



NOAA Technical Memorandum NMFS-AFSC-68

# Hot Branding: A Technique for Long-term Marking of Pinnipeds

by

R. L. Merrick, T. R. Loughlin, and D. G. Calkins

**U.S. DEPARTMENT OF COMMERCE**

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by  
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## ABSTRACT

Long-term studies of pinniped population dynamics, behavior, and movements require a sample of uniquely identified, permanently marked animals from the population. The mark must be large enough for animals to be identified from a distance and the marking process should subject the animal to minimal stress. Hot branding provides a marking technique which meets these criteria. Using hot branding equipment and techniques developed for studies of Steller sea lions, 1,489 pups were branded in 1987-89 at rookeries in Alaska and Russia. Survival in the month following branding was high (99.8 %). Observed returns of branded pups (through their eighth month) at Marmot Island, Alaska, may be different from returns of unmarked pups, but the differences are difficult to confirm because of possible immigration of unmarked pups from other rookeries. Most (95.8 %) of 142 brands observed 5-8 months after branding were legible, and 92.3 % of 26 brands seen 6-7 years after branding were legible. Of 751 pups branded at Marmot Island in 1987-88, 151 (20.1%) have been resighted at least once. Most resightings (56.9 %) occurred at Marmot Island, but animals have been resighted up to 1,700 km away.

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## INTRODUCTION

Long-term studies of pinniped population dynamics, behavior, and movements require that a sample of the population be individually and permanently marked with unique marks. Because of the difficulty in recapturing pinnipeds, the mark should be sufficiently large enough to be unambiguously read at a distance. Finally, the marking process should not subject the animal to significant stress.

Two techniques provide permanent, uniquely identifiable, large marks--freeze branding and hot branding. Freeze branding can be used to produce two different types of marks. Short contact by the branding iron (10-20 sec. per character) destroys pigment-producing cells and results in an unpigmented brand. Prolonged contact ( $> 45$  sec. per character) destroys both hair and the pigment-producing cells for a bald brand. Hot branding involves brief (2-4 sec. per character) application of a red-hot iron to kill both hair follicles and **pigment-**producing cells for a permanently bald brand.

Hot branding is equal or superior to freeze branding in several ways. First, the logistical difficulties of performing freeze branding at remote sites are daunting. The major problem is to obtain, transport, and maintain coolants in remote areas. Secondly, hot branding provides a better chance of producing permanent, readable marks. Many freeze brands are unreadable the first month, while hot brands are immediately readable (Harkonen 1987). Unpigmented brands are also difficult to read on light-colored animals. Freeze branding does not guarantee a permanent mark because melanocytes may return and cause the brand to disappear (G. Antonelis, Natl. Mar. Mamm. Lab., pers. **comm.**, 1994; Keyes and Ferrell 1979). Those using hot branding have had greater success obtaining long-term identifiable marks. In

particular, there was considerable success with hot branding of Steller sea lions (*Eumetopias jubatus*). Alaska Department of Fish and Game (ADF&G) biologists hot branded 7,046 pups in 1975-76 with a single character on the shoulder (Calkins and Pitcher 1982). Marked animals continued to be resighted through 1994. Finally, the limited data on the physiological stress induced by hot or cold branding suggests that neither procedure is clearly less stressful. Literature on cattle branding indicates that both procedures stress the subject (Lay et al. 1992 a, b, c). With the cattle studied, freeze branding produced a protracted chronic stress, partly due to the prolonged restraint of the animal and partly due to the slow thawing of the wound. A 3-digit bald freeze brand required 3 minutes or more for application of the brand, compared to 12 seconds for a comparable hot brand. Thus, hot branding produces a brief acute stress, and the animal recovers more quickly than with freeze branding. Preliminary results from a study of the effects of freeze and hot branding harbor seals (*Phoca vitulina*) indicated there were no differences in heart or respiration rates (W. Stobo, Bedford Inst. Ocean, pers. comm., 1993).

We chose to use hot branding for the reasons cited above in our marking of Steller sea lion pups at Marmot Island, AK, during July 1987-88. Despite the use of hot branding on pinnipeds since 1914 (Osgood et al. 1915) and its continued use (Carrick and Ingham 1962, Hoek 1979, Keyes and Farrell 1979, Warneke 1979, Harkonen 1987, Aurioles et al. 1988), procedural information is rare in the literature (Rand 1950). As a result, we developed our own equipment and methods based on conversations with other researchers and our own experience. To facilitate the use of hot branding by other researchers, we report



here the techniques and equipment that we developed. We also discuss the survival of branded Steller sea lions and the legibility of their brands up to 7 years after application.

## METHODS

Hoek (1979) provides a review of commercial hot branding equipment. Commercial systems provided unsatisfactory results under the working conditions experienced in most pinniped research. Based on his results and those of Calkins (1979), we developed the branding system (Fig. 1) described below.

### Branding Irons

Branding iron design is crucial to a successful branding operation. Brands should be made from rolled steel stock without sharp edges and with open letters and numbers. Many commercial brands are made from a solid block with raised letters or are made from square stock (NASCO 1993). Solid block brands could mark the thin skin of pinnipeds as one block, and the characters would disappear. Square stock brands could burn in at the edges and the brand would be slow to heal, scab, and produce a blurred mark.

We designed and built our own branding irons because of the lack of a suitable commercial brand. The shaft of the iron was 13 mm in diameter and 75 cm long, with a wooden handle mounted at the end of and perpendicular to the shaft. The brand was fabricated separately from 10 mm rolled stock, and then welded to the shaft. Each number or letter was attached to a separate iron (we used separate irons for flexibility in the branding

operation). Design of individual characters was important. We used Arabic numerals (rather than abstract codes such as the Farrell Angle Numerical marks) because we expected that resightings would often be made by inexperienced observers. All brands were approximately 5 cm wide by 8 cm high, This provided a brand sufficiently large enough to be read at 100 m with 7x binoculars.

### Branding Forge

Commercial branding forges are typically large and heavy (30-40 kg) and are not field portable. The forge that we constructed was made from a 18 L (5 gallon) steel drum. A 10 cm diameter hole was cut in the wall at the base for the burner. The lid was hinged so that it could be partly opened and still keep out rain and wind. The inside of the forge was insulated with a 3 cm thickness of Kao-wool wired to the walls. Light-weight fire bricks were placed in a “V” opposite the burner hole to backstop the flame. Finally, a layer of ceramic briquettes was placed at the bottom of the forge to retain heat and to avoid ripping the Kao-wool with the brands. The complete forge weighed less than 10 kg (22 lb) and could heat up to four irons simultaneously.

We used propane supplied from 9 kg (20 lb) cylinders to heat the forge. Propane provides an intense heat and is easy to obtain and store in the field. A commercial “weed burner” (basically a simplified venturi burner) was used to heat the forge. The burner was connected to the propane with a rubber hose without a regulator. Flow from the propane cylinder was regulated with valves on the tank and burner. One cylinder was sufficient for

application of over 200 1- to 3-digit brands, if the operation moved along relatively quickly. The entire system (brands, forge, burner, and fuel tank) could be carried on two pack frames.

### Operations

After lighting, the burner was inserted into the forge through the hole at the forge's base. The burner remained lit throughout the operation, although at a reduced flame during breaks in branding activity. This kept the forge hot and speeded operations.

One person operated the forge. Irons were placed into the forge, resting on the briquettes and the rim of the forge. Once a brand was red hot, the operator passed the iron to the brander. As an iron was withdrawn the operator attached a pair of locking pliers (e.g., Vise grips) to the shaft to allow the brander two locations to hold the iron. The operator wore heavy gloves (asbestos or heavy leather) because of the intense heat over the top of the forge and on the iron's shaft.

Three persons were required to mark an individual pup. Two persons hand-restrained the animal, usually with one person sitting over the animal's midsection and the other holding the hindflippers. It was important that the animal handlers restrained the animal at the time of the brand's application; otherwise, the animal's movement would blur the brand. The brander extended the foreflipper on the side to be branded (brands were applied to the shoulder area), gently stepping on the flipper to hold it in place. This kept the brand area accessible. The brander then applied the brand at a right angle to the animal's shoulder. Curved brands (e.g., 0, 3, 6, 8) were rolled slightly during application. Light, even pressure (ca. 5 psi, and the flesh was not deeply pressed in) was applied to the skin for approximately 2-4 seconds.

Contact was maintained until all the hair burned off and the skin was lightly singed. After the brand was removed, the character appeared golden brown and was distinctly readable. Too much or prolonged pressure would burn through the skin into the underlying muscle and blubber.

The brander then applied the next brand to the animal. Distances between characters was no less than 2-3 cm. This process was repeated until all characters were applied. It usually required no more than 1 minute to apply a 3-4 digit brand.

We first determined the animal's sex, applied numbered Allflex cattle-ear tags to the foreflippers (same number as the brand), and in some cases weighed the animal. Branding was the last step in the process, and the animal was released immediately afterward. Animal reactions at the time of release varied. None showed obvious signs of distress; many pups had to be picked up and carried away from the branding area.

Speed of the operation was constrained by capture and handling time. Two-hundred animals were branded with 1-3 digit brands in 5-6 hours (with rests after every 25 animals).

#### Post-branding Observations

National Marine Fisheries Service (NMFS) and ADF&G biologists made observations at Marmot Island during December 1987 through March 1988. Presence of marked individuals was recorded and the number of pups (alive and dead) counted 3-4 times per week at a study area adjacent to where animals had been branded the preceding summer (the tagging beach was empty in winter). They also censused four other locations on the island several times each month.

Using these data, we compared survival and returns of pups in two ways. First, we compared the proportions of the marked and unmarked pup cohorts observed dead on the beach during the December-March period. Second, we compared the monthly maximum numbers of the original cohorts (branded versus unmarked) observed returning to the island during the period using contingency table analysis (Pearson Chi-square;  $\alpha = 0.05$ ).

Resight information at Marmot Island subsequent to branding operations was gathered primarily during June and early July in conjunction with daily population censuses during 1989-94. Additional daily observation time was devoted solely to searching for branded or tagged animals beginning in 1991. Resightings at other locations and during other times of the year were opportunistic, reported by biologists from numerous state and federal agencies, and by the general public.

## RESULTS

During 1987-89, we branded and tagged 1,489 Steller sea lion pups (Table 1) at Marmot Island, Alaska, and rookeries in the Russian Kuril Islands (Brat Chirpoyev, Lovushki, Raikoke, and Srednego Islands; Fig 2.; Merrick et al. 1990). Fifty pups were tagged at Marmot Island in 1987, in addition to the 350 pups branded and tagged there that year.

### Survival After Branding

No mortalities occurred during branding operations. The week after branding at Marmot Island (1987 and 1988) and Lovushki Island (1989), a total of 2 dead marked pups were found out of the 1,000 pups marked. These mortalities could not be directly linked to branding.

The original cohort of 2,910 pups counted at Marmot Island in 1987 included 400 marked pups (350 branded and tagged, and 50 tagged only). Of the 400 pups marked, 199 identifiable individuals (174 branded and 25 tagged) were observed alive through March 1988. Observed returns were not different for animals with tags only (50.0%) and brands plus tags (49.7%).

A maximum of 40 dead pups were observed at Marmot Island during November through March--6 with tags or brands, and 34 without marks. Observed mortality (1.5 % for marked animals and 1.4 % for unmarked animals) was not different for the two groups.

The proportion of the original cohort of branded animals resighted on the island was different from the proportion of the unmarked cohort observed (Table 2; Pearson Chi-square = 15.90,  $P < 0.01$ ). Significant differences were observed in 3 of the 4 months of observations (December, January, and March; Table 2).

#### Brand Legibility

Winter 1987-88 observations from Marmot Island produced descriptive information on 142 of the 174 branded pups seen. All of the 142 sea lions were observed at least twice during the winter, and each brand was confirmed from numbers on the animal's flipper tags. Virtually all brands were completely healed by November 1987. By November, at least 6 animals had lost one or both of their flipper tags. One hundred and four (73.3 %) of the brands were described as completely legible. Another 32 (22.5 %) of the brands were judged readable but had minor problems (e.g., adjoining digits were too close, or the enclosed interior

portion of the 0, 6, or 8 brands had filled in). Only 6 (4.2%) of the brands had characters which were illegible.

Twenty-five of the Marmot Island animals were seen during the summer of 1993 (5-6 years post-branding) and a twenty-sixth was seen in March 1994. Twenty-four (92.3 %) of the animals had completely legible brands; only 2 (7.7 %) of the brands were difficult to read. At least 10 (38.5 %) of the animals were missing one or both of their flipper tags. Colors and numerals on the remaining flipper tags were difficult to read because of the tag's discoloration and the sighting distance (> 50 m in many cases).

#### Resightings of Branded Animals

Through December 1994, 151 individuals (20.1% : 78 females and 73 males) of the 751 branded Marmot Island pups have been resighted as yearlings or older. Most (114 or 77.6%) have been resighted only once; 19 (12.9%) have been resighted twice; 9 (6.1%) were seen three times; 3 (2.0 %) were seen four times; and 1 each (0.7 %) were resighted five and six times. Of the 49 pups tagged but not branded, only 1 female was resighted on a single occasion. Considering all observations through December of 1994, there has been no apparent difference in the resighting rate for branded males and females or for the 1987 and 1988 cohorts ( $\chi^2$ ;  $P > 0.05$ ; Chumbley et al. in prep.).

Branded Marmot Island sea lions have been observed at 23 different locations in Alaska and British Columbia. The greatest number of resightings (116 of 204: 56.9%) were from Marmot Island; an additional 33 resightings (16.2 %) were from the Kodiak Archipelago or Sugarloaf Island, 75 km distant. One female that was tagged but not branded was also

resighted at Marmot Island. The resighting most distant (1,700 km) from Marmot Island was at Loretta Island (53°45'N, 128°50'W), in the upper reaches of Douglas Channel, British Columbia, Canada (P. Olesiuk, Dept. Fisheries and Oceans, Pacific Biological Station, Nanaimo, British Columbia, Canada V9R X6., pers. commun., 1990). Tags from 13 branded-tagged animals (6 females, 7 males) were recovered from the stomach of a killer whale found dead on the beach in Prince William Sound, Alaska, and two animals were killed in gillnets (National Marine Mammal Lab, 7600 Sand Point Way, Seattle, WA 98115, unpub. data). All other resight observations were of live animals.

The greatest number of resightings of Marmot Island occurred when animals were about 1-year-old. Yearlings accounted for 72 of 187 (38.5%) or 71 of 186 (38.2%) resightings, depending on whether the analysis included animals that were tagged but not branded. For males, the frequency of resighting was low for 2- through 5-year-olds. Resighting generally was low for females two or more years old; the greatest frequency of resighting (10 individuals) was for 7-year-olds from the 1987 cohort. The observed number of females and males was significantly below the number of animals expected to be alive at any given age ( $\chi^2$ ,  $P < 0.01$ ; Chumbley et al. in prep.).

By 1994, nine branded females were observed with pups. Two were seen on Marmot Island during June 1993 (one pup was later abandoned) and one was with her pup on Latax Rocks, approximately 70 km from Marmot Island, in March 1994. During June 1994, three branded females were observed with pups on Marmot Island and three were observed on the rookery at Sugarloaf Island, approximately 75 km north of Marmot Island. The pup abandoned on Marmot in 1993 and one of the 1994 Sugarloaf pups did not survive.



Fifty-six (7.6%) of the 739 sea lions branded in the Kuril Islands in June 1989 have been resighted as yearlings or older through June 1994 (V. Burkanov, KamchatRybVod, Petropovsk-Kamchatskii, Russia, pers. comm., 1994). Resightings have occurred from the Yellow Sea north to the Kamchatka Peninsula.

## DISCUSSION

The branding technique and equipment developed in this project provide a fast, efficient field-portable method to mark pinnipeds. The technique has been used to brand 400 Steller sea lion pups by the Oregon Department of Fish and Wildlife (n = 400) at Rogue Reef, by NMFS and Russian Commonwealth biologists (n = 1,200) in the Kuril Islands in 1990 and 1996, and by the ADF&G (n = 800) at Lowrie Island, Alaska, during 1994-95. NMFS personnel have also used the technique and equipment to brand California sea lions (*Zalophus californianus*).

Brands provided better resighting information than tags. Most of our identifications of live animals required brands. In part, this was a result of the gregarious nature of the species. When sea lions come ashore, they usually group tightly together. Visibility of flippers is then obscured by other animals, while the shoulder region (where the brand is located) is usually visible. The other factor aiding identification was the generally greater visibility of the brand compared to tags. Thus, observers (park rangers, lighthouse keepers, etc.) frequently noticed branded animals, even when they were not searching for them. For example, during damage assessment activities after the 1989 Prince William Sound oil spill, ADF&G observers identified 22 individual Steller sea lions. Of these, 19 (86.4%) were identified from the brand.

Researchers using hot branding have reported that cool brands need to be applied longer and with more pressure, thus producing wounds which were susceptible to infection (Cat-rick and Ingham 1962, Warneke 1979). Our experience indicates that brands can be consistently heated to a temperature where such wounding does not occur (no open wounds were observed in the 142 brands monitored at 5-8 months post-branding). The branding irons were kept so hot that the brand and shaft tended to distort; they could, however, be easily straightened while the iron was hot. This problem has been alleviated by using stainless steel stock (R. DeLong, Natl. Mar. Mamm. Lab., pers. comm., 1993)

Extremely wet animals (those sufficiently wet that moisture could be pressed out of the pelage) provided unsatisfactory results because water in the fur absorbed the heat and cooled the iron. There was no visible difference in branding results for damp and dry animals.

Spacing and design of individual characters is very important. There is some migration of the brands as the animal grows, and unless brands are initially spaced at least 2-3 cm apart, adjacent characters may grow together. Skin on the enclosed areas of brands (e.g., the inside of the number "0") tended to be singed in branding, and the detail of the brand was lost. Brief application times minimize this effect. Opening the enclosed spaces of numerals and letters may also help. If only a single mark is to be placed on the animal, the mark should be designed so that it does not duplicate a natural mark. For example, the letter "0" was used in the 1975 ADF&G branding work with Steller sea lions. However, the resulting brand was difficult to distinguish from a common, natural fungal mark. The use of the letter (by itself) was discontinued.

Our Marmot Island studies suggest that branding may lead to increased mortalities. However, at least two difficulties exist in our comparison of returns of marked and unmarked pups. The population is open; some pups dispersed from or to Marmot Island during the observational period. We assume that emigration was equal for marked and unmarked animals. Immigration may also have occurred and presents a more serious problem in interpreting these results. Sugarloaf Island (60 km north of Marmot Island) contains a large rookery which is vacated by December. Some of the 2,000+ pups born there in 1987 may have dispersed to Marmot Island. If this number was significant (e.g., 25 % of the surviving Sugarloaf Island pups) then the proportion of returning marked pups would not have been significantly less than the apparent returns of unmarked pups. This suggests that our estimate of Marmot Island unmarked pup returns (or survival) through the eight month may be overstated, although the estimates for branded pups would remain unchanged.

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Table 1.--Counts of Steller sea lion pups branded by site, year, and brand type.

Island	Year	Number		Brand type
		Female	Male	
Marmot	1987	186	164	Right shoulder, 1-3 digit brand
Marmot	1988	206	194	Left shoulder, 1-3 digit brand
Raikoke	1989	75	64	Right shoulder, "P" plus 1-3 digit brand
Lovushki	1989	97	103	Right shoulder, "JI" plus 1-3 digit brand
Srednego	1989	95	105	Right shoulder, "C" plus 1-3 digit brand
Brat Chirpoyev	1989	112	88	Right shoulder, "5" plus 1-3 digit brand



Table 2.--Monthly maximum counts, proportion of original cohort, and test statistics of branded (n = 350) and unmarked (n = 2,5 10) Marmot Island Steller sea lion pups for December 1987 through March 1988.

Month (no. counts)	Branded		Unmarked		X <sup>2</sup>	P
	No.	Proportion	No.	Proportion		
December (12)	36	0.103	467	0.186	14.67	< 0.01
January (18)	62	0.177	427	0.170	0.1	0.74
February (16)	69	0.197	650	0.259	6.23	0.01
March (15)	74	0.211	652	0.260	3.75	0.05



Figure 1. -- Branding irons, forge, burner, and propane cylinder used in the hot branding of Steller sea lion pups.

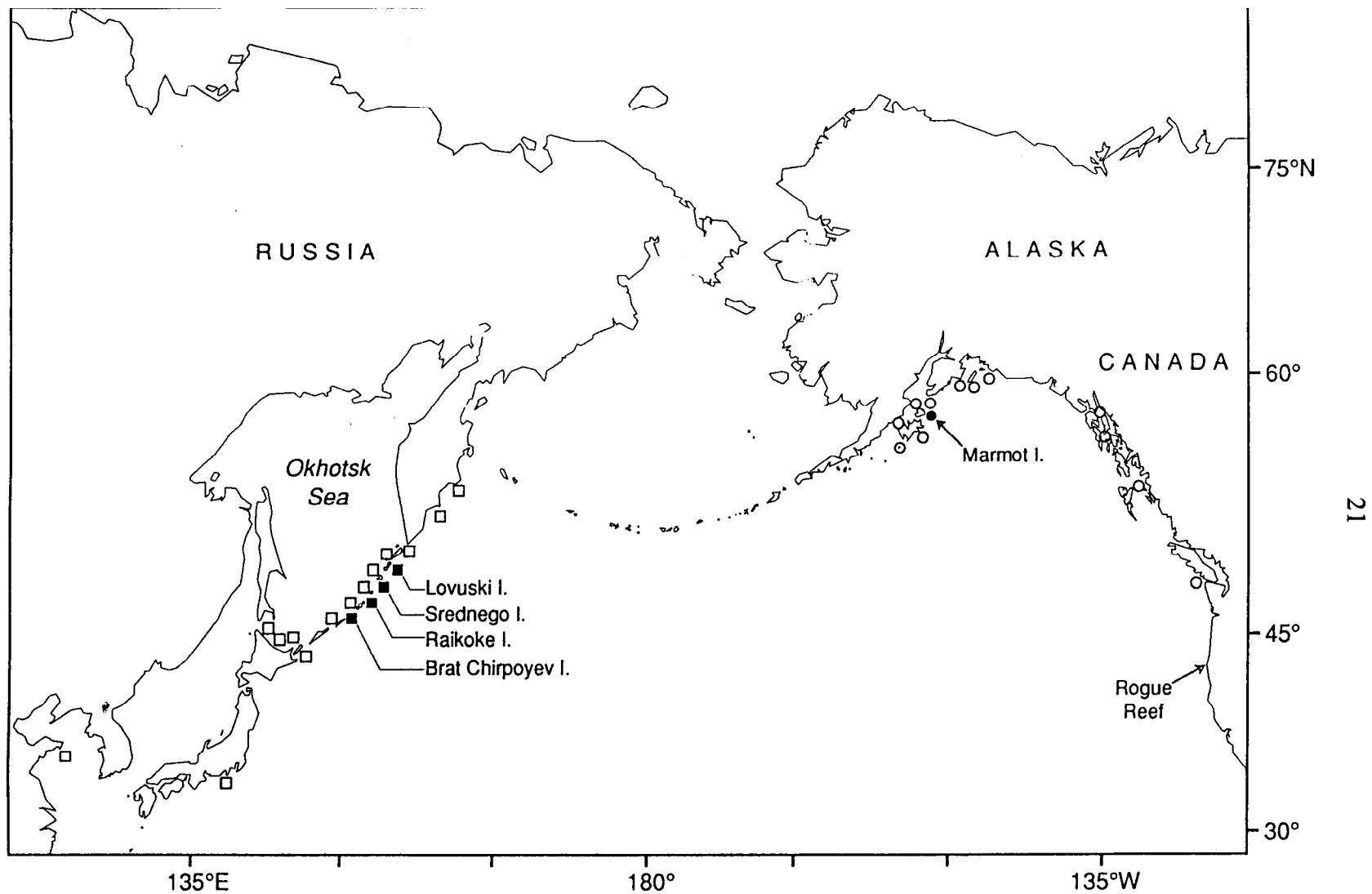


Figure 2.--Rookeries at which Steller sea lions were branded during the summers of 1987-89 and locations where animals were subsequently resighted. Marmot Island is shown by a • and resights of these animals by a ◻. Kuril Island branding sites are shown by a ■ and resights by a ◉.

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