at the Fouke Fur Company plant. Frank G. Ashbrook is handling the research.

#### Albino seals

Two pure albino pups were reported from the Pribilof Islands during the count of bulls in July.

#### Marine organisms on fur

Barnacles were observed on the pelts of two females taken on the Washington coast in April. Barnacles and a heavy coating of red algae were observed on a female taken off California in December (Fig.9). Samples of the algae have been sent to Dr. G. F. Papenfuss for identification. One is led to suspect that marine organisms are common on seals during the time they are wintering in warm waters. On the Pribilofs, the seals are clean.

#### POPULATION: METHODS OF ESTIMATING

#### Aerial photography

A "Preliminary Report of Aerial Photography of Fur Seal

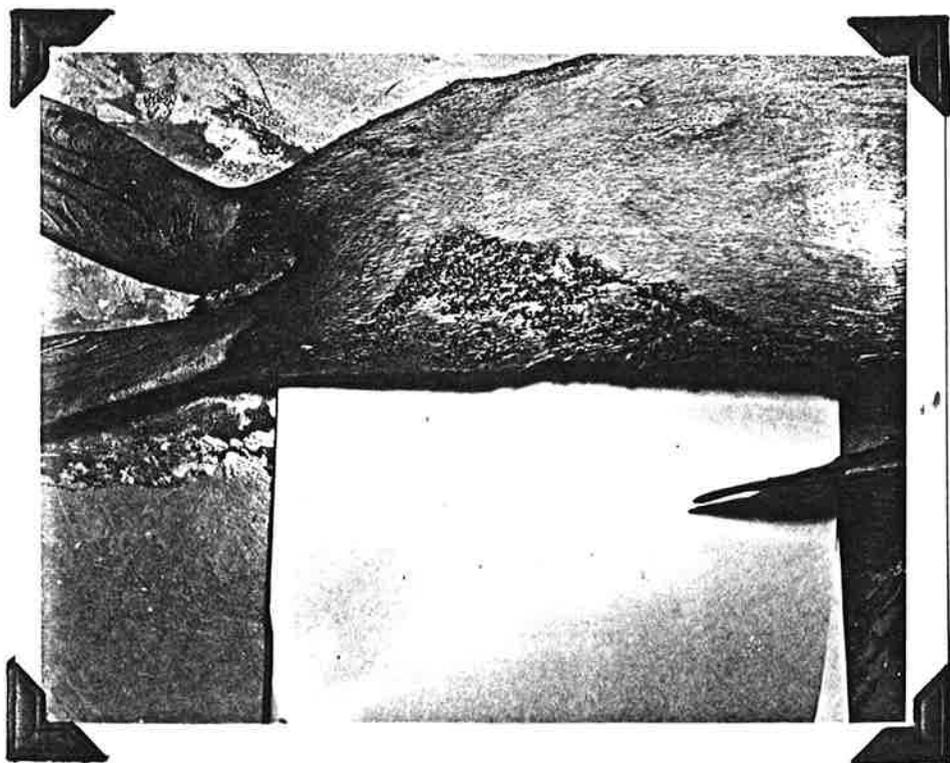


Fig.9 Belly of fur seal showing growth of marine algae;  
seal shot off Farallon Island, California, 12 December 1948.  
(Photo 2464)

Breeding Areas on the Pribilof Islands, July 14-15, 1948" was completed by Kenyon on the 27th of September. A more complete report, supplemented with a mosaic map of the rookeries, will be prepared in the spring of 1949. The aerial survey was intended to facilitate a count of fur seal pups. As far as this objective is concerned, the results are not satisfactory. The photographs are not sufficiently distinct. A new experiment should be tried, using a Sonne Continuous Strip Aircraft Camera, Model S-7, and a trained technician-photographer.

While the photographs do not fulfil critical requirements they suggest an interesting possibility, that of computing seals on the basis of area. The 1948 photographs reveal that the masses of breeding animals are rather compact and well defined. The suggestion is made that an experiment be tried in 1949, as follows:

1. On or near the 18th of July, photograph Zapadni Reef rookery from an airplane or with a balloon-supported camera. The 18th is the date when the annual count of bulls is made on this rookery.
2. On an enlarged photoprint, measure the area occupied by the breeding animals.
3. On the 10th of August, drive off the adult seals and count the pups, as was done during a demonstration pup count in 1940. The annual computation of fur seals, or "closing of the books" for the year is figured as of the 10th.
4. Calculate the number of pups (and mothers) per unit

area on Zapadni Reef.

5. On a complete rookery mosaic map apply the seals-per-square-unit factor which was obtained on Zapadni Reef, and therefrom calculate the Pribilof pup population as of the 10th of August. The rookery mosaic could be based on the 1948 photographs although it ought to be based on photographs made with the Sonne Strip camera.

6. The above experiment would be modified, in so far as practicable, to include several rookeries, or parts of rookeries, in addition to Zapadni Reef in order to study the effect of areal spacing of seals on various types of terrain.

#### Balloon camera

In 1947 the biologists constructed a 4 x 5 inch camera and suspended it from a Weather Bureau balloon for the purpose of mapping seal rookeries from the air. In 1948, on the 6th of August, a new and larger balloon with capacity 200 cubic feet (1 cylinder) of hydrogen was sent aloft four times, at elevations between 400 and 900 feet (Fig.10). The day was remarkably calm, and as a result the balloon rose almost directly above the operators. It would have been better had a light breeze pulled the balloon away from the reel, toward the rookery. Figure 11 is a photograph taken from a height of 400 feet, covering a plot of ground 260 x 350 feet. Photographs taken from the airplane in 1948 are sharper than those taken from the balloon. Since, however, the balloon is simple to handle, experiments with it will be continued. The next step will be to add 5 pounds of lead to the



Fig.10 Apparatus for photographing seal beaches from the air: balloon with camera suspended, reel, dry cells, and cylinder of hydrogen. Polovina, St. Paul Island, Alaska, 6 August 1948.  
(Photo 2431)

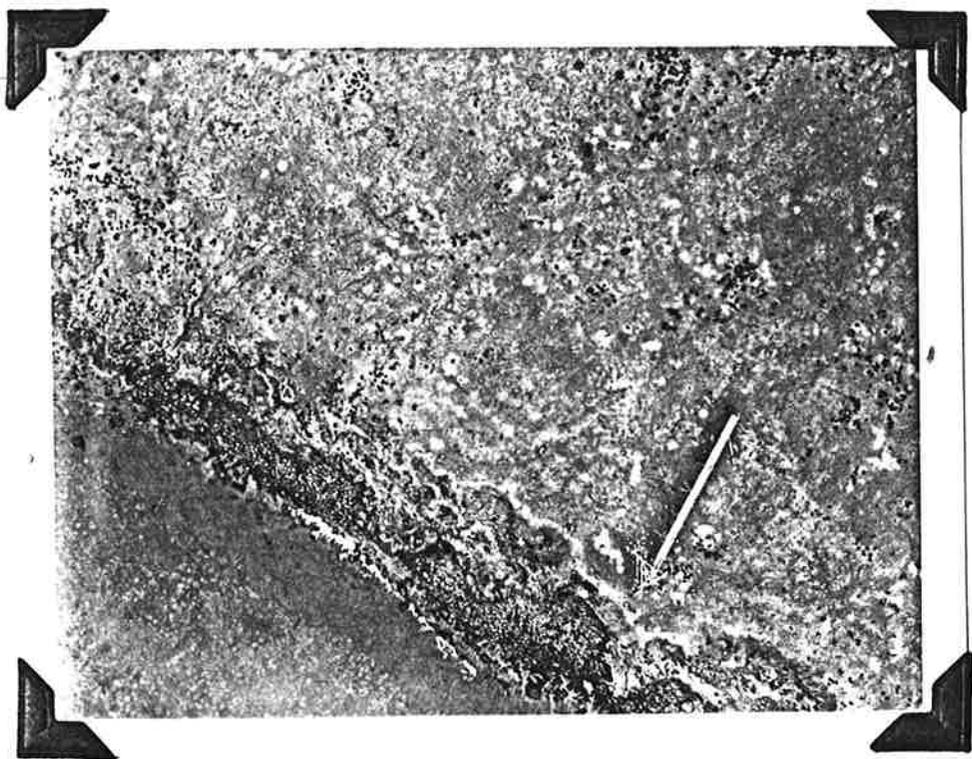


Fig.11 Photo from balloon, elevation 400 feet, Polovina, St. Paul Island, Alaska, 3:25 p.m., 6 August 1948; overcast; exposure 1/200 second at f:4.5. The structure shown is an elevated walk about 70 feet long. (Photo 2433)

camera and to extend the supporting line to a length of 100 feet, in order to reduce vibration and sway from air currents.

#### Computed size of the seal herd

On the 18th of March, Scheffer submitted a graph entitled "Counted Elements in the Alaska Fur Seal Herd Compared with the Computed Size of the Herd." Evidence was presented that 1. the computed size of the herd is too high, 2. a discrepancy between actual and computed size started to develop in the early 1930's, 3. the herd is now at, or near, its maximum size, 4. it is fluctuating more widely than it did in the 20's and 30's, 5. the publicized mortality rate for pups (1.7. per cent) is too low, and 6. the publicized ratio of breeding bulls to cows (1:95) is too high.

#### REPRODUCTION: ANATOMY

#### Growth of testes and baculum

Certain data on the weight of the testes and the length of the baculum in marked, known-age seals have been accumulating since 1941. An article for publication will be prepared shortly on this subject. The bacula have been cleaned and dried and are preserved in the Seattle lab. Most of the testes were discarded while fresh, although a few were sent in formalin to Swarthmore College. The samples are meager for certain ages, although for the critical ages from four to five, when spermatogenesis begins, they are adequate.

TABLE I. WEIGHT OF THE TESTES IN FUR SEALS FROM BIRTH TO AGE 7 YEARS(1)

Age	N	Arithmetic mean	Geometric mean	Coefficient of variation
Newborn(2)	3	2.8	2.8	12
1 year	1	3.2	3.2	-
2 year	6	10.2	9.8	32
3 year	111	21.9	19.0	56
4 year	180	55.9	52.0	33
5 year	27	81.2	78.4	26
6 year	22	94.2	92.6	20
7 year	6	103.6	101.6	21

- 
1. Weight, in grams, of the fresh testes; samples from marked animals of known age collected in mid-summer on St. Paul Island, Alaska. The geometric means are plotted in Fig.12.
  2. Newborn pups and full-term fetuses.

TABLE 2. LENGTH OF THE BACULUM IN FUR SEALS FROM BIRTH TO AGE 7 YEARS(1)

Age	N	Arithraetic mean	Coefficient mean <i>of baculum</i>
Newborn(2)	8	27.5	16
1 year	11	49.4	7
2 years	6	54.3	7
3 years	111	66.5	8
4 years	180	82.4	8
5 years	27	97.0	8
6 years	21	108.4	5
7 years	6	116.1	4

- 
1. Length, in millimeters, of the dried baculum; samples from marked animals of known age collected in mid-summer on St. Paul Island, Alaska. The arithmetic means are plotted in Fig. 12.
  2. Newborn pups and full-term fetuses.

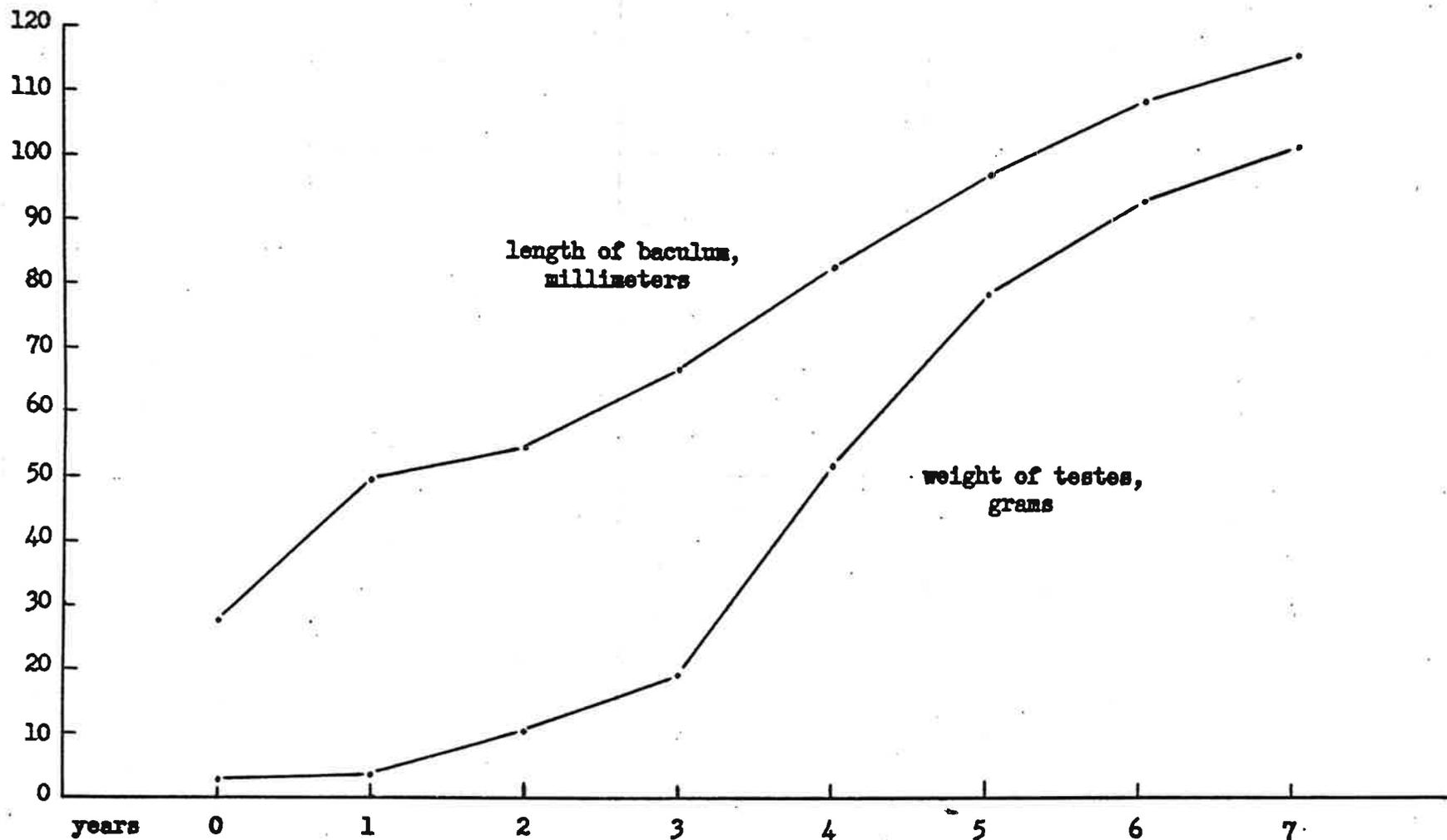


FIG.12 WEIGHT OF TESTES AND LENGTH OF BACULUM IN ALASKA FUR SEALS FROM BIRTH TO AGE 7 YEARS

(From data in Tables 1 and 2)

The data in Tables 1 and 2 are shown graphically in Fig. 12. The weight of the testes increases suddenly in the fourth year. Since, in most mammals, swelling of the testes occurs along with or just before the onset of spermatogenesis, it may be deduced that the fur seal becomes sexually mature in its fourth year. In a letter dated the 9th of September 1946 Dr. Robert K. Enders, of Swarthmore College, wrote to Scheffer:

"Our material (from the Pribilofs) indicates that spermatogenesis may start in the fourth year in some, but that it is questionable whether viable sperm are produced until the fifth year. It is very possible that the male seal may become active in sex behavior at an earlier age than spermatogenesis is established. Sex play before fertility is common among carnivores, and is rather to be expected in an animal with the social organization such as exists among the fur seals. If it is of sufficient importance to you I will do a statistical study of the number of sperm found, (1) - this would be a rough estimate of reproductive ability, - in four and five year olds. It is my present belief that in most animals five years is required to reach the stage where seals can sire pups."

It will be noted that variability is greatest in the three year group. This confirms the direct evidence that some three year old testes are definitely small and juvenile while others are definitely large and mature.

Figure 12 shows that the length of the baculum increases fairly steadily in ages up to the seventh year. (The reason for

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1. Scheffer replied, asking Enders to undertake at his convenience, a count of sperms in certain known-age testes.

the small peak at age one is uncertain. It probably indicates an inadequate sample.) The baculum does not show a sudden increase in growth and does not, therefore, offer a clue to the age when the seal matures sexually.

The data provided by the testes and the bacula indicate that, at age seven, the male seal is far from full grown. It will be interesting to carry the study onward to the point where the growth curves flatten out. Perhaps in the 10th year? the 15th?

Knowing the age at which the fur seal matures sexually is of practical importance. Maturity is tied in with the hauling-out rhythm of the bachelor seal and, therefore, with the commercial harvest of skins. If, as now appears, the average three year old is sexually immature, one can assume that the stimuli which drive him on land in the summer are less powerful than the sex drive that brings the four and the five year old animal out of the water. And, continuing this line of reasoning, weather conditions which normally prevent the three-year seal from hauling out might not deter the four and five year olds, with their stronger self-contained drives. The result is evidence in favor of killing from the four-year class rather than the three, other things being equal.

#### Sexual abnormality

Agent Dan Benson saw among the rejects on the Reef kill on the 20th of July, an animal referred to as a hermaphrodite. No cryptorchids, hermaphrodites, or other sex freaks were collected

by the biologists in 1948.

### Twin births?

During the annual bull count, Johnston and Wiltsie saw a living, small, almost hairless, pink pup on Reef rookery. On the next day, the 16th of July, the biologists recovered and examined the pup, which was by then dead. It weighed only 3-1/2 pounds, about one-third the normal weight.

Later, during a count of dead pups on the 10th of August at Northeast Point, the biologists saw four or five other premature pups. They were of several sizes and were sparsely haired; all of them dead. Two of the carcasses weighed 3-7/8 and 5-7/8 pounds, respectively. They had been dead perhaps a week.

Premature seal pups have not previously been reported although no one had searched for them. They presumably die before, or soon after, birth, and are trampled into the filth of the rookeries. An interesting thought occurs here: Perhaps each one is the runty twin of a normal pup. There is little concrete evidence on the possibility of twinning in the fur seal, but there are hypothetical cases, for example:

1. A female two years old impregnated for the first time in both horns of the uterus.
2. A seal two years old, or older, impregnated in one horn of the uterus, but two eggs present in this horn.
3. A seal four years old or older, having missed a year, being impregnated in both horns of the uterus.

In May 1923, a Bureau of Fisheries agent examined a female seal killed by natives near Sitka, Alaska, and found that she carried twin pups, one weighing 5 pounds 11 ounces and the other 1 pound 8 ounces.\* No one questions the fact, of course, that a single young is normally born.

#### REPRODUCTION: BEHAVIOR

##### Duration of fast of bull seals

Lavrenty Stepetin, an intelligent 17-year old native, visited Gorbach rookery each morning and evening, five days a week, from the 24th of May to the 22nd of July. He selected three bull seals on the basis of outstanding scars and kept a record of their position. They remained on their respective stations for 34, 54, and 59 days. These are minimum figures, since the bulls were on hand when Lavrenty first saw them.

##### Birth of young

On the 28th of June Lavrenty saw a wet cow haul out at 11:15 a.m. When he next saw her at 1:15 p.m. she had given birth to a pup.

##### Percentage of non-breeding females

Up to now the biologists have examined three mature females (specimens BDM 101, 102, and 292) taken in the winter and have found that two of them were not pregnant. While the sample is very small, it is thought provoking. It raises the old, and

\* VBS  
 ... said ...?

as yet unanswered, question as to the percentage in the herd of barren cows, and cows that for one reason or another are not impregnated. Can the percentage be estimated? Does the present ratio of one idle bull to about three harem bulls in late July indicate a truly adequate supply of male breeding stock or does it merely represent man's idea of an adequate stock?

Appearance on the rookery of tagged males

The seals tagged and branded as pups in 1941 have been a continual source of interest. In 1948 a tagged male, a seven-year old "half bull" was seen on Tolstoi rookery. This was the first observation of a tagged male in actual possession of a harem. The individual weighed about 300-400 pounds and was first seen at the edge of the rookery, with three cows, on the 19th of July. He stayed there for several weeks.

SEALING: COMMERCIAL(1)

The human error in measuring seals

Since 1918 it has been the practice on the Pribilof Islands to measure, with a beam caliper, the length of the freshly killed body of each fur seal<sup>taken</sup> for commercial purposes. The length provides an indication of the age, and from the numbers and ages of the seals killed, the management draws certain

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1. For description of the 1948 kill see under "Migration: Arrival and Departure."

conclusions as to the size of the herd and the effect of the kill upon the breeding stock. For the past ten years or more, a native, John Hanson, has been responsible for the job of measuring the seals killed on St. Paul Island. In 1948 the biologists suggested that a check be made on the accuracy of Hanson's work. Agent Dan Benson kindly agreed to employ another caliper man, <sup>Vasilli (Bee)</sup> ~~William~~ Stepetin, Jr., on alternate days. Stepetin was given a five day training period and then, from the 8th to the 27th of July, he and Hanson worked on alternate days. Each man measured about 20,000 seals. At the end of the trial, the mean length of the seals measured by Hanson differed by 0.68 inch from the corresponding figure obtained by Stepetin (Table 3). Hanson showed a tendency to read a slightly higher figure on his caliper than did Stepetin, and as a result Hanson called 54 per cent more four-year olds than did Stepetin (that is, 1,194 as against 775).

In evaluating the results of the preceding experiment the twofold aim of the measuring policy has been kept in mind. Seals are measured, first, to impress visually and audibly on the clubbers the necessity for killing within certain desirable limits of size, and, second, to provide statistics used by the management in making up the annual computation of the size and composition of the seal herd. Insofar as the first aim is concerned, the biologists feel that the bias introduced by the caliper man is of little importance. Insofar as the second aim is concerned, the bias seems to be of sufficient size to throw doubt on the value of herd computations made on the basis (in

TABLE 3. COMPARISON OF LENGTH MEASUREMENTS OF FUR SEALS AS OBSERVED BY TWO CALIPER MEN ON ST. PAUL ISLAND, ALASKA, IN 1948(1)

Caliper man	<i>Vasilli (Bill)</i> <del>William</del> Stepetin, Jr.				John Hanson			
	2 year	3 year	4 year	Total	2 year	3 year	4 year	Total
Number of seals measured in each age class	387	18,638	775	19,800	297	18,505	1,194	19,996
Mean length of seals measured, inches	29.84	42.18	46.37	42.30	39.93	42.89	46.67	43.08
Per cent seals in each age class	2	94	4	100	1	93	6	100

part) of field measurements.

#### SEAL SPECIMENS FOR SCIENTIFIC USE

##### 1948 collection

A tabulation of the number and kinds of fur seal specimens taken was submitted to the Washington office in December. These included parts of 39 dead animals, as well as 2 living

1. Over the 20-day period, 8th to 27th July. The two men measured on alternate days, each measuring on 10 days. In addition to the seals listed here, a few yearlings, 5-year olds, and cows, totalling 198 seals, were killed. Data from FWS Form 3-1734.

specimens for the Balboa Park Zoo.

#### Previous collections

There are over a hundred skins of Alaska fur seals, collected since 1940, in the Biological Surveys Collection of the National Museum. While all of the skins are labelled, some of them lack the small paper strip-labels which are standard for the BSC. If time permits, the biologists will complete the labelling in January 1949. Eventually, they hope to study this assemblage of known-age specimens and to prepare a report on pelage with relation to age and sex.

#### Regulations

Until recently it has been considered illegal for the biologists to acquire, for research use, skins of fur seals taken on the Northwest Coast, that is, away from the Pribilof Islands. In May 1948 the chief counsel of the FWS advised that this restriction on the source of the skins no longer holds.