

SCHEFFER, VICTOR B. - FILE COPY

EXPERIMENTS IN THE MARKING OF SEALS AND SEA-LIONS



SPECIAL SCIENTIFIC REPORT: WILDLIFE No. 4

LIBRARY
National Marine Mammal Lab.
7600 Sand Point Way N.E., Bldg. 4
Seattle, Washington 98115-6349

Washington, D. C.
April 1950

EXPERIMENTS IN THE MARKING OF SEALS AND SEA-LIONS

by

Victor B. Scheffer

Special Scientific Report Wildlife No. 4

United States Department of the Interior. .Oscar L. Chapman, Secretary
Fish and Wildlife ServiceAlbert M. Day, Director

TABLE OF CONTENTS

	Page
Introduction	1
Review of marking methods	1
Clipping, northern fur seal, Alaska	1
Branding, northern fur seal, Alaska	1
Branding, northern fur seal, Okhotsk Sea	5
Branding, northern fur seal, Kamchatka	7
Branding, southern fur seal, South Africa	7
Branding, Weddell seal, Antarctica	7
Branding, Pacific harbor seal, British Columbia	7
Shearing, northern fur seal, Alaska	7
Tagging, northern fur seal, Alaska	8
Tagging, northern fur seal, Okhotsk Sea	14
Tagging, northern fur seal, Kamchatka	14
Tagging, southern fur seal, South Africa	16
Tagging, Steller sea-lion, Alaska	16
Tagging, harp seal and hooded seal, White Sea	18
Girdling, northern fur seal, Alaska	20
Painting, northern fur seal, Alaska	20
Painting, harp seal, White Sea	21
Punching, northern fur seal, Alaska	21
Results of marking experiments on the Pribilof Islands	24
Percentages of recoveries of marked seals	24
Percentages of seals returning to the exact marking site.	25
Effectiveness of hot-iron brands	25
Effectiveness of metal tags	27
Relative merits of selected metal tags	27
Relative merits of selected tag locations on the body	28
Accuracy of sex identification in marking operations	29
Summary	29
Literature Cited	31

United States Department of the Interior, Geographical Names Branch
 Fish and Wildlife Service, Alaska, U.S. Fish and Wildlife Service

INTRODUCTION

In this paper we review experiments in the marking, for study purposes, of seals, sea-lions, and fur seals in the North Atlantic, North Pacific, and Antarctic regions. We also discuss the results of certain studies of the northern fur seal, especially the series from 1940 to 1949 carried out by Government agents on the Pribilof Islands, Alaska.

REVIEW OF MARKING METHODS

Clipping, northern fur seal (Callorhinus ursinus), Alaska.--The spectacle of a million fur seals resting on the shores of the Pribilof Islands has evidently been to biologists and irresistible temptation to mark one from the other. Thus, to date, about 150,000 seals have been singled out and marked by brand or other device.

(1) At some time in the last century, probably in the 1860's, the Russian owners of the Pribilof Islands "drove up a number of young males from Lukanon, cut off their ears, and turned them out to sea again. The following season, when the droves came in from the 'hauling-grounds' to the slaughtering-fields, quite a number of those cropped Seals were in the drives" (Goode 1884: 77).

(2) In 1870, two years after the purchase of Alaska by the United States, Captain Charles Bryant clipped the ears of 200 seal pups on St. Paul Island. On pups from Lukanin Rookery he clipped the right ear, and on pups from Reef, the left. He was trying to prove or disprove the theory that seals always return to the island and rookery of their birth. He repeated the experiment in 1871. Marked seals were killed in 1872 and 1873 in sufficient numbers to disprove the theory (U. S. Treasury Dept. 1898(1):29, 38, and 41).

Better evidence on the wandering of seals has been gathered since the time of Bryant. His early experiment is still of interest, however, because it suggests that ear clipping, or ear tagging, is a practical way to mark seals. The animals are usually seen in a compact group on the summering grounds. In crowded formation most of the body is hidden and only the head and ears are conspicuous. From the standpoint of recovering specimens, the advantages of marking a prominent feature are obvious. On the other hand, the ear of a seal is a delicate valve-like organ. By excluding water it allows the seal to dive to depths of 240 feet or more. Scar tissue resulting from an injury to the ear might lead to the death of the animal. We have refrained from using the ear-clipping technique during the modern era of research on the Pribilof Islands.

(3) The ear tips of 1,000 seals about three years old were removed in the summer of 1924 (Bower 1925: 149). The operation was presumably done with wool shears, since the animals were said to have been sheared as well. The results of the experiment are not recorded.

Branding, northern fur seal, Alaska (table 1).--(1) Branding was carried

out between 1896 and 1903 in order to scar the pelts of females and thereby render them unattractive to pelagic sealers. Around the turn of the century the United States Government was trying desperately to build up the Pribilof herd in the face of increasing losses of females at sea. After eight years had elapsed and after 25,000 seals had been branded, the program was dropped as infeasible. Of those branded, all but a few were pups. The branding irons were heated on coal or coke forges and were applied to seals held on the ground by native workmen. Electric cautery was also tried. It was clean and quick-acting but was not as practical under field conditions as the flame-heated iron (Jordan 1899(3): 325-338).

(2) A second series of brandings was directed in 1912 by George A. Clark of Stanford University, to provide specimens of known-age animals for study of the growth rate. The findings were of great value, and the age-length standards established in the course of the study are still in use. Clark used three branding irons heated in relays by a plumber's blowtorch. He was able to mark up to 1,000 seal pups in a day (Hanna 1917: 97).

(3) A third series of brandings was started in 1923 for the purpose of marking a definite number of male seals as breeding reserves. Altogether, 5,047 bachelors estimated to be three years old were burned on the back of the body, or in some cases, on the back of the neck. In addition, they were sheared on top of the head. Operations were carried out in June at the start of the seal-killing season. Thirty-nine seals died as a result of handling--a mortality of 0.77 percent (Bower 1925: 118-119). Hot-iron branding was never again used as a means of marking breeding reserves.

(4) Branding operations on a small scale were carried out in the years 1925, 1927, 1928, and 1929 (table 1, p.). Altogether, 1,400 bachelor seals were treated. The brandings of 1925 were apparently for scientific purposes (Bower 1926: 149) but were not again referred to in official reports. The brandings of 1927, 1928, and 1929 were done in conjunction with tagging, as we shall point out on p. 8. They were planned as a means of gathering new facts on the fur seal, since Japan had asked, in 1926, for a review of the premises upon which the treaty of 1911 was based. Some of the seals branded in the late 'twenties apparently wandered to the Commander Islands, where Soviet workers reported that they saw "fur seals which were unquestionably marked (sheared spots in the fur, burned out brands), although the question was by whom and where?" (Barabash-Nikiforov 1936: 228, translation).

(5) Introducing a new series of biological studies of the fur seal herd, branding operations were resumed in 1940 after a lapse of eleven years (fig. 1*). Five thousand pups were branded, primarily to serve as a source of known-age specimens. Operations were carried out between September 17 and 28, although 95 percent of the pups were handled between September 24 and 27. On one day under good working conditions, a crew of 25 men branded 1,639 pups in four hours.

The following tools were used: (1) an operating table 2 feet high, 2

* All photographs by the author.

feet wide, and 6 feet long; (2) a gasoline blowtorch with a special firebox and a rack for supporting the irons; (3) six branding irons, each with a straight handle 16 inches long and a rectangular head 0.5 x 1 x 2 inches; and (4) a wire brush for cleaning the iron after each application.



Figure 1.--Branding fur seal pups on St. Paul Island, Alaska, September 19, 1940.

The gasoline torch heated the irons at a rate of six per minute. The proper working temperature of the iron was a dull red heat, almost hot enough to ignite the fur. A colder iron gummed up the fur instead of disposing of it in smoke and created smoldering fumes which annoyed the workmen.

Tables of three sizes were tried. On a table lower than 24 inches the men could easily swing the seals into position but they could not bend over the struggling animals without suffering fatigue.

Branding was carried out in the following steps: The crew surrounded a group of several hundred seals resting on the beach and drove them in a narrow file for a few hundred paces to level ground. The adult seals, faster moving, gradually took the lead in the procession, whereupon the men pinched off the file behind them and obtained a "pod" or detachment of pups. Two "watchmen" kept the seals from straying. A "carrier" selected a seal from the pod, grasped it by the hind flippers and dragged it to the table. He glanced at the genital region of the seal to ascertain its sex, then swung it belly-down on top of the table. A "holder" instantly grasped the fore flippers and pinned them to the table with his palms. Another holder pulled the chin of the seal over the edge of the table so that the wrinkles in the back of the neck were eliminated. All workers wore leather gauntlets and rubber boots for protection from the quick, needle-sharp teeth of the pups, but in spite of these precautions, there was a high casualty in clothing, not to mention

underlying parts of the body. As he swung each seal to the table, the carrier shouted male or female and the "tallyman" repeated the word.

The "brander" placed the iron on the back of the seal's neck, or slightly on the near side. He held the iron in place for five or six seconds, pushing it back and forth to clear away the burned fur. The resulting brand was a clean, light-brown area of skin about 0.75 to 1 inch wide and 2 inches long, crosswise of the body (fig. 2). The seal pups showed no marked sign of discomfort during or after the branding process. The brander then passed the iron to a "forge operator" who brushed off the accumulation of charred fur. Another operator took a fresh hot iron from the forge and passed it to the brander. The carrier removed the branded pup and took it 25-50 paces away, toward the ocean or toward a rock pile. The stubborn tendency of the pups to return to the scene of activities and to crowd around the feet of the workmen was a source of annoyance and delay.

At the season when the branding was done, September 17-28, most of the pups were two or three months old, weighed an estimated 20-30 pounds, and were well coated with the silvery hair of autumn. Some were still shedding the rusty black hair of summer. A few, apparently orphans, were so small that they were spared from the branding. No seals were killed in the branding process itself, although 36 were smothered in drives--a mortality of 0.72 percent.

(6) In 1941 on St. Paul Island, Ford Wilke and A. Henry Banner branded, as well as tagged, 10,000 seal pups. They worked between the dates of September 23 and October 8, considerably later than the best time. Their methods and instruments were, in the main, the same as those used in 1940. We shall discuss the 1941 operations more fully under tagging, p. 9.

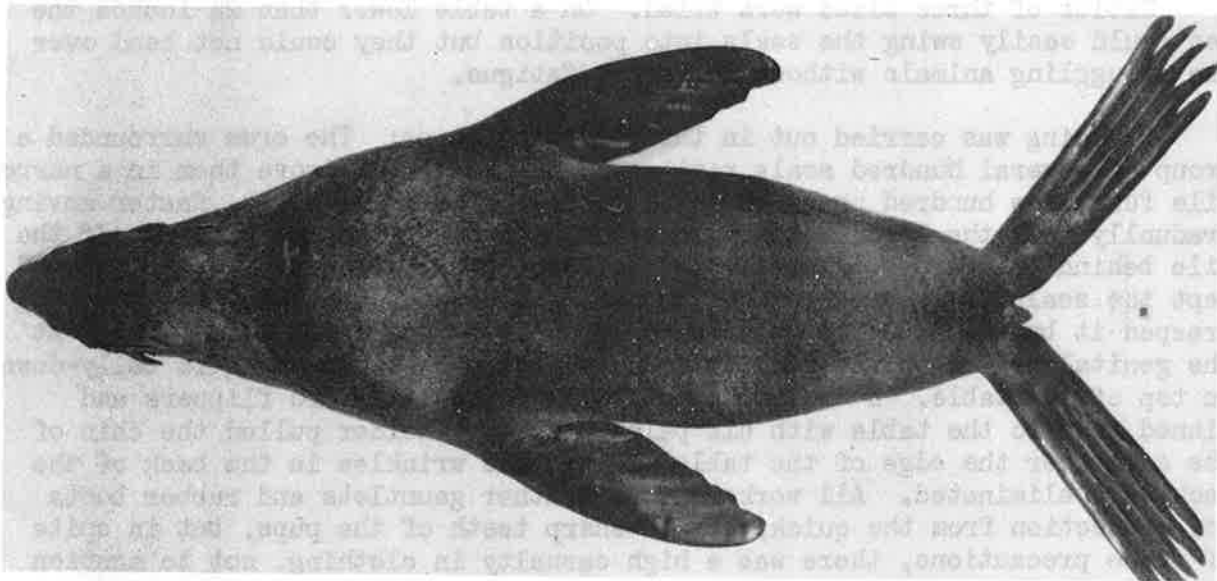


Figure 2.--Fur seal branded as a pup in September 1940; killed June 28, 1944. Male, weight 90 pounds, specimen EDM 69, St. Paul Island, Alaska.

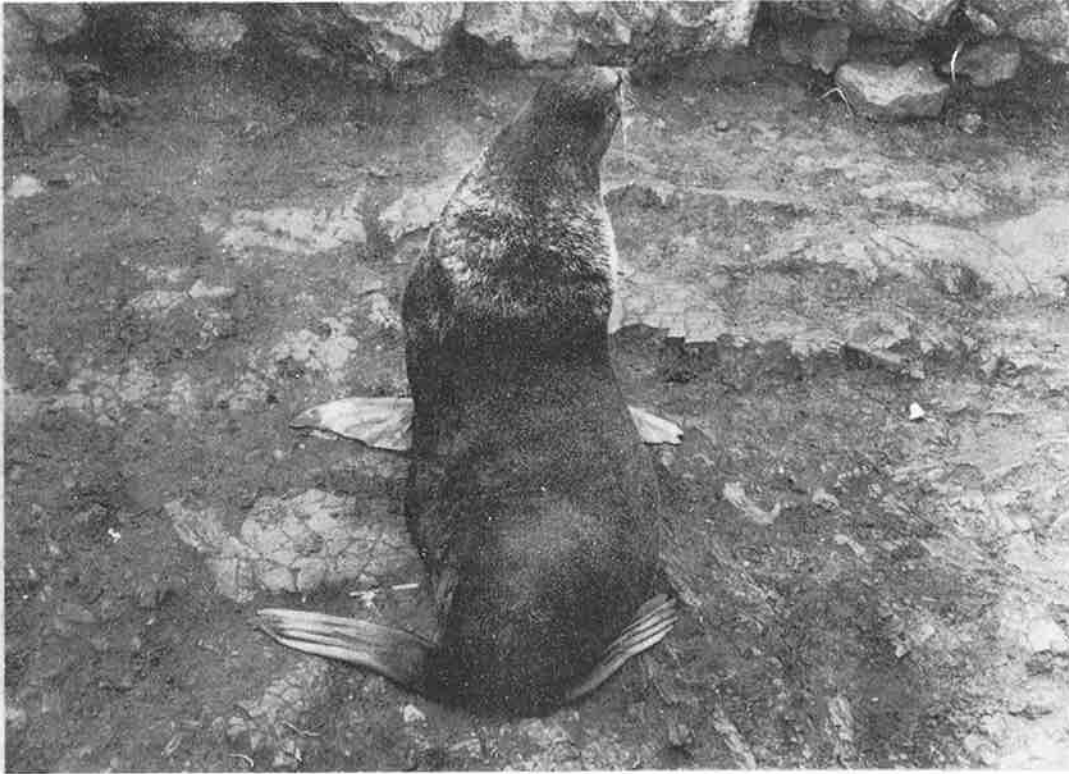


Figure 3.--A nine-year male fur seal wearing a hot-iron brand across the back of his neck, St. Paul Island, Alaska, June 27, 1949. The brand was applied to the 3-months old seal.

Branding, northern fur seal, Okhotsk Sea.--The fur seal treaty of 1911, to which Japan was a party, was to remain in effect for 15 years, and thereafter until terminated by a year's written notice by one or more of the parties. Toward the end of the 15 year period, Japanese scientists undertook to gather fresh information on the seals in the western Pacific Ocean and Sea of Okhotsk (Japanese Bureau of Fisheries 1933: 12-13). Annually from 1925 to 1932, and perhaps later, they branded a number of seals on Robben Island (near Sakhalin Island, now under Soviet rule). The total amounted to 1,028 seals. They used a hot iron in the shape of an ideograph and applied it to the shoulders or rump of seals of assorted sizes and sexes, no pups or old bulls. From 1926 to 1932 they confined their branding to the middle of the rump of bachelor males.

TABLE 1.--Record of fur seals branded on the Pribilof Islands,
1896 - 1941^{1/}

Year	St. Paul Island		St. George Island		Total
	Pups	3-yr. Males	Pups	3-yr. Males	
1896	315		62		377
1897	5,371		1,880		7,251
1898	2,363		- - -		2,363
1899	2,191		- - -		2,191
1900	1,698		- - -		1,698
1901	4,173		686		4,859
1902	1,416		1,326		2,742
1903			1,352		1,352
1904		- - -			- - -
1912	3,227		2,001	295	5,523
1923		4,246		801	5,047
1925				800	800
1927		200			200
1928		200			200
1929		200			200
1940	5,000				5,000
1941	10,000				10,000
Total	35,754	4,846	7,307	1,896	49,803

^{1/} Data for the period 1896-1903 are from Hanna (1921: 111-112), except that his record for St. Paul for 1903 has been changed to indicate no seals branded rather than no record kept. All seals branded from 1896 to 1903 were female pups, with the exception of 158 female adults. In 1904, seals were branded but no record was kept (Lembkey 1908: 72). Data for 1912 are from Hanna (1917: 97) and Lembkey (1913: 81-82). They represent pups of both sexes. Data for the period 1923 to 1929 are from annual reports of the Bureau of Fisheries and from the St. Paul Island log. Another report, probably unreliable, states that 1,733 male 4-year old seals were branded in 1924 (Japanese Bureau of Fisheries 1933: 11).

Branding, northern fur seal, Kamchatka.--Barabash-Nikiforov stated that "in order to maintain a reserve of males, three-year old bachelors were branded [kleimenie]" on the Commander Islands (1936: 230, translation). He did not elaborate on this statement.

Branding, southern fur seal (Arctocephalus pusillus), South Africa.--Biologist R. W. Rand initiated experiments in marking seals on the Union Government Guano Islands in 1947. He states "I have been branding pups (8-10 months old) on the dorsal posterior surface and find this suitable for quick identification. . . .Black pups (i.e., those that have not undergone their first moult) are too thin skinned to stand the shock" (personal communications). He continued the program in 1948, using consecutive numbers.

Branding, Weddell seal (Leptonychotes weddelli), Antarctica.--A photograph in The National Geographic Magazine shows a Weddell seal and bears the following caption: "Assisted by Paul Siple. . . .the medical officer weighed, measured, and tagged numerous seal pups and carefully recorded their growth and habits" (Byrd 1930: 144). This work was carried on in the Antarctic summer of 1928-1929. We have been unable to find further reference to the experiment.

Alton Lindsey branded 243 Weddell seals in Antarctica in 1934 and 1935. He reported that "a five-foot wooden handle held a T-shaped iron holder containing three rectangular sockets. Into each socket was placed a number made on quarter-inch square iron rod." Both adults and young were branded. "When possible the brand was placed dorsally, a foot or two in front of the tail. The number first was clipped into the wool with shears" (1937: 134). Three of the marked seals were recovered five and seven years later "within a very short distance of the point where they were branded. . . .The numbers were recorded and measurements were made of the two that were captured" (Perkins 1945: 279). Perkins published a photograph of one of the seals showing the number on its back.

Branding, Pacific harbor seal (Phoca vitulina richardii), British Columbia.--On September 5, 1946, near the mouth of the Skeena River, a fisherman shot a harbor seal bearing the brand X C on its back. We have been unable to find out who branded the animal and why (Dean Fisher, letters of November 18, 1946 and April 10, 1948).

Shearing, northern fur seal, Alaska.--Each summer for many years on the Pribilof Islands it was the custom to mark a certain number of young male seals as breeding reserves. Whenever they appeared later in the summer they were spared by the killing crew. As nearly as we can determine, over 60,000 seals, most of them three-year olds, were treated during the reserving operations of 1904 to 1932. A round patch of fur was removed, with wool shears, from the top of the head, leaving a temporary mark that lasted throughout the sealing season. The operation was variously referred to as shearing, clipping, or branding although, strictly speaking, it was shearing.

From 1904 to 1912, about 2,000 seals were reserved annually. From 1913

to 1918 there were no regular killings and, accordingly, all seals were spared as reserves. From 1919 to 1922 the reserves were not marked. From 1923 to 1927, about 10,000 seals were sheared annually. There followed a steady decline in the number of seals sheared, from 8,800 in 1928 to 3,000 in 1932. Since 1933 the manager of the Pribilof Islands has depended upon field observations and sealing records for assurance that an ample breeding reserve is maintained.

Eleven seals thought to have been sheared on the Pribilof Islands, were recovered between 1926 and 1928 in Japanese waters. A twelfth seal was recovered on Medny (Copper) Island in 1925 (Japanese Bureau of Fisheries 1933: 14-16).

Tagging, northern fur seal, Alaska.--Six series of experiments in the tagging of fur seals have been carried out on St. Paul Island (table 2).

(1) In each of the years 1927, 1928, and 1929, Pribilof Superintendent Harry J. Christoffers applied aluminum tags to the flippers of 200 bachelor seals judged to be three-year olds. The tag was of a size commonly used on the ears of sheep, and the fins of fish, quite similar to the one shown in figure 4. The tag was applied to the hind margin of the fore flipper close to the body and, in addition, a hot-iron brand was placed on the seal's back. In the 1927 series, the animals were not only tagged and branded but were sheared as well! (St. Paul Island log, July 21, 1927; July 21, 1928; July 26, 1929).

Over 50 seals from this series of taggings were recovered. During sealing operations on the Pribilofs, 27 tags were recovered, as follows: 5 in 1928, 13 in 1929, and 9 in 1930. Each tag recovered was of the series of the previous year, i.e., was found on an animal approximately four years old.

Twenty-eight tags were said to have been recovered in the coastal waters of Japan from 1928 to 1930. Photographs of three of the tags, nos. 14466, 14479, and 14494, were published (Japanese Bureau of Fisheries 1933: 16-18).

In 1929, Soviet authorities reportedly killed a seal bearing tag no. 14554 USEF, on Bering Island. The animal was presumably a four-year old (Glavzvyerovod, letter of April 28, 1945).

In 1949 we found one of these tags on the sand beach at Northeast Point. It was 9 x 22 mm. in closed position and bore the legend "U.S.B.F. '27 - 1482(?)." How long it remained on its original host is not known.

A report by the Japanese fisheries expert Keisi Isino possibly refers to the same series of taggings. Isino states that: "When I went to the Commandovsky group in 1925 to inquire into the conditions of the seal business, I happened to find there several animals bearing the tags of the Pribilof Islands [however, no seals were tagged on the Pribilofs before 1927. Perhaps Isino meant branded seals of the 1923 series]. . . .When I was out to the Pribilofs in 1926 I worked with American authorities and had metal tags put

on 200 young male animals [Isino was on the Pribilofs for 40 days in the summer of 1926, actually a year before tagging operations took place]. Some of these tags were discovered on animals caught in December 1929 in the sea off the northern provinces of the Pacific seaboard of our main island. There is now no question about seals visiting Japanese islands from America" (1939: 43-44).

(2) In 1941 an experiment in tagging seals was carried out on St. Paul Island as a basis for studies of migration, growth, mortality, reproduction, and pelage. Ten thousand pups were both tagged and iron branded by Ford Wilke and A. Henry Banner between September 23 and October 8. For experimental purposes, a number of variables were introduced. Tags of two sizes and of two metallic alloys were applied to three different parts of the body. Specifications of the tags:

Small size: Sheep ear-tag (Salt Lake Stamp Company, Salt Lake City, Utah); dimensions before folding 0.6 x 8 x 69 mm. (0.025 x 5/16 x 2-3/4 inches; U. S. Gauge 24); weight 2.7 g.; monel metal (nickel 67%, copper 30%, manganese 1%, iron 1.4%; cold-rolled strip); on obverse numbered consecutively 1 to 5,000 with numbers 5 mm. high; on reverse stamped "USA"; cost 3.25 cents.

Medium size (fig. 4): Hog ear-tag (Salt Lake Stamp Company); dimensions before folding 0.5 x 11 x 81 mm. (0.028 x 7/16 x 3-1/4 inches; U. S. Gauge 23); weight 4.5 g.; stainless steel (iron 73%, chrome 18%, nickel 8%, carbon 0.09%; type 302, finish 2-B); on obverse numbered consecutively 5,001 to 10,000 with numbers 6.5 mm. high; on reverse stamped "USA"; cost 3.5 cents.

On each seal a tag was applied to the hind margin of the fore flipper near its base--the right flipper in males and the left flipper in females. On 2,000 seals a duplicate tag, bearing the same number, was fastened to the hind flipper either in the interdigital web or over a digit. The duplicate tags were evenly divided between monel and stainless steel. The clinching or locking tip of the tag, as well as the arm bearing the numbers, was downward in the final position.

Seals were tagged on the major rookery groups as follows: Reef (2,000 tags in duplicate), Northeast Point, Zapadni, Tolstoi, Polovina, and Kitovi; total 10,000 pups and 12,000 tags. The greatest number of pups marked in a single day by 24 men was 1,618. In the marking operations 49 seals were killed, a mortality of 0.49 percent. Thirty-seven were killed at one time in a pile-up.

(3) In 1945, we started an experiment designed to test the value of a large metal tag in lieu of a hot-iron brand. Our thought was that a tag flashy enough to be seen at a distance of ten paces or more would effectively substitute for a brand. (A secondary purpose of the experiment was to provide known-age seals for study of reproduction). Altogether, 973 pups were tagged on Tolstoi Rookery on August 24 and 25, about one week earlier than the optimum season for this kind of work. Specifications of the tag (fig. 5):

Cattle ear-tag (Style 19M of National Band and Tag Company, Newport, Kentucky); dimensions before folding 0.9 x 9.5 x 101 mm. (0.036 x 3/8 x 4 inches; U. S. Gauge 20); weight 7.1 g.; monel metal (No. 35 of Eagle Metals Company, Seattle, Washington); numbered consecutively 11,001 to 13,000 with numbers 6.5 mm. high; cost 4.125 cents. This tag was narrower and longer than any previously used.

The tag was applied to the hind margin of the left fore flipper, on the furred part one-half to one inch proximal to the naked part. The clinching or locking tip of the tag, as well as the arm bearing the numbers, was upward in the final position. The tag was so thick and heavy that considerable force was required to clinch it. The tagger placed the lower leg of the plier against the table and bore down once or twice on the upper leg with the heel of his hand. Rarely did a drop of blood appear. Operations were carried out in a chill wind with mist and rain. Sand and rockery filth clinging to the flippers of the pups gummed up the pliers and, as a consequence, 27 tags failed to close properly and were thrown away. No seals were killed or injured in the tagging operation, so far as we know.

(4) In 1947 we tagged and punched nearly 20,000 seal pups of both sexes-- probably the largest group of mammals ever marked at one time. The purpose of the tagging was to provide a basis for a new measure of the size of the seal herd. By comparing the numbers of tagged and untagged three-year olds in 1950 we shall be able to estimate the number of pups born in 1947. We found that tagging 20,000 seals was a long, difficult, and somewhat dangerous operation, in the course of which we were obliged to handle about 300 tons of live animals.

Details of the punching procedure are given on p. 21. Specifications of the tag are as follows:

Sheep-ear tag (Model 18 M HASCO of the National Band and Tag Company, Newport, Kentucky); dimensions before folding 0.7 x 8 x 69 mm. (0.030 x 5/16 x 2-3/4 inches; U. S. Gauge 22); weight 3.2 g.; monel metal; on obverse numbered consecutively 1 to 20,000 with numbers 4 mm. high and prefix "A"; on reverse stamped "NOTIFY F AND W SERVICE WASH D C"; cost 2.2 cents (fig. 13).

We tagged between September 24 and October 10, 1947, on seven of the fourteen rookeries of St. Paul Island, avoiding the steeper, rock-strewn ones. Because 817 of the tags failed to clinch properly, we released a net total of 19,183 tagged animals. Sixty-seven pups and 14 cows died of smothering or overheating during the operation, representing a mortality of 0.42 percent.

We followed essentially the same procedure in handling the seals that we have described on pp. 3-4. The crew included 13 native workmen and 4 biologists. We used 2 tables 25 inches high and three sections of fence each 2 x 16 feet. We tagged each pup on the hind margin of the left fore flipper, at the junction of the naked and the furred surfaces, allowing the tag to project about one-quarter of an inch beyond the edge of the flipper. We fastened all but about the last 500 tags with point downward. We concluded,

though, that there were several advantages to having the point upward. The tags were not satisfactory because a substantial number of them failed to clinch properly. While they were similar to the sheep tags used successfully in 1941, they had a slightly different style of clinching tip and were heavier (p. 9).

(5) Between September 13 and 22, 1948, we tagged 19,532 pups of both sexes on St. Paul Island, using a monel tag, sheep-ear size, serial nos. E 1 - B 19,673. The tag was applied to the left armpit. Thirty-five seals died in drives, a mortality of 0.17 per cent.

(6) Between August 29 and September 6, 1949, Karl W. Kenyon and crew tagged 19,960 pups of both sexes on St. Paul Island, using a monel tag, cattle-ear size, serial nos. CS 1 - CS 20,000. The tag was applied across the first and second digits of the left hind flipper, across the penultimate phalanges. This tag is conspicuous because of its large size and its location at the rear of the seal.

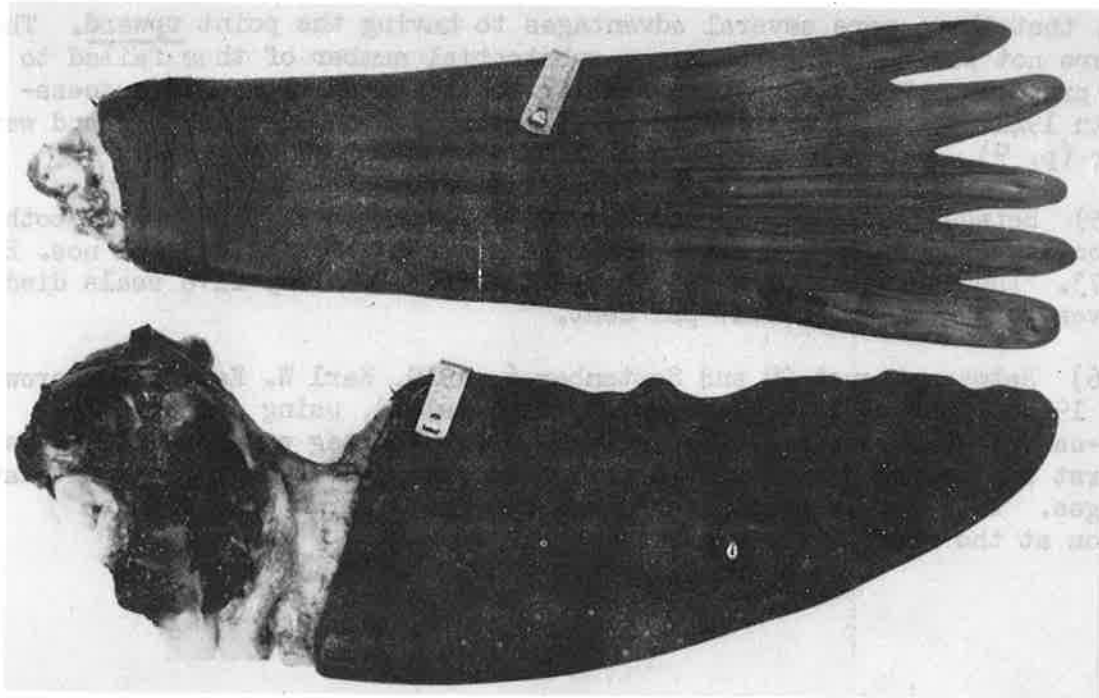


Figure 4.--Medium-size stainless steel tags after 32 months on flippers of male fur seal. Tags were applied on a pup October 6, 1941, and were recovered June 28, 1944. Tag. no. 5372, standard hog-tag, right fore and hind flippers, ventral view, St. Paul Island, Alaska.



Figure 5.--Large monel tag, standard cattle ear-tag, applied to left fore flipper of fur seal pup. Tag no. 11159, August 25, 1945.

TABLE 2.--Record of fur seals tagged on St. Paul Island,

1927 - 1949^{1/}

Year	Pups	Bachelors	Serial no.	Size of tag	Kind of metal	Location of tag ^{3/}	Other marks
1927		200	<u>2/</u>	S	Al	FF	Branded
1928		200	<u>2/</u>	S	Al	FF	Branded
1929		200	<u>2/</u>	S	Al	FF	Branded
1941	5,000		1-5,000	S	Mon	FF+HF	Branded
1941	5,000		5,001-10,000	M	SS	FF+HF	Branded
1945	973		10,001-11,000	L	Mon	FF	None
1947	19,183		A 1-20,000	S	Mon	FF	Punched
1948	19,532		B 1-19,673	S	Mon	FF	None
1949	19,960		CS 1-20,000	L	Mon	HF	None

^{1/} Abbreviations: Al - aluminum; FF - fore flipper; HF - hind flipper; L - large, cattle-ear size; M - medium, hog-ear size; Mon - monel; S - small, sheep-ear size; SS - stainless steel.

^{2/} The tags applied from 1927 to 1929 carried serial numbers in the 14,000's.

^{3/} All tags were applied to the left flipper except those applied in 1941 to the right flipper of females.

Tagging, northern fur seal, Okhotsk Sea.—According to the Japanese Bureau of Fisheries (1933: 12-13), 338 fur seals on Robben Island were tagged up to the year 1932. We have no later information on Japanese taggings. Each tag was applied to the base of the right fore flipper of a 3-year old male and was accompanied by a hot iron brand.

1930. Nickel ring with V engraved thereon; 90 seals.

1930. Aluminum ring with Japanese numerical ideographs; 50 seals.

1931. Aluminum ring with Japanese numerical ideographs; 98 seals.

1932. Aluminum ring with legend "1932"; 100 seals.

No fur seals showing evidence of having been tagged, or branded, or otherwise marked by the Japanese have even been seen on the Pribilof Islands.

Tagging, northern fur seal, Kamchatka.—Fur seals on the breeding grounds of the Commander Islands have been tagged by Soviet biologists. We have been unable to learn the details, but understand that a number of pups were tagged in the years 1924 to 1928, inclusive; 1931; and possibly later (Barabash-Nikiforov 1936: 224, 230). "For marking black pups [1-3 months old] in 1931, tags in the form of aluminum strips sharpened at one end were introduced. They were 8 x 95 mm. They pierced the fold of the skin in front of the fore flipper and were then bent into a ring [fig. 6]. The slowness and painfulness of the operation and the fact that aluminum is oxidized in sea water make this method unsatisfactory. Among its faults may be mentioned the large size of the ring, leading occasionally to tearing of the skin when it catches a sharp rock. The silver ear-rings which were previously applied also gave poor results, since they occasionally ruptured the ear shell (pinna). In the future we should use corrosion-proof tags. Probably the best tag would be in the form of a small disc with a tail of the type used for tagging fish [fig. 7]. In order to pull the long tail through the skin a needle, such as a sail or 'gypsy' needle, might be used" (loc. cit., p. 230, translation).

According to the Japanese Bureau of Fisheries (1933: 13) fur seals on the Commander Islands were tagged as follows:

"1929--Nickel ring with 9B or 9M engraved thereon attached to left ear.
1930--Nickel ring with 30B or 30M engraved thereon attached to left ear."
No information on the kinds or numbers of seals tagged was given."

Further details of Soviet tagging operations are given in a letter from Glavzvyerovod, April 28, 1945: "On the Commander Islands, the tagging of newborn seals with aluminum and, later, brass rings has been done periodically in August and September since 1928. Up to 1930 the tags were attached to the ear and since 1931 to the fold of the skin in the armpit of the fore flipper. During the war no tagging has been done. Each tag bears a letter indicating the first letter of the island on which the tagging was done, that is, B for Bering, M for Myedni, and a number indicating the year of tagging" (translation).

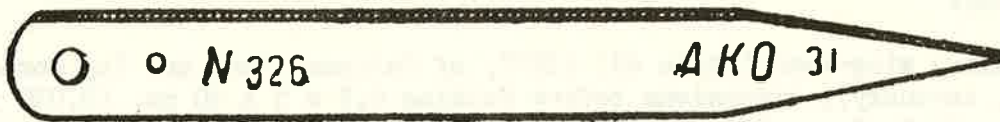
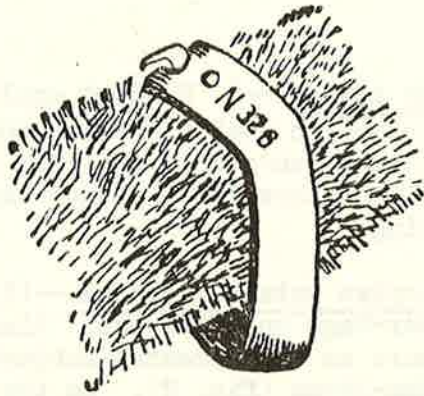


Figure 6.--Aluminum tag, 8 x 95 mm., applied by Soviet investigators to fur seals on the Commander Islands, 1931. The tag was clasped in the form of a ring around a loose fold of skin ahead of the fore flipper (Barabash-Nikiforov 1936: 230, fig. 49).

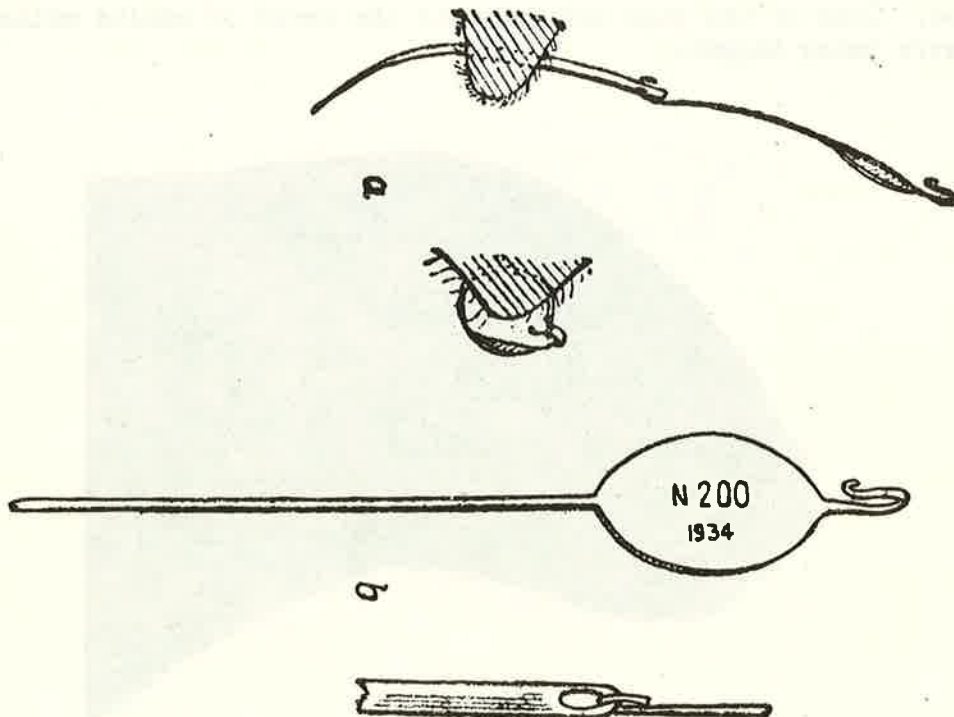


Figure 7.--Disc used by Soviet investigators for tagging fish; suggested by them for use on fur seals. (a) Disc being pulled by a needle through a fold of skin and clinched. (b) Disc intact, and method of attaching tail piece to eye of needle (Barabash-Nikiforov 1936: 231, fig. 50).

Tagging, southern fur seal, South Africa.--R. W. Rand applied disc-like tags to the tails of a number of seal pups in 1947 (personal communications). The design of the tag was similar to Sivertsen's (fig. 10, a). On the rocky Government Guano Islands, however, the tags tore loose rather easily and Rand turned to branding as a means of marking.

Tagging, Steller sea-lion (*Eumetopias jubata*), Alaska.--(1) In 1946 we started an experiment in the use of ear-tags on pinnipeds. Since fur seals are too valuable to use in large numbers as experimental subjects where risk of mortality is involved, we tagged sea-lions (fig. 8). To the best of our knowledge there have been no previous attempts to tag or mark sea-lions. Thus we believe it advisable to report on the 1946 experiment in some detail. At Northeast Point, St. Paul Island, on June 20, we tagged 66 pups. Specifications of the tag:

Poultry wing-band (Style 893 JIFFY, of National Band and Tag Company, Newport, Kentucky); dimensions before folding 0.5 x 5 x 50 mm. (0.020 x 3/16 x 2 inches; U. S. Gauge 25); weight 1 g.; monel metal; numbered consecutively 10,001 to 11,000 with numbers 3.5 mm. high; cost 2.4 cents (fig. 9).

When the rookery was visited on June 20, the mating season was in, or just past its peak, and hundreds of adult sea-lions defended the center of the pupping ground. Huge bulls weighing a ton or more rushed at the working crew. Only those pups that were resting at the margin of the rookery could be approached. Some of the pups escaped into the crowd of adults while their fellows were being tagged.

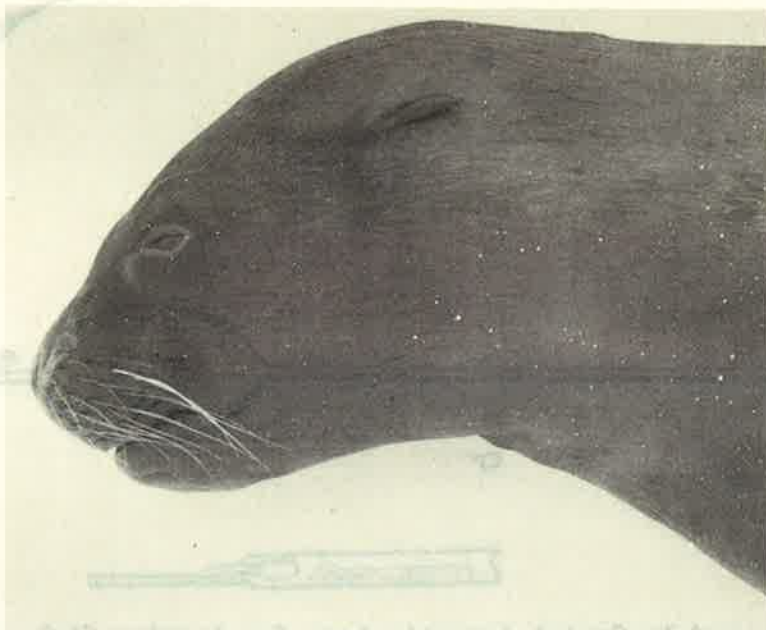


Figure 8.--Head of Steller sea-lion pup several weeks old, weight about 50 pounds, St. Paul Island, Alaska, June 20, 1946.

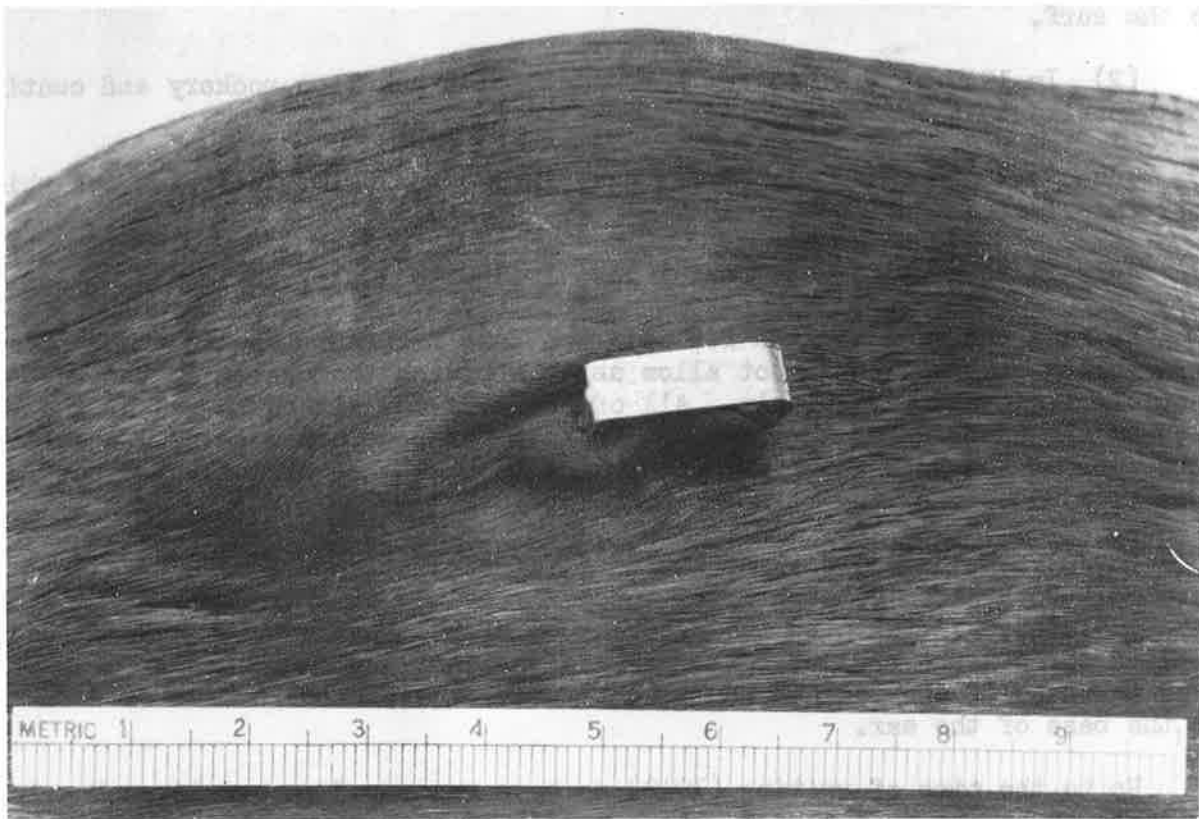


Figure 9.--Same specimen as in Fig. 8 with tag no. 10013 on left ear. The tag is of monel metal, weighs 1 gram, and is a standard poultry-wing band.

The biologist and three native boys tagged 66 pups in an hour. One boy passed out the tags while the other two searched for pups among the boulders. One boy sat astride the pup's back and held its head down while the biologist kneeled and applied a tag to the right ear. The pup usually uttered a bleat when the tag penetrated its ear but showed no other sign of distress. We saw a tagged pup sleeping about 15 minutes after it had endured the operation.

We pushed the sharp point of the tag downward through the ear about halfway between its base and tip. We had trouble in getting the tags to clinch, until the boy who passed them out learned to partly close each one with his fingers before he placed it in the pliers. The first few tags were oriented at right angles to the axis of the ear. Later, the tags were oriented lengthwise of the ear (fig. 9).

Tags nos. 10,001 to 10,077 inclusive were applied, of which eleven failed to clinch and were discarded.

Follow-up observations of the sea-lion rookery were made on two occasions.

On June 28 several tagged pups were seen on land and on July 18 one was seen in the surf.

(2) In 1947 we visited the Northeast Point sea-lion rookery and continued our experiments with ear tagging:

June 9; 26 pups tagged; serial nos. 10,078 to 10,107 inclusive, of which four tags failed to clinch.

July 2; 50 pups tagged; serial nos. 10,108 to 10,157 inclusive.

We made the June visit a few days too late for best results. The bulls were belligerent and would not allow us to approach the center of the rookery. The July visit was more timely. All of the cows and all but a few of the bulls fled to the water as we approached. On this visit we noted several sea-lion pups wearing the tags which we had applied three weeks earlier; also several pups from whose ears the tags had been lost.

On July 22, native workmen killed five sea-lion pups for food. They were able to kill only these five, since all of the other rookery animals, pups included, had taken to the water. One of the five carried an ear tag applied three weeks earlier. The ear was swollen; the flesh had grown partly over the base of the tag and was slightly raw. We picked 26 lice from the hair at the base of the ear.

Up to the time of writing (1949) we have recovered no sea-lions bearing evidence of having been tagged. As a result of a previous study (Scheffer 1945) and our experiences in 1946 and 1947, we tentatively conclude that ear tags are unsatisfactory. They are difficult to apply and they probably do not remain on for more than a few weeks. We shall have more definite ideas on this matter when we have opportunity to examine the ears of sea-lions killed at Northeast Point during the coming seasons.

If sea-lion pups are to be marked, we suggest that the best times for handling them are the first week in June, before the height of the mating season, and the first week in July, after the mating season and before the pups are taking to the water.

Tagging, harp seal (*Phoca groenlandica*) and hooded seal (*Cystophora cristata*), White Sea.--Migration studies of the harp seal and the hooded seal were effected by means of tagging experiments in the White Sea (Sivertsen 1941; 54-61; Høst 1943: 8-9).

(1) Between 1928 and 1932, Norwegian biologists tagged 171 harp seal pups. The first year, they applied silver tags of three types to the fore flipper, hind flipper, and tail, finally concluding that a tag on the tail was best. In later years, they developed tags of aluminum alloy which were forced through the skin and fastened by paired wires (fig. 10). "This method of marking was very humane; most of the young seals did not react at all during the experiment. In order to avoid the risk of the marked White-coats

[pups] being taken by the sealers while they were still on the ice, a large red cross was painted on the back of each" (Sivertsen, p. 56). Eleven of the marked seals were subsequently recovered, eight of them near the tagging site within a year after tagging. One which had been tagged on the hind flipper with a silver plate was recovered eight years later, near Spitzbergen.

(2) Sivertsen mentions briefly that seven young hooded seals were tagged in 1932, presumably with the aluminum alloy plates. Only one was recovered, 13 days after the operation and 400 nautical miles away!

(3) "Per Høst, a Norwegian naturalist. . . . was out on several of the Norwegian vessels operating this spring on the coast of Newfoundland. He managed to tag 95 seals with a tail tag similar to that described by Sivertsen" (Dean Fisher, letter of May 27, 1949).



a



b

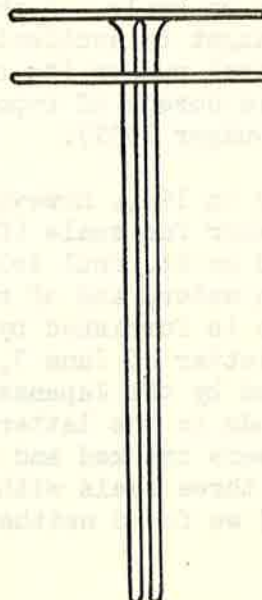
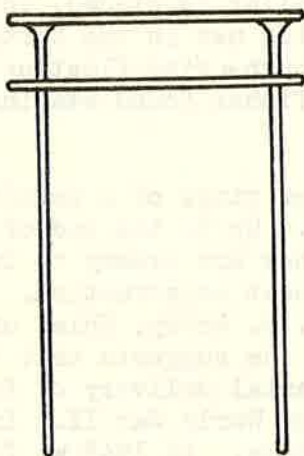


Figure 10--Tags used on harp seals in the White Sea, 1928-1932. (a) Tail tag; (b) flipper tag. Both silver and aluminum-alloy were used. "The two thin needles from the upper-most plate were stuck through the skin, in the case of the tail-mark on both sides of the tail-vertebra, and fastened to a similar but pierced plate on the underside" (Sivertsen 1941:56, fig. 24).

Girdling, northern fur seal, Alaska.---From time to time, perhaps once a year, a bachelor fur seal wearing a collar is seen on the killing fields of the Pribilof Islands.

(1) Christoffers reported that "each of three of the 3-year old males that were killed during the 1936 season had around its neck a very tight rubber band that had evidently been on for a long time. These bands, apparently cut from inner tubes of automobile tires, must have been placed around the necks of seals by human hands" (1937:342).

(2) We recovered a strip of inner tube from a bachelor seal killed in 1940. Johnston reported that "in nearly every year recently seals have been found with bands around their necks. Many of these bands have been cross sections of an inner tube of an automobile tire; several have been of rawhide, and even heavy string has been used. In 1941 on St. George Island one rubber band was removed and on St. Paul Island several were removed. One seal, picked up in a drive on Tolstoi Rookery, St. Paul Island, had a heavy cord bound so tightly around the neck that it had cut into the flesh. In the short time the seal had been ashore fly larvae had developed. The same seal was later seen at Northeast Point with the wound nearly healed" (1943: 62-63).

(3) In 1943, Palmer saw "a few animals. . .with what looked like rope burns around the body. It is possible that these animals may have become temporarily ensnared in a net or tangle of rope while at sea. Two young animals were noted with a rubber band around the neck and one with a cord. In each case, the band or cord was deeply embedded in the fur and was cutting into the skin."

In most cases we believe that little importance can be attached to the finding of collars on seals. Perhaps a collar is placed, in a spirit of fun, on a young seal caught by accident in a fish net in the North Pacific or Bering Sea. Or a young seal pushes its nose through a ring floating as detritus on the sea. There are dozens of reports of fishes found wearing girdles of one kind or another (Gudger 1937).

(4) Starting in 1944, however, rubber rings of a peculiar nature began to appear on bachelor fur seals (fig. 11). Up to the end of 1948, ten of these had been recovered on St. Paul Island. They are creamy to brownish-black, soft, lighter than water, and of rolled sheet construction. A plausible theory as to their source is furnished by Col. H. M. McCoy, Chief of Intelligence, U. S. Air Force (letter of June 7, 1948). He suggests that they are fragments of rubber bags used by the Japanese for aerial delivery of food and water in the Aleutian Islands in the latter years of World War II. In 1947 we observed that the collars were cracked and old-looking. In 1948 we found one seal with a collar and three seals with neck scars only, the collars having disappeared. In 1949 we found neither collars nor scars. (See also Anonymous, 1949.)

Painting, northern fur seal, Alaska.---(1) Millard C. Marsh, naturalist on the Pribilof Islands in 1911 "made experiments with various methods of marking



Figure 11.--Bachelor fur seal wearing rubber necklace. Seal 2-3 years old, weight 38 pounds; St. Paul Island, Alaska, July 27, 1947.

and reported unfavorably upon at least one form of commercial stock marker. He recommended a cautery [chemical?], however, as being of possible value" (Hanna 1916: 5).

(2) In 1941, on the morning of July 6, we attempted to mark a number of fur seals with ordinary white house paint. Our immediate purpose was to identify certain "rejects", that is, seals dismissed from sealing drives as unfit for the commercial kill. Our ultimate purpose was to check on the recurrence of marked animals in the daily drives. Each of two workmen carried a bamboo pole about six feet long, at one end of which was tied a paint brush. A boy carried a pail of white paint. As each reject left the killing site and headed for the beach, a man gave chase and attempted to swipe it across the back with the brush. In pursuing the seal, the man was at times 300 paces from the killing site. The boy with the pail ran back and forth between the marking men in an attempt to keep their brushes wet with paint. The results were unsatisfactory.

We believe that it would be feasible to mark seals with a quick-drying enamel. The enamel would perhaps have a rubber base and would be sprayed from an atomizer. We are planning an experiment along these lines (fig. 12).

Painting, harp seal, White Sea.--The painting of harp seals has been mentioned on p. 19

Punching, northern fur seal, Alaska.--In 1947 we ventured to mark pinnipeds by the use of a leather punch. We did this in conjunction with a tagging operation to insure that, even though the tag might be lost later, the animal would remain marked (p. 10). We punched 20,000 fur seal pups of both sexes on

St. Paul Island, September 24 to October 10, 1947. Specifications of the punch are as follows:

Single screw tube spring action, belt type, 8-inch, diameter of hole 1/4 inch (Model 181 BERNARD, Wm. Schollhorn Company, New Haven, Connecticut); cost \$3 (fig. 13). We used two punches and held two for emergency use. We also had spare screw tubes, steel, 2 dozen, no. 8 size, cost \$4.80 a dozen, and spare screw anvils, brass, 1 dozen, cost \$4.20 a dozen.

We punched a hole in the web of the left hind flipper between the first and second digits (fig. 14). The web is about 2 mm. thick; tough and rubbery. When the punch was sharp it made a clean hole but when it was dull as a result of the abrasive action of sand and rookery mud, it left a ragged edge. We replaced the screw tube with a freshly sharpened one about four times a day. Experiments should be made with other types of punches, for example, one having a solid piston instead of a steel tube. On several two-year seals examined in 1949, the punched hole was found to be distinct.



Figure 12.--Apparatus for painting fur seal, St. Paul Island, Alaska, August 5, 1949. Biologist Karl W. Kenyon carries a pressure tank, hand operated, and a DeVilbiss atomizer.

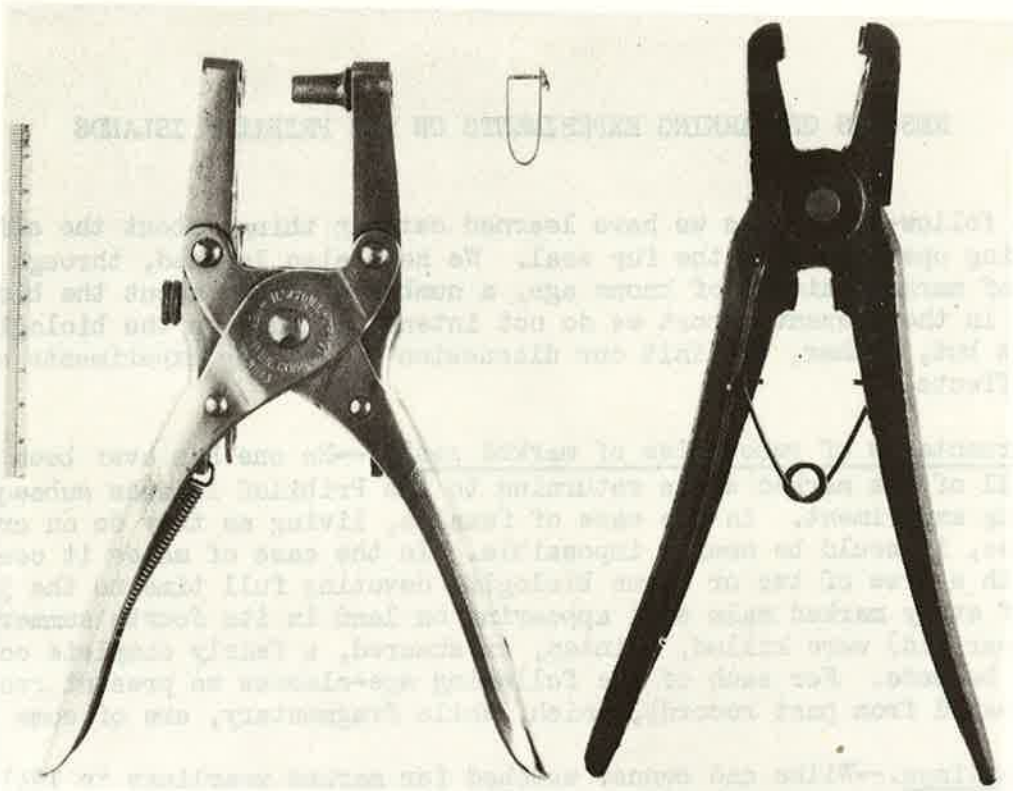


Figure 13.--Marking tools used on St. Paul Island, Alaska, in the fall of 1947; (left to right) flipper punch, monel tag, and tag applicator or plier.

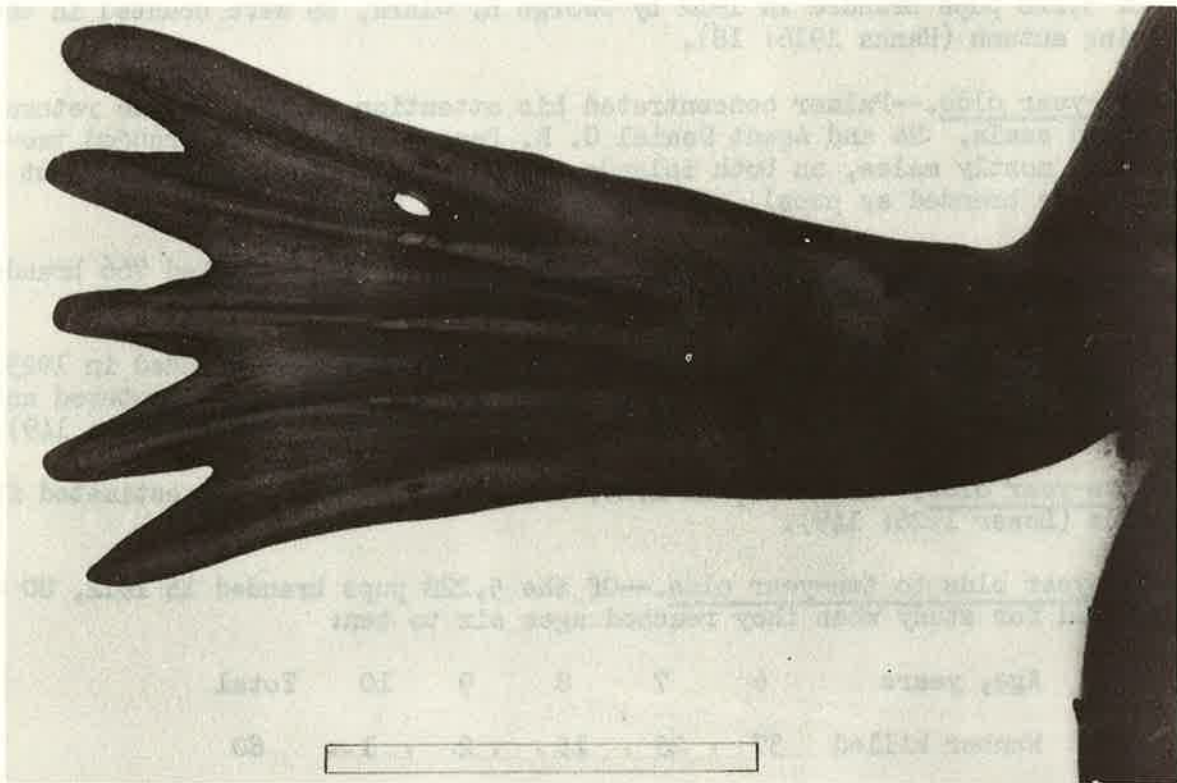


Figure 14.--Freshly punched hole 1/4 inch in diameter in left hind flipper of fur seal pup, 26 pound female, dorsal view, St. Paul Island, Alaska, September 24, 1947.

RESULTS OF MARKING EXPERIMENTS ON THE PRIBILOF ISLANDS

In follow-up studies we have learned certain things about the efficiency of marking operations on the fur seal. We have also learned, through the medium of marked animals of known age, a number of facts about the biology of seals. In the present report we do not intend to dwell on the biological findings but, rather, to limit our discussion to marking experiments and their after effects.

Percentages of recoveries of marked seals.--No one has ever been able to count all of the marked seals returning to the Pribilof Islands subsequent to a marking experiment. In the case of females, living as they do on crowded rookeries, it would be nearly impossible. In the case of males it could be done with a crew of two or three biologists devoting full time to the job. Thus, if every marked male seal appearing on land in its fourth summer (as a three-year old) were killed, painted, or sheared, a fairly complete count could perhaps be made. For each of the following age-classes we present recovery data gleaned from past records, which, while fragmentary, are of some value.

Yearlings.--Wilke and Banner watched for marked yearlings in 1941. They counted 1 in July, 22 in October, and 28 in November, or a total of 51 (out of 5,000 seals branded as pups). Of those whose sex was determined, 41 were males and 6 were females. Seventeen were killed for study (1941a).

Of 5,228 pups branded in 1912 by George H. Clark, 89 were counted in the following autumn (Hanna 1916: 18).

Two-year olds.--Palmer concentrated his attention in 1943 on the return of branded seals. He and Agent Daniel C. R. Benson counted 311 branded two-year olds, mostly males, on both islands, between July 10 and August 4 (out of 10,000 seals branded as pups). Of these, 155 were killed.

Three-year olds.--Likewise, Palmer and Benson in 1943 counted 766 branded three-year olds, of which about 500 were killed.

Four-year olds.--Of the 5,047 estimated three-year olds branded in 1923, about one-third were counted in the following summer. Employees captured and sheared 1,733 of the animals between June 12 and August 5 (Bower 1925a: 149).

Five-year olds.--Likewise, in 1925, employees sheared 1,525 estimated five-year olds (Bower 1926: 149).

Six-year olds to ten-year olds.--Of the 5,228 pups branded in 1912, 80 males were killed for study when they reached ages six to ten:

Age, years	6	7	8	9	10	Total
Number killed	37	25	15	2	1	80

Percentages of seals returning to the exact marking site.--Ten thousand seal pups were marked in 1941 with individually numbered tags, on all six of the rookery groups of St. Paul Island. The pups went to sea in the late fall and the survivors among them returned in each successive summer. For only the males do we have adequate data on the return to the home site of each year class:

	1943	1944	1945	1946	1947	1948	1949
Age of seal in years	2	3	4	5	6	7	8
Number of tagged seals recovered	111	158	149	11	21	6	2
Percentages found on hauling ground adjacent to home rookery	<u>28</u>	<u>64</u>	<u>69</u>	<u>73</u>	<u>86</u>	<u>100</u>	<u>100</u>

It is thus apparent that the two-year male seal is drawn less strongly to the site of his birth than is the older seal. Further evidence on this point is furnished by Soviet investigators. Three fur seals tagged as pups on St. Paul Island in 1941 were killed as two-year olds on the Commander Islands, 1,800 miles away, in the summer of 1943 (Glavzvyerovod, letter of April 28, 1945).

The homing instinct of the male seal varies greatly with the site of his birth. Thus, we found, over the period 1943 to 1946, the following percentage of return for each of the six rookery groups on St. Paul Island:

	<u>Number of tagged seals recovered</u>	<u>Percentage found on hauling ground adjacent to home rookery</u>
Northeast Point	73	77
Reef and Gorbatch	135	64
Polovina Group	62	58
Tolstoi	58	55
Lukanin and Kitovi	30	40
Zapadni Group	<u>70</u>	<u>29</u>
Total	429	Mean 57

We can not explain this wide range in values, from 29 percent to 77 percent.

With regard to the homing instinct of females we can only say that eighteen tagged females were recovered in 1945-1949, sixteen of them on the rookery of their birth.

Effectiveness of hot-iron brands.--In the 1940 and 1941 series, the size of the brand at the time of application was about 0.75-1 by 2 inches, or 1.5-2.0 square inches. In 1940 the brand was placed across the body and in 1941

lengthwise of the body. We later found that the crosswise brand healed more rapidly and the scar was less subject to cracking, while the lengthwise brand was more easily seen (figs. 2 and 3). In a follow-up study, Palmer rated the survival of certain brand scars as follows:

	<u>Satisfactory</u>	<u>Poor</u>	<u>Undetected</u>
2-year males; lengthwise brand; size of sample, 266	87%	13%	---
3-year males; crosswise brand; size of sample, 733	70%	15%	15%

The satisfactory brands were readily seen in the field; the poor brands required close examination; the undetected brands were overlooked until they reached the inspection table in the blubbering shop.

In 1944 we estimated the size, to the nearest one-quarter inch, of the brand scars on 100 males three and four years old. The scar on both age classes was commonly about 0.5 by 1.5 inches. We considered only the naked scar on the freshly killed, unskinned animal; not the surrounding fringe of tan or reddish fur.

	<u>Number examined</u>	<u>Range in area, square inches</u>	<u>Mean area, square inches</u>
3-year olds	85	0 to 2.25	0.73
4-year olds	15	0 to 3.13	0.75

These figures show that the scar on the bachelor is only half the size of the original brand on the pup. Evidently the skin contracts as the scar tissue grows. When, however, the pelt of the bachelor is forcibly stripped from the warm, freshly killed animal, the brand scar stretches and often splits open. On living seals that are driven across country the brand scar occasionally appears to be cracked and raw. When the branded pelt is washed, blubbered, salted, and put through the score or more stages of processing the brand scar disintegrates quite completely, leaving an unsightly hole.

A well made hot-iron brand is a permanent scar. Of 2,742 fur seals branded as pups in 1902, nine were seen later at age 17, seven at age 18, four at age 20, and three at age 21. A word of caution is necessary. A supposed brand mark may occasionally be a scar resulting from a natural injury. We feel, however, that the chances are slight of a natural scar imitating both the location and appearance of a brand scar.

Effectiveness of metal tags.---Metal tags have held up well after eight years of use. By recovering marked male seals of the 1941 series (which were branded as well as tagged) we have been able to estimate the percentage of loss of tags, as follows:

	1943	1944	1945	1946	Total or mean
Age of seal in years	2	3	4	5	---
Number of seals recovered	155	177	192	14	538
Percentages (of those recovered this year) retaining tag	65	89	77	79	78

(While we recovered tagged seals after 1946, they were selected specimens and can not be compared with those taken previously.)

When metal tags are improperly clinched they are inefficient. Toward the end of the 1941 tagging season the plier, or fastening tool, became worn with use. Some of the last seals tagged were at Northeast Point, and at this rookery four years later we observed that 17 out of 39 branded seals were without tags, representing an efficiency of only 44 percent. Taking into consideration a number of small factors upon which we shall not dwell here, we believe that it is reasonable to expect a tag efficiency of 75 percent after five years of service, using one tag, or 94 percent using two tags.

Relative merits of selected metal tags.---Starting in 1941, metal tags of three different sizes have been applied to the flippers of fur seals. These tags are modifications of standard ear tags used in the United States on sheep, hogs, and cattle. Reviewing, after eight years, the efficiency of these tags as used on fur seal pups we conclude that the smallest tag is best adapted to short-term studies and the largest to long-term studies. That is, the small tag fastens to the flipper of the infant seal with a minimum of discomfort and tearing of flesh. It is more apt to stay in place, up to age five years, than is the large one. From age five onward, however, when the flipper becomes broad and thickened, the large tag is more suitable. The following table gives a comparison of sheep-size and hog-size tags recovered over a six-years period:

Age of seal in years	1944		1945		1946		1947		1948		1949	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Seals recovered with small tags, sheep size	82	<u>52</u>	89	<u>60</u>	8	<u>73</u>	9	<u>43</u>	0	<u>0</u>	0	<u>0</u>
Seals recovered with medium tags, hog size	76	<u>48</u>	60	<u>40</u>	3	<u>27</u>	12	<u>57</u>	6	<u>100</u>	2	<u>100</u>

You will note that the metal tags, totalling eight, which were recovered from male seals aged seven years and older were all of the hog size. (It should be mentioned that on female seals, which remain relatively small throughout life, the sheep-size tag is satisfactory.)

Let us now compare the largest tag, the cattle-size, with the foregoing two. The complete returns are not yet in at the time of writing (1949) but the indications are that the largest tag is the most efficient to date. The following table gives a comparison between the recoveries of medium-tagged seals and large-tagged seals. The comparison is difficult to make, because, first, one group was hot-iron branded and the other was not; second, the intensity of effort in recovering was perhaps greater for one group than the other.

	3-year males		4-year males	
	No.	%	No.	%
Seals recovered with medium tags, hog size (1941 series; 5,000 male pups tagged).	76	<u>1.5</u>	60	<u>1.2</u>
Seals recovered with large tags, cattle size (1945 series; 486 male pups tagged).	55	<u>11.3</u>	26	<u>5.3</u>

Keeping in mind the qualifications we have just mentioned, you may reasonably conclude that the cattle-size tag is the most efficient of the three sizes thus far tested.

Relative merits of selected tag locations on the body.--When Wilke and Banner tagged 10,000 pups in 1941 they varied the position of the tag, as follows: (1) base of fore flipper on or near the boundary of the black skin and the fur, (2) hind flipper through interdigital web, and (3) hind flipper over a digit, usually the fifth. When we looked at specimens three and four years later we found that tag losses from the hind flippers were twice as great as from the fore.

Age of seal in years	1944		1945	
	No.	%	No.	%
	3		4	
Tag intact on fore flipper	96	<u>81</u>	136	<u>76</u>
Tag scar only on fore flipper	22	<u>19</u>	42	<u>24</u>
Tag intact on hind flipper	14	<u>48</u>	16	<u>41</u>
Tag scar only on hind flipper	15	<u>52</u>	23	<u>59</u>

Nearly all of the losses from the hind flipper were of tags fastened through the thin black web. Tags clasped over a hind digit were about as secure as those fastened to the fore flipper. As we have mentioned (p. 11) the tagging of 20,000 pups in 1949 is an experiment designed to test the efficiency of hind-flipper tags.

Accuracy of sex identification in marking operations.--We found that, of 118 three-year males tagged as pups, only 89 percent had been correctly sexed and recorded by the original tagging crew. The sex of a seal pup can be determined in a matter of five or ten seconds by examination of the anal region. If any importance is attached to the operation it should be done by trained and careful observers.

SUMMARY

Biologists have marked earless seals (Phocidae) and eared seals (Otaridae) for study purposes. Certain useful techniques have been demonstrated, namely: branding, tagging, shearing, painting, and punching. Clipping of ears has not been properly tested. Girdling is probably not worth testing.

1. Hot-iron brands last for life. They have been seen on fur seals over 20 years old and on one Weddell seal seven years old. A crew of 25 men can brand 1,000-2,000 fur seals in a day, with a mortality of 0.5-0.7 percent. On the Pribilof Islands, the best season for branding (and tagging) is September 1-10. Under no circumstances should the handling of seal pups be prolonged into October. A transverse brand following the fold on the back of the seal's neck is preferred to a longitudinal brand. Branding should be used only when a permanent mark is required, for example, in determining the life span of a pinniped. As compared to tagging, branding is: slower, harder to apply, and possibly more painful to the animal. It seriously reduces the commercial value of the pelt. It may effect the growth rate of the animal and thus detract from its value as a study specimen, although there is no tangible evidence of this effect. It does not lend itself to the marking of large series of individually numbered specimens.

2. Metal tags have lasted for eight years on the harp seal (a silver tag on the hind flipper) and for at least eight years on the fur seal (corrosion-proof alloys on various parts of the body). Aluminum is too readily oxidized by sea-water to be useful. Silver, monel, and stainless steel hold up well; monel perhaps the best.

The ideal tag is thick enough to resist corrosion and abrasion and wide enough to be seen at a distance, yet not large enough to injure the flesh or to catch on sharp rocks. For fur seal pups, a standard cattle ear-tag has proved most useful. (Not, however, fastened to the ear of the seal.) The best locations for tags on the fur seal pup are (a) the hind margin of the fore flipper at the junction of the furred and the leathery parts, and (b) the hind flipper over the first or fifth digit, proximal to the claws. If duplicate tags are applied, the efficiency at the end of five years should be in the

neighborhood of 94 percent.

About as many pups are accidentally killed in tagging as in branding. The principal losses in either case are during the driving and herding operations.

Soviet workers applied silver tags to the ears of fur seals and found that they often tore the pinna. In 1946 and 1947 we applied small monel tags to the ears of sea-lion pups but recovered no specimens. The best time to tag sea-lions on the Pribilof Islands is early June or early July.

3. By means of hand, and power-operated wool shears, thousands of Alaska fur seals have been marked as breeding reserves. The practice has been discontinued. The sheared spot remains visible for at least four months in the fall of the year, perhaps longer.

4. Painting has been used as a means of temporarily marking young harp seals on the ice. It would seem practical only where the pelt of the animal is dry. We hope to experiment with spray paint for temporarily marking fur seals in order to study pelage changes.

5. Clipping of the ears of northern fur seals was tried on two occasions many years ago. Tagging of the ears would presumably serve the same purpose and would be more humane. Neither method has been carefully studied.

6. Punching the thin, black, interdigital web of the hind flipper is an easy method of marking fur seals. By varying the number and the location of the holes the method can be used to identify individually a series of animals totalling several hundreds. The punched holes are difficult to see on living, moving animals. The holes are quite certainly permanent although we have the evidence of only two years as yet to support this contention.

As regards the recovery of marked pinnipeds we have quantitative data only on the Alaska fur seal, and even these data are scanty. When 5,000 fur seal pups of both sexes are marked as pups on the Pribilof Islands, we expect to see 800 to 1,000 marked bachelors on land three years later. The instinct to return to the exact birthplace is feebly developed in the juvenile (e.g., two-year old) and strongly developed in the adolescent (e.g., five-year old). Over 90 percent of the adult males return to their native rookery. The homing instinct appears to be as strong in the female as in the male.

LITERATURE CITED

ANONYMOUS.

1949. Seals with mystery collars picked up war food bags. Popular Mechanics, January, p. 170, 2 photos.

BARABASH-NIKIFOROV, I. I.

1936. Pinnipeds of the Commander Islands, pp. 223-237. In The marine mammalia of USSR Far East, resources and commercial use. Trans. Institute Fisheries and Oceanography USSR (VNIRO) 3: 1-276, illus. (Russian, with brief abstract in German.)

BOWER, WARD T.

1925. Alaska fishery and fur-seal industries in 1923. U. S. Bur. Fish. Doc. 973, 140 pp.
- 1925a. Alaska fishery and fur-seal industries in 1924. U. S. Bur. Fish. Doc. 992, 169 pp.
1926. Alaska fishery and fur-seal industries in 1925. U. S. Bur. Fish. Doc. 1008, 166 pp.

BYRD, RICHARD EVELYN.

1930. The conquest of Antarctica by air. Nat. Geogr. Mag. 58: 127-227.

CHRISTOFFERS, HARRY J.

1937. Computation of fur seals, Pribilof Islands. In Alaska fishery and fur-seal industries in 1936, U. S. Bur. Fish. Administrative Rept. 28, 347 pp.

GOODE, G. BROWN.

1884. Natural history of useful aquatic animals. Section I. In The fisheries and fishery industries of the United States. Senate Misc. Doc. 124, 47th Congr., 1st Sess., 895 pp.

GUDGER, E. W.

1937. Fishes and rings. Notes and illustrations of various fishes wearing rubber bands. Sci. Monthly 45: 503-512, figs. 1-7.

HANNA, G. DALLAS.

1916. The branding of pup fur seals on the Pribilof Islands and data derived therefrom. Typewritten report, U. S. Bureau of Fisheries, 37 pp.
1917. Census of the fur-seal herd. In Alaska fisheries and fur industries in 1915. U. S. Bur. Fish. Doc. 834, 149 pp.
1921. Fur-seal census, Pribilof Islands, 1920. In Alaska fishery and fur-seal industries in 1920. U. S. Bur. Fish. Doc. 909, 154 pp.

- HØST, PER.
1943. With the Norwegian sealers. Nat. Hist., 51: 6-15, illus.
- ISINO, KEISI.
1939. Sea otters and fur seals. In Japan's fisheries industry. Japan Times and Mail, Tokyo. pp. 42-44, 7 photographs.
- JAPANESE BUREAU OF FISHERIES.
1933. Migration of Pribilof fur seals into the waters off the coast of Japan. [Tokyo?], 21 pp., 7 figs., 1 map.
- JOHNSTON, EDWARD C.
1943. Computation of fur seals, Pribilof Islands, 1941. In Alaska fishery and fur seal industries, 1941. U. S. Fish and Wildlife Service Statistical Digest 5, 71 pp.
- JORDAN, DAVID STARR.
1898- The fur seals and fur-seal islands of the North Pacific ocean.
1899. Washington, Govt. Print. Off., 4 v.
- KENYON, KARL W.
1949. Report on 1949 fur seal tagging, St. Paul Island, Alaska. Type-written report, Fish and Wildlife Service, 14 pp.
- LEMBKEY, W. I.
1908. Preliminary report of October 15, 1906. In Reports relating to Alaskan seal fisheries. Senate Doc. 376, 60th Cong., 1st Sess., 120 pp.
1913. Fur-seal service. In Fishery and fur industries of Alaska in 1912. U. S. Bur. Fish. Doc. 780, 123 pp.
- LINDSEY, ALTON A.
1937. The Weddell seal in the Bay of Whales, Antarctica. Jour. Mamm. 18(2): 127-144.
- PALMER, L. J.
1943. Investigations of branded fur seals, Pribilof Islands, Alaska, 1943. Typewritten report, U. S. Fish and Wildlife Service, 45 pp.
- PERKINS, JACK E.
1945. Biology at Little America III. . . Proc. Amer. Philos. Soc., 89: 270-284.
- SCHEFFER, VICTOR B.
1945. Growth and behavior of young sea lions. Jour. Mamm. 26: 390-392.
- SIVERTSEN, ERLING.
1941. On the biology of the harp seal, Phoca groenlandica Erxl. Investigations carried out in the White Sea, 1925-1937, Hvalrådets Skrifter, no. 26, Norske Vidensk.-Akad., Oslo, 166 pp.

U. S. TREASURY DEPARTMENT.

1898. Seal and salmon fisheries and general resources of Alaska.
Washington, D. C., 4 vols., 55th cong., 1st sess., House Doc.
92, pts. 1-4.

WILKE, FORD, AND BANNER, A. HENRY.

1941. Report on 1941 fur seal branding. Typewritten report, Fish and
Wildlife Service, 14 pp.

1941a. Recovery of branded yearlings. Typewritten report, Fish and
Wildlife Service, 5 pp.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C. 20250

PLANT INDUSTRY
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C. 20250

PLANT INDUSTRY
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C. 20250