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Northern Fur Seal Research Techniques Manual

Edited by
George Antonelis

March 1992

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NORTHERN FUR SEAL RESEARCH

TECHNIQUES MANUAL

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PREFACE

This manual describes techniques and methods developed for collecting and processing data and material for various research projects conducted on the northern fur seal (Callorhinus ursinus) populations of the Pribilof Islands. This work has changed little from year to year: however, as new techniques are introduced this manual will be updated. This document describes the current (early 1990s) sampling methods and provides historical information on the use of these methods to give the reader an understanding of the evolution of this research.

Many researchers have contributed to the development of this manual, some of whom no longer work at the National Marine Mammal Laboratory (NMML). Charles Fowler, Roger Gentry, and Anne York are current NMML employees who have made significant contributions to this manual.

COUNTS OF ADULT MALES

The counts of adult male northern fur seals began in 1911 and have been continued since then as a way to measure recruitment of young males into the breeding stock of the fur seal population. Between 1980 and 1990 an important purpose for obtaining these counts was the calculation of pup production estimates based on the relationship between numbers of territorial males with females and pups born (next chapter). The counts have traditionally been made in mid-July (10-25 July) when most of the females have arrived and given birth to their pups with the objective of conducting the count as near as possible to July 10.

Two categories of males, harem and idle. have been recorded each year since 1911. By definition, a harem male is one that is defending a territory containing one or more females. The idle males are about 7 years of age and older (Johnson 1968) and may or may not have territories and never have females (idle males were separated into several classifications beginning in 1966).

The adult males were not counted on either of the Pribilof Islands in 1942 because of the Second World War (1941-45). The relative locations of what have been historically defined as five separate classes of adult males are as follows:

Class 1: Shoreline--full-grown males without females but apparently with established territories at the high-tide mark. Most of these seals are age 7 years and older (idle males).

Class 2: Territorial without females--full-grown males without females but with established territories above high-tide and on the rookery. Most of these seals are

age 7 years and older (idle males) and the majority are found at the periphery of the rookery.

Class 3: Territories with females--full-grown males with one or more females and established territories in the rookery. Most of these seals are 9 years of age and older (harem males).

Class 4: Back fringe--males without females and territories that are found along the inland fringe of the rookery Most of these seals are of estimated ages of 7 years and older (idle males) and readily abandon their location when approached by the counting crew.

Class 5: Hauling ground--adult males (> 7 years old) without females and territories that are found on traditional hauling grounds. Most of these males are 7, 8, and 9 years of estimated age. Also present are 2- to 6-year-old males which are not counted (bachelors not Class 5 males). A few may be older (10+), having spent a previous season or more on the rookery as territorial males.

Since 1975, Classes 1 and 4 were combined with Class 5 into a single count because it was found that, although animals belonging to Classes 1 and 4 could be identified readily enough, no useful application of the results was evident. Classes 2 and 3 were continued so that we now have three classes of males: 2, 3, and 5 (Fig. 1).

The following outline summarizes the adult male classification schemes from 1911 to the present:

1911-65: Two classifications. harem and idle

a. Harem = territorial with one or more females

b. Idle = territorial without females and all nonterritorial estimated to be age 7 and older

1965-74: Five classifications as listed above (1, 2, 3, 4, and 5)

a. Class 3 = harem male classification used from 1911 to 1965

b. Classes 1, 2, 3. and 5 = subdivisions of the idle male classification used from 1911 to 1965

1975 to present: Three classifications (2, 3, and 5)

a. Class 3 = harem male classification used from 1911 to 1974

b. Classes 2 and 5 = subdivisions of idle male classification used from 1911 to 1965 (Class 5 includes Classes 1 and 4)

One more aspect of the counts of adult males was changed beg-inning in 1966 when each rookery (except Ardiguen on St. Paul Island and East Reef on St. George Island) was divided into numbered sections containing approximately 100 harem (Class 3) males (less than 108 in certain places where prominent natural boundaries existed). Since that year, the counts for each rookery have been recorded by section number and the results have been used to randomly distribute marking effort when carrying out the shearing-sampling program for estimating the number of pups born. From 1911 through 1965, the counts of the adult males on the rookeries were not subdivided into sections.

Equipment needed

The following equipment is needed to conduct the adult male counts:

1. Two-unit hand tally or two single hand tallies

2. Rite-in-the-Rain' booklet, No. 311

3. Bamboo poles(s) 10-12 ft long

4. Binoculars

5. Pencil

6. Camera

7. Notebook with record of section boundaries.

8. Revolver (optional. .38 caliber used in the past)

The hand tally is used to record the three classes of males as the census taker progresses down the rookery. When the census taker completes a count for one of the rookery sections, he or she records the appropriate figures in the booklet, resets the tally to zero, and be-gins the count of the next section, The bamboo pole is used as an aid in counting and in warding off charging males. In the past, a revolver was used for protection or, when fired, to elicit an upright posture in males so they could be seen for counting. Currently researchers have not elected to use a revolver during bull counts. Although a census taker can work alone on some small rookeries. he or she should have at least one assistant at all times for reasons of safety and this is optimal for most rookeries. There axe several locations on Zapadni and Polvina Cliffs where at least four assistants are required. Beware of sleeping fur seals at all times, they are easily overlooked and their bite can cause serious injury.

"Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Description of Rookery Sections on the Pribilof Islands

The following section provides detailed descriptions of known northern fur seal rookeries and hauling grounds on St. Paul and St. George Islands (Figs. 2 and 3). Sampling strategies and key landmarks used to establish sampling boundaries are included for each rookery section.

Counts of Class 2 and 3 males are made from various vantage points, along the inland perimeter of the rookery. Natural physiographic boundaries, breaks in the distribution of seals, or an imaginary line between two conspicuous objects are used to identify reference points for subtotals in the census and to avoid duplicate counts of males when counters move from one location to another.

Counts of Class 5 males are obtained by the census crew as they pass hauling ground areas. The distance between hauling grounds and rookeries will dictate how they are counted. When the two areas are in close proximity, counters move slowly between the rookery and hauling ground so that males are not frightened into the rookery, thus avoiding disturbance of breeding fur seals. A slow movement of males away from the rookery is desired. Hauling grounds isolated from rookeries are also approached slowly, but in this situation males are allowed to slowly move into or toward the water in front of the census crew. In both cases counts of Class 5 males are facilitated by the movement of males on the hauling grounds. The speed and direction of male movement can be regulated by the distance which is kept between the seals and the census crew. Care must be taken to count Class 5 males that lag behind or remain sleeping in the hauling grounds as the counters pass.

St. Paul Island

Got-batch-Counts are conducted from selected vantage points on cliffs bounding the rookery, or from tripods, while moving from north to south (Fig. 2E). There are six sections in this rookery. AU section numbers are marked with yellow paint or black and white plastic signs.

- The hauling ground at Zoltoi Sands on the sandy beach, about 0.5 mile north of observation blind at Gorbatch rookery is counted before Section 1.

- Section 1 ends at a large square rock (= 8 sq. m) with vegetation growing on top. The rock is located at the base of a cliff directly below the tourist observation blind.

- Section 2 ends at the first wooden tripod located to the south on a point of land overlooking the rookery.

- Section 3 ends at the second tripod, a tripod which is located on level ground.

- Section 4 ends at a rock with a yellow painted number 4. This rock is located adjacent to the remains of a fallen tripod.

- Section 5 ends where the number 6 was mistakenly painted on a rock. A sign with the number 5 was attached to the tripod. The number 5 was also painted on a rock near the fourth tripod (which has fallen).

- Section 6 ends where the ground behind the beach slopes up to the bluff. Seals located beyond the flat-topped rock (with a rock blind used for hunting) are considered to be part of the Ardiguen rookery.

Ardiguen--Counts are made along a north to southwest transect from several vantage points along the cliff which borders the rookery. Safety is a primary criteria for selection of census locations. The rookery ends at a point of land where the coastline turns abruptly to the southeast marking the beginning of Reef rookery (Fig. 2E). There are no sections or painted numbers located in this rookery.

Reer: Counts are conduct& moving from west to east (Sections 1-5) and then south to north (Sections 6-11). AU sections were numbered on signs with yellow paint in 1987 or replaced with black and white plastic signs in 1990.

- Section 1 ends at the termination of the first section of catwalk where a sign with the number 1 is painted on a collapsed tripod.

- Section 2 ends at the first upright tripod.

- Section 3 ends at the section of catwalk with a tripod located deep in the old rookery area.

- Section 4 ends at the next tripod. It is located along the remaining upright catwalk which began in Section 2.

- Section 5 ends after a fallen section of catwalk and at the beginning of the next section of upright catwalk.

- Section 6 ends at the next tripod but includes only the rookery area between the catwalk and the shoreline.

- Section 7 ends at the same location as Section 6 but includes only the rookery area inland of the catwalk.

- Section 8 ends at the next tripod with a short catwalk attached.

- Section 9 ends at the next tripod with catwalk attached.

- Section 10 ends at the final tripod with catwalk attached.

- Section 11 ends about 150 m beyond the last tripod where the near-shore topography changes from rocky intertidal to shear cliffs.

Lukanin

Counts are conducted from vantage points along the cliffs overlooking the rookery while moving from north to south (Fig. 2D). There are 2 sections in this rookery which are usually counted just before counting Kitovi.

- Start counting idle males for Section 1 at the point where the road meets the beach.

- Section 1 starts at the north end of the rookery and ends at the middle of the rookery just beyond the prominent cliff outcropping. The end of this section is indicated by a rock about half the distance up the hillside with the number 1 on it.

- Section 2 begins at the location where Section 1 ends and there is an obvious change in the topography. Section 2 is characterized by a sloping hillside with large boulders which continues to the end of the rocky point immediately north of the Kitovi Amphitheater. Do not attempt to walk around this point in the intertidal zone.

Kitovi Amphitheater and Kitovi

Counts are conducted from vantage points overlooking the rookery moving from north to south. There are 5 sections in this rookery, all of which are marked with yellow paint or black and white plastic signs.

- Section 1 begins at the rocky point where the Lukanin rookery ends. This first section, with the amphitheater, ends south of the cement house near a rock with the number 1 on it. A separate subtotal count for the amphitheater is recorded separately from the total for Section 1. The section markers on Kitovi rookery were all repainted in 1937. Rock number 13 was repainted (a new number 13 was painted on this rock because of an earlier mistaken reading of number 1).

- Section 2 ends about 100 m to the south end at the end of a rocky outcropping on a small cliff (-3-4 m high) which overlooks the large rock shelf of Section 3. A large inland rock marked with the number 2 at this location marks the end of this section.

- Section 3 ends at a rock with the number 3 on it, approximately 50 m beyond the fallen tripod overlooking this section. This rock is uphill from a ridge south of the fallen tripod. The inland portion of this section rookery is relatively flat and slopes toward the water.

- Section 4 ends at a rock with the number 4 on it and is very close to a pipe which was used as a reference point in the past. The end of Section 4 is also identified by a rock wall projecting out toward the point where the coastline makes a 90° turn to the west. The tripod which was also used to identify Section 4 is now almost completely demolished.

- Section 5 includes the area on top of the rock wall, to the west, and to the end of the rookery. After this count is completed, counts of idle males are made at the haul out behind Sections 4 and 5.

Polovina

Counts are conducted from various vantage points overlooking the rookery while moving from south to north (Fig. 2C). There are 2 sections in this rookery.

- Section 1 begins at the south end of the rookery with idle mail counts of the haul outs to the south. and ends at a metal pole with the number 1 on it just beyond the second tripod {down for many years) and about 100 m inland.

- Section 2 ends at the north end of the rookery where the north edge of flat intertidal rock meets the beach below the cliff. A small cliff obscures a complete view of part of this section. Counts of seals on top of the cliff should be made from locations overlooking the rookery. Fur seals below the cliff should be counted by walking to the flat rock intertidal area extending out from the rookery (preferably at low tide). Counts of idle males on this expanse of rock should be made while they enter the water in response to the presence of the counters.

Polovina Cliffs

Counts are conducted moving from south to north. There are 7 sections in this rookery which are identified by pole markers or black and white plastic signs.

- The dividing line between Polovina and Polovina Cliffs is marked by a 0.3 m pipe in the ground at the grassy point of land north of the flat, rocky intertidal area. This pipe is difficult to locate because it is partially covered by grass and marks the beginning of Section 1. Section 1 ends at the second tripod (which is down) identified by the number 1.

- Sections 2 and 3 boundaries are identified by numbers on tripods.

- Section 4 ends at a small point where a stake, approximately 300-400 m past the tripod, is identified with the number 3.

- Section 5 is marked by a pipe in a concrete weight approximately 200 m past the end of the fourth section (originally used in shearing-sampling work). A second pipe which has been painted white and is located approximately 50 m inland from the shoreline also marks the end of Section 5.

- Section 6 ends at a gully where the cliff becomes less precipitous allowing seals easy access to the water. The end of the section is also identified by a rock pinnacle at the end of the gully. which is in line with a white pole approximately 50-75 m inland.

- Section 7 continues to the end of the rookery under the cliffs with idle males counted al! the way to the beginning of Little Polovina.

Little Polovina

Counts are conducted moving from south to north (Fig. 2C). This rookery was originally divided into two sections but is now considered one because of the small number of animals utilizing the area. The rookery begins on the side north of the sand cliffs (north of Polovina Cliffs) where they meet the rocky coastline overlooking the rookery. Counts continue to the area of rocky break seaward of the swamp or pond north of the rookery.

Moriovi

Counts are conducted primarily from tripods while moving from south to north (Fig. 2B). Each of the six sections in this rookery have been marked with a corresponding number.

- To start the count on the Morjovi rookery, walk down a grass covered road which is approximately 200 m past the barrier on the main road north of the Webster House. This small (unused) access road leads to the east where the rookery begins. Before arriving at the main rookery there are a few seals on the second point south of Sea Lion Neck (the counts for this point are recorded separately from the rest of the rookery).

- Beginning at Sea Lion Neck count all idle males along the beach until reaching the main portion of the rookery where Section 1 begins (north of the sandy beach used as a male hauling ground and approximately 50 m south of the first tripod.)

- Section 1 ends at a pipe north of the firs tripod (ignore the painted rock at the first tripod).

- Sections 2, 3, and 4 end at the numbered tripods. Section 3 on Morjovi ends at a small tripod. Section 4 ends at the fourth tripod (the third tripod with a catwalk).

- Section 5 ends at a rock painted with the number 32. The end of this section is also identified by the most prominent rock outcropping in the intertidal zone (natural jetty) about 200 m north of the last tripod.

- Section 6 ends on the south side of the rock blind used for hunting at the tip of northeast point (essentially the tip of the point).

Vostochni

Counts are conducted from cliffs overlooking the rookery, vantage points at the rookery edges, tripods, and catwalks while moving from east to west (sections 1-8) and from north to south (sections 9-14) (Fig. 2B). All sections in this rookery are identified by corresponding numbers or physiographic characteristics.

- Section 1 starts on the north side of the blind at the tip of Northeast Point and ends at the second of two small points where the number 1 has been painted on a rock (almost completely worn off). The count for this section includes all hauling ground males in the small bay between the two points.

- Section 2 ends at a rock with a number 2 on it.

- Section 3 ends where a yellow number 4 and an orange number 3 are painted on a big rock, about 150-200 m west of the beginning of the section.

- Section 4 ends at the first prominent point of land along the coast where a tripod was destroyed in 1991 (about 150-200 m west of the rock with the number 51 painted on it).

- Section 5 ends at a point directly in Line with the small rock outcropping sloping off Hutchinson Hill and extends toward the beach. It corresponds to the position of a collapsed tripod and where the catwalk begins.

- Section 6 ends at a sign with the number 6 approximately midway between the beginning of the catwalk and the first tripod (number 7). This section also ends along an imaginary line connecting a series of orange tipped poles on the inland side of the catwalk.

- Section 7 ends at the number 7 on the first tripod at the west comer of the catwalk.

- Section 8 ends at the first tripod (collapsed in 1991) southwest of the main catwalk below Hutchinson Hill.

- Section 9 does not end at the next tripod, but ends at the following tripod marked with the number 9 (apparently an extra tripod was constructed between Sections 8 and 9).

- Section 10 ends at a rock midway between the next two tripods. There is a number 13 on the rock, and it is located about 200 m to the west of Section 9 and just west of a rock with a "+" symbol painted on it.

- Section 11 ends at a rock identified by the number 11.

- Section 12 continues to the next large cove south and ends where fur seals are no longer present in the immediate area.

- Section 13 is the next isolated section of the rookery on a rocky point about 0.25 mile from the end of Section 12.

- Section 14 is the last isolated section of the rookery and is separated from Section 13 by a large cove. Idle-male counts continue through the first part of the expanse of beach to the west.

Tolstoi

Counts are conducted from cliffs, tripods and catwalks overlooking the rookery while moving from southwest to northeast (Pig. 2F). The eight sections of this rookery are identified by their corresponding numbers or unique physiographic characteristics. Starting at the southwest end of the rookery the count is made from various vantage points overlooking the rookery. Follow the path between the cliff edge above the rookery and the large rock outcropping which leads toward the end of Tolstoi Point. Historically this path is used by foxes and leads down the hill toward the rookery approximately 100 m from the end of Tolstoi point or the end of the trail. It may be necessary to displace a small number of territorial males as the crew moves into this area. Remember to be aware of sleeping seals hidden in the boulders.

- The end of Section 1 is marked by a number 1 on a rock which may not be visible from the beginning of Section 1. but does become visible as counting proceeds to the northeast.

- Section 2 ends at the beginning of the inland extension of the rock boulders, just a few meters to the southeast of the solitary cubical rock (2 m x 2 m x 2 m) with vegetation growing on top. This count is made from the outermost point overlooking this section where the Section 2 marker is located on a rock which is visible from the middle of Section 3. It is about one-half or a third of the way up the rookery from the shoreline.

- Section 3 ends where the number 3 is located on a rock inland from a large, oblong rock (3 m x 1.5 m) visible in the surf (or at the surf line, depending on the tide). This rock is the largest rock along the coastline in this section. Seals in the inland extension of rookery are included in the count for this section.

- Section 4 ends at a large angular rock located at the bottom of the vegetation extending almost to the shoreline near the bottom of the cliff and southwest of the next major inland extension of the large boulders. This rock is located near the largest rock (shaped like a diamond with rounded comers) in the splash zone.. Counts in this section are made from the cliffs near the end of Section 3. Binoculars are essential for counting the bulls farthest away. Under conditions of large populations, the use of noise from a gunshot may he necessary to cause the males to assume an upright posture and thus become more visible for counting. Several counts are obtained and then averaged at this location.

- Sections 5, 6, and 7 are identified by their corresponding numbers on signs attached to catwalks. Section 5 ends at the southwest comer (or end) of the catwalk which is atop a ridgeline of rocks extending toward the water. This section is counted at two locations: One just above the end of Section 4 at a rock marked with a white “+”; and the other at the southwest comer of the catwalk where the section ends. Section 6 is also counted from this location and additional counts are made from various vantage points along the ridgeline where the catwalk was once complete. The end of Section 6 is marked by 2 orange poles, 1 m high, one 20 m and the other 75 m from the high tide line. Counts of Sections 6 and 7 are also made from a tripod northeast of the number 6 sign. The final count of Section 7 is made from the northeast comer of the catwalk at the number 7 marker.

- Section 8 continues to the end of the rookery and idle male counts continue through the adjacent male hauling ground on the sandy beach to the north.

Zapadni

Counts are conducted from cliffs and tripods overlooking the rookery while moving from southwest to northeast (Fig. 2H). To begin this count, the area should be approached from the hills behind the rookery to avoid disturbing fur seals. Most of these sections on this rookery have been marked with a corresponding number.

- Prior to counting Section 1. the Zapadni Point hauling ground along the rocky intertidal zone is counted from the cliffs overlooking the coastline.

- Sections 1, 3, 4, 5, 6 and 7 are all designated with numbered signs attached to tripods or catwalks.

- Section 2 ends at a collapsed tripod on a small rock pile with a catwalk leading IO it.

- Section 8 starts on the east side of the number 7 sign and ends at the hauling grounds at Zapadni sands beach.

Little Zapadni

Counts are conducted from tripods while moving from west to east (Fig. 2G) All six sections are identified by their corresponding numbers or unique physiographic characteristics.

- Sections 1 through 4 begin end at the corresponding tripods. Section I tripod collapsed in 1991.

- Section 5 ends at the dead-pup sign on a pole (~ 4 cm in diameter) in the middle of the rookery about 150 m east of the fifth tripod. This pole should not be mistaken for the other orange-tipped poles in the area.

- Section 6 continues until the end of the rookery and idle male counts continue through the hauling ground. Before continuing east toward Zapadni Reef, count the hauling ground males in the water from Little Zapadni. This will avoid confusion when counting the rest of the hauling grounds.

Zapadni Reef

Counts are conducted from tripods and selected vantage points overlooking the rookery while moving from west to east (Fig. 2G)

- Section 1 begins at the westernmost end where fur seals are first sighted and ends at the fourth tripod (several tripods collapsed in 1991) from the east.

- Section 2 ends at the end of the rookery with idle male counts continuing through the hauling grounds on the sandy beach to the east.

St. George Island

Most of the section markers on St. George Island (Fig. 3) have been knocked down by vandals or are located too far inland to be useful with the herd reduced to its present level. Geographical markers are available and should be used during shear-sampling projects for pup production estimates.

East Cliff Rookery

All counts are made from atop the cliff. Surveys begin at Kitasilough hauling ground several hundred meters west of the rookery, proceeding from west to east (Fig. 3D).

- Section 1 begins on the east side of the male hauling grounds. It includes the entire hillside and adjacent shoreline. This section ends at a rock slide where the rookery abruptly narrows at the shoreline.

- Section 2 continues to the end of the rookery.

East Cliff Hauling Ground

The hauling ground extends from the west end of East Cliff rookery to Sea Lion Point. Most of this rookery can be counted from the cliff at East Cliff rookery. The potion of the hauling ground that extends behind East Reef rookery must be counted from the ground.

East Reef Rookery

This area (Fig. 3D) is best surveyed from the ground, although the western portion can be counted from the catwalk. Counting the area east of Sea Lion Point usually disturbs the west end of East Reef hauling ground, so the hauling ground should be counted first. There are no sections in this rookery.

East Reef Hauling Ground

This area can be counted from the observation tower at the west end of East Reef rookery, or from the ground if the tower has not been erected.

Northeast Hauling Ground

Because of a small hill in the center of North rookery, counts must be made from two or three locations around the edge of this bowl-shaped hauling ground (Fig 3C). From the flat-topped hill at the western side, animals on the rocky beach beneath the cliffs at the eastern end of the present airstrip can be counted (looking back toward the village).

North Rookery

All of this rookery is counted from the cliff tops at various locations. This description proceeds from east to west (Fig. 3C).

- Section 1 begins at the end of a gully which opens to a rocky, boulder-strewn beach. The cliffs along the beach increase in height until the end of the section, which is at a point of land where the cliff line begins to turn to the west.

- Section 2 begins at this point (i.e. the end of Section 1) and ends at a steel pole which is located to the west of a flat-topped hill and is easily seen when counting seals along the edge of the cliff. Recent bull counts (after 1975) use this pole to divide the rookery into eastern and western halves.

- Section 3 ends at the tip of a peninsula of land which is followed by a southwest turn in the coastline.

- Section 4 ends at a pole marker two hills to the west of the Section 2 pole marker. This location is accessed by a road from the airplane hangar on the air field. This marker is so far inland (3/4 distance up a hillside) that it cannot be seen when counting seals along the shoreline. An imaginary line from the pole marker to the beach marks the end of the rookery.

- Section 5 continues to the end of the rookery.

North Hauling Ground

This hauling ground occupies a hill that can only be counted completely by adding counts from three angles: the cliffs east and west of it and inland (south) of it. Walking around this hill to the north causes a great deal of disturbance on the rookery.

Northwest Hauling Ground

Most of this area can be counted from the spur road adjacent North rookery that runs north from the airplane hangar. The hauling ground extends westward to the old quarry site.

Starava Artil Rookery

Virtually all the rookery and hauling ground (Fig. 3B) can be counted from the existing catwalk. There are only two sections on this rookery. An old section marker exists about halfway up the hill. An imaginary line from this pole to the shoreline denotes the end of Section 1 and the beginning of Section 2. Counts of males on the hauling ground are obtained as the counters approach the catwalk. To count males at the base of the cliffs, it may be necessary to walk around the rookery and view the rookery from the hillside above.

Zapadni Hauling Ground

Counts must be made from two locations (Fig. 3E): 1) from the low hill closest to the breakwater, the area inland of the berm can be counted; 2) from the catwalk leading to the blind at part of upper Zapadni, both the inland portion of the hauling ground that surrounds the upper

Zapadni rookery and the beach area seaward of the berm (looking back toward the breakwater) can be seen.

Zapadni Rookery

Since 1975, counts at Zapadni rookery (Fig 3E) have been made from three locations: 1) from the blind at the upper part of Zapadni, 2) from the end of the catwalk at Lower Zapadni, and 3) from the edge of the cliff on the hill that separates Zapadni from South rookery. The latter site gives a view of the beach below the cliff.

The rookery has been divided into the following three sections as counts were conducted from north to south.

- Section 1 ends at an imaginary line drawn from the end of the catwalk at the upper part of Zapadni to the shoreline.
- Section 2 ends at an imaginary line drawn from a metal pole (may have been destroyed in recent years) on the hillside to the shoreline.
- Section 3 continues to the end of the rookery.

South Hauling Ground and Rookery

The entire rookery can be seen from various locations along the cliff top. Counts are obtained proceeding from north to south.

- Section 1 ends at a conspicuous point of land which is identified by a shallow reef directly offshore.
- Section 2 ends at a rocky, boulder-strewn outcropping along the shoreline.
- Section 3 continues to the end of the rookery.

"ROUNDUP'" OF JUVENILE MALE FUR SEALS FOR TAG RETURN INFORMATION AND ASSESSMENT OF ENTANGLEMENT RATES

A "roundup" is the method used to herd fur seals into a group at a convenient location near the water's edge. Roundups of juvenile male fur seals began in 1985 for the purpose of assessing tag returns and the rate of entanglement by fur seals in small pieces of marine debris. This work has been conducted only on St. Paul Island following the termination of the commercial harvest (at the end of the 1984 season).

Procedures and Research Techniques

Roundups of juvenile male fur seals are conducted daily in July and August on selected haul-out areas. During roundups, the seals on certain haul-out areas are herded together over a short distance from shore, usually about 50-100 m, allowing the animals to distribute themselves to avoid overcrowding. Then they are allowed to return to sea in single file or in small groups, allowing observers to count the number of seals with tags, debris, or net marks. This procedure is very efficient for handling and checking large numbers of seals in a relatively short period of time. It is also less stressful than traditional drives during harvests because the seals are not driven long distances or held for prolonged periods. When tagged animals are sighted the numbers on their tags are recorded. Data from these and subsequent sightings of tagged fur seals provide the information needed to calculate abundance and survival estimates of entangled juvenile males.

The numbers of animals to be rounded up depends on the location, terrain. and availability of animals. Where large numbers (e.g., 500-600) of animals are available, the overall group is subdivided into smaller groups (e.g., 100 individuals) to prevent overcrowding. Where the terrain is such that animals tend to crowd together (e.g., grassy swales or rocky outcroppings), the groups are also restricted to smaller numbers of animals whenever possible. Such terrain is to be avoided whenever possible to prevent these problems.

The distance seals are moved away from the water also depends on the terrain. In all cases the work is conducted on the hauling grounds so that animals do not move long distances. For example, on St. Paul Island at Zapadni, Lukanin, and Gorbatch hauling areas, some animals are moved up to 100 m away from the water; at other locations less distance is involved. Whenever fur seals are rounded up, time is taken to allow recovery from any observed stress before they return to the water. To reduce the chances of overheating, roundups are conducted during cool weather conditions when air temperatures are below 10°C. Roundups are not conducted on hot, clear days when there is no wind. Incidental harassment is kept to a minimum by taking precautions to avoid disturbing any seals not involved in the roundups whenever possible. In most cases this is of little concern because the haul-out areas are of sufficient distance from the rookeries to cause little or no disturbance.

Care is taken to minimize any threat of accidental death by preventing overcrowding and overheating of fur seals during roundup procedures. To accomplish this, the research team is supervised by an experienced fur seal biologist with extensive training in conducting roundups and handling animals with the ability to recognize the signs of thermal or behavioral stress. Research activities a.. interrupted immediately if fur seals begin to exhibit signs of thermal

stress. Water is always available to pour on an animal's extremities in the event that it becomes overheated and needs to be cooled. Any time animals are observed to be overcrowded, the group is moved or allowed to disperse so as to permit the animals sufficient room for effective thermoregulation. Those involved make certain that the fur seals enter the water moments after terminating the roundup.

When entangled animals are encountered, they are captured, restrained, examined for type of debris and general health condition. disentangled and released, or tagged and released. In years prior to 1989, these seals were not disentangled. If a tag is applied. two nonentangled fur seals are also tagged as controls. Resighting efforts in subsequent seasons will allow the estimates of mortality rates (tag returns) for the entangled, disentangled, and control seals. By comparing these rates, it will be possible to evaluate the impact of different sized pieces of netting and other debt-is on the survival of juvenile males:

Fur seal males that have been doubled-tagged with monel tags (see chapter on tagging pups) are also examined during the roundup procedure. Each monel tagged seal seen during the roundups is captured using a wooden pole with a noose at the end (Fowler and Ragen 1990, Fowler et al. 1990) and placed on a restraint board (Gentry and Holt 1982). With the exception of a few seals captured at times when the scales were in disrepair, and when warm weather prohibited prolonged handling, weights were recorded for each seal tagged with a monel tag. A nylon harness was used to suspend the restraint board and seal from a spring scale, which was attached to a metal pipe held by two workers while the weight was read. Weight values were recorded to the nearest 2.0 lb (0.9 kg) increment. All weights were corrected to exclude the weight of the restraint board. Data recorded at the time of recapture included the tag number

and information regarding the condition of the tag, the presence or absence of a tag on both flippers, and the condition of the flippers, especially at the site of tag attachment.

ASSESSING PUP PRODUCTION

Since 1961, the "shearing-sampling" mark-recapture method has been used to estimate the number of northern fur seal pups born on a rookery during a single breeding season. The development of the shearing-sampling method on the Pribilof Islands is described in Chapman and Johnson (1968), and the method applied to subsampling rookeries is discussed by York and Kozloff (1987).

From 1980 to 1989 estimates of the number of pups born on St. Paul Island were usually obtained from shearing-sampling at subsampled rookeries and counts of dead pups on all rookeries. A census was conducted on all rookeries of St. Paul Island about every 3-5 years. Estimates of the pup population on St. George Island was obtained by shearing-sampling at all rookeries, usually every 3-5 years.

Whereas shearing-sampling is conducted mainly on the subsampled rookeries (which change every year), counts of breeding males and dead pups are conducted on all rookeries. Live pup numbers are estimated by multiplying the total number of breeding males on all rookeries by the ratio of pups to breeding males on the sample rookeries. The total number born is estimated by adding the count of dead pups to the total live count at the time of sampling.

To insure the safety of the crew and the accuracy of the estimate, the work is done as the breeding structure diminishes and relatively few aggressive territorial males remain on the rookery, but before the pups start spending large amounts of time in the water.

The following sections discuss the methods and precautions necessary to ensure that the resulting estimate is as accurate and reliable as possible. A list of equipment necessary and

approximate timetables are also given. Refer to the previous section on Counts of Adult Males for locations of rookery sections.

Shearing

Numbers and Allocation of Shearing

Because pups tend to cluster in groups throughout the rookery, it is necessary to distribute the marking effort equally over the entire area so that each pup has an approximately equal chance of being marked. Allocation of the number of pups to be sheared within a particular rookery section is proportional to the number of territorial adult males with females counted there in mid-July (Chapman and Johnson 1968). The marks are then distributed randomly throughout each rookery subsection. The number of pups to be sheared on a rookery is fixed at about 10% of the number estimated during the previous pup census of that rookery. After the mid-July harem-bull counts have been completed (by section), the leader of the shearing-sampling crew determines the total number of pups to be sheared within the sections of each rookery. For example: suppose we decided to shear 1,000 seals on a three-section rookery and the harem-bull counts for the three-sections are 8, 20, and 12. The total count of harem bulls is 40, so on the first section we would shear 8/40) or (0.20) of the 1,000 pups to be sheared or 200 pups; on the second section 20/40 (0.50) of 1,000 pups or 500 pups, and on the third section, 12/40 (0.33) of 1,000 pups or 300 pups.

Personnel and Equipment Required

The shearing procedure requires a crew of 8-14 persons. During years when estimates are made from only four rookeries, a smaller crew will suffice; during those years when censuses are conducted on all rookeries, a large crew is necessary. All shearers are equipped with the following:

1. a set of rain gear (pants and jacket);
2. a pair of knee-high rubber boots:
3. a sharp, handheld pair of sheep shears;
4. two nylon stretchy liner gloves;
5. one welder's glove for the nondominant hand;
6. one lightweight glove for the dominant hand;
7. one or two leather gauntlets, usually for the nondominant arm;
8. one hand tally to record the number of animals sheared.

The crew leader must be certain a complete first-aid kit is brought into the field at all times.

Procedure

Pup shearing occurs during the first or second week of August. At this time two or three persons from the crew (this number will be determined by the crew leader based on the tenacity of the adult male fur seals and the experience of the crew) are equipped with bull poles. They always go ahead of the other crew members as the group enters the rookery and carefully drive adult males and females into the water or away from the areas where pups will be sheared. At this point, usually all but one of the bull polers can rejoin the rest of the crew and participate

in the shearing. At least one person should remain with a bull pole at all times. Those with bull poles must be experienced and knowledgeable about fur seal behavior and the conditions of each rookery so that neither the crew nor the animals are endangered. For example, care must be taken not to drive animals toward the crew. nor to isolate the crew among the seals. Care is also necessary in some areas so that fur seals are not driven over cliffs.

The crew begins shearing pups by surrounding small groups of 20 to 30 animals. The number of animals to be sheared in each section is divided by the number of shearers available and an approximate number of pups to be sheared by each shearer is determined. The leader must always attempt to allocate the sample evenly throughout the section because the sections are of variable size and the animals are not always uniformly distributed. This is done by approximating how many groups of pups will be available throughout the section and allocating the number to be sheared proportionally. Large numbers of pups should not be driven past section boundaries.

Usually one of the bull polers can head the pups off at the section boundary if the boundary is not a natural barrier. Care must also be taken not to herd large groups of pups together (especially against narrow rocky barriers) because they may climb on top of each other, suffocating those at the bottom of the pile.

The shearing technique is variable among individuals. There are, however, two techniques which appear to be the most commonly used. First, for a right-handed person: grab the pup by the left foreflipper with the left hand (protected by a welder glove and leather gauntlet); swing the pup up between the legs just above the knees, securing it quickly in the midsection; quickly release the left foreflipper to hold the pup’s head against the left knee with

the left band, and shear off a patch of guard hair exposing the lighter colored underfur from the back of the ears to the forward part of the head. The sheared area should be about 7-10 cm in diameter. Second. for a right- or left-handed person: grab the pup by the base of a rear flipper and move to a clear location where the pup's body can be braced against the ground with the knee(s); as the pup's neck is also held against the ground the nondominant hand is used to apply the shear mark. Shearers will record each seal sheared on the hand tally. At the end of each section, the leader will record the count of animals sheared by each crew member.

Fur seal pups are energetic and feisty and will attempt to bite anything that moves. Inexperienced shearers must be cautioned to be careful and to keep their faces away from the mouth of the fur seals. They must also be aware of the pup's ability to twist backward as they are being handled Care must also be taken to avoid injuring pups. Despite their feistiness, fur seal pups are fragile and can be injured easily if they are squeezed too tightly, dropped, or tossed on the ground. Never purposefully mistreat pups while conducting these activities.

The time required for shearing depends on the number of people in the crew, their ability and enthusiasm, weather conditions, terrain of the rookery, and the total number of rookeries to be sheared. An average of 250 to 300 pups per day per person is a good estimate of an experienced crew's ability to complete a shearing project.

sampling

At least 3 days after the marking, the rookeries are sampled by two or three persons to determine the ratio of marked to unmarked animals. This is the most difficult part of the census, and it is best if most of the samplers have had some experience with the process of

randomly sampling the ratio of sheared to unsheared pups. The samplers begin at one end of a rookery and proceed, more or less abreast, to the opposite end. The person nearest to the water stays about 5-10 yards (metric equivalent) ahead of the others so that pups near the shoreline are not driven into the water before a count can be obtained. Samplers always attempt to count different groups of pups. In order to compensate for the eye's tendency to be attracted to the marked animal, the sampler tries to begin a count by sighting on a fixed object such as the first rock seen, a dead pup, a piece of kelp, or a log. Twenty-five pups are sampled within the vicinity of the object, along a line away from the object, or as the pups file past the object; the hand tally is punched whenever a marked animal is observed in the sample. During recent years binoculars have been found to be an excellent tool for making such counts because they reduce the sampler's field of vision, allow counts to be made at a greater distance, and thus minimize disturbance to pups. Binoculars also enable samplers to accurately discriminate between marked and unmarked pups (especially when the pups are wet or beginning to molt). It is impossible to rely entirety on any one method. A method which may be appropriate in some areas may not work in others. Thus, samplers are reminded to be flexible in their techniques so that they are able to obtain a sample that accurately represents an unbiased fraction of marked pups in the population. The sampler notes the number of sheared pups within each group of 25 animals on a waterproof card or notebook. The samplers do not discuss their results until the completion of the survey (they do not even joke about their results). Each rookery is sampled on one or two separate occasions to estimate the ratio of marked to unmarked animals.

Potential sources of bias of the shearing-sampling method are any violations of the assumptions required for any mark-recapture estimate. Most importantly, it is required during

the marking phase that each pup have an approximately equal chance of being marked and that during the resighting phase. the marked pups have the same probability of being observed as the unmarked pups. The only direct method of assessing the bias of estimates based on shearing-sampling has been to count the total number of living pups. Such counts. however, are difficult to obtain on the rookeries of the Pribilof Islands. The procedures for obtaining total pup counts are described in the following chapter. In the past. separate counts were not made of the sheared and nonsheared animals. In the future. if counting is done on a rookery, it is recommended that such data be collected as an additional check on the shearing-sampling estimate whenever possible.

Beginning in 1990. fur seal researchers decided to shear sample on all Pribilof Island rookeries every other year. This decision was based on increased variability in the pup production estimates obtained from the subsample technique (York and Kozloff 1987). This variability was caused by a change in the relationship between territorial males and pups born, which resulted from an increased number of males after the cessation of the juvenile male commercial harvest in 1985.

DIRECT COUNTS OF LIVE PUPS

The only proven method of checking the accuracy of estimates based on shearing and sampling is to actually count the total number of living pups. Six to 10 individuals are employed for this task: 2 are primary counters, 2 keep the pups moving between the counters, and the rest prevent counted pups from moving toward and mixing with uncounted pups. In practice. the crew begins at one end of the rookery and proceeds to the other end, separating successive groups of 200-500 pups from the rookery population. Four to five individuals are stationed between the encircled pod of pups and the rest of the rookery population to keep counted and uncounted animals separated and to count pups going into the water that obviously will not be counted by primary counters. The primary counters are stationed about 8-20 ft (2.44-6.10 m) apart between the pod of pups and the shoreline.

The two crew members responsible for moving pups use bamboo poles as aids in slowing or increasing the rate at which the pups move toward the water and between the primary counters. Two counts (one from each primary counter) from each pod are recorded; tallies are reset to zero between counts of pods. The counts of pups on a rookery are completed without stopping to minimize the likelihood of intermixing between counted and uncounted pups. Sometimes pups will naturally form separate groups which are counted easily without the aid of the other crew members. Counters should count these separate groups whenever possible to avoid additional disturbance and to speed completion of the census.

In recent years, attempts to conduct direct counts of live pups have been unsuccessful because large proportions of the pups were in or near the water. This made it impossible to round up all pups in the desired area. We suspect that success may be achieved if this work is

done earlier in the year at the time just prior to the first phase of the shear-sample study (approximately August 4-7).

COUNTS OF DEAD PUPS

Early mortality studies of Pribilof Islands fur seals concentrated on complete or partial counts of pups that died on land. Dead pups were counted on some or all rookeries in 1896, 1906, 1908-09, 1912-24, 1941, and 1948-79 (Rappel 1984). Death rates calculated from complete counts of living and dead pups on all rookeries in 1916 and 1922 were the basis for estimating total numbers of dead pups on all rookeries during 1917-21 and 1923-24, respectively, when counts were made on sample rookeries assumed to be representative of the pup population's growth trend after pelagic sealing ended in 1911.

Dead pup surveys were not conducted during 1925-40, but annual values were calculated for each rookery using complete counts of dead and live pups on all rookeries in 1922 when the death rate was 1.73%. Based on complete or partial counts of live pups, production was estimated to have increased annually at the rate of 8% during 1912-24. The factor 1.73% was applied to these estimates of annual pup production to calculate annual numbers of dead pups during 1925-40. By 1940, however, researchers realized that the fur seal population was following a sigmoid growth curve rather than a straight line, that it was approaching its natural ceiling, and that earlier methods of computing various herd elements were no longer applicable.

The counts of dead pups were resumed on St. Paul Island in 1941 and during 1948-52, and on both St. Paul and St. George Islands from 1953-79 except in 1955 when no count was made on St. George Island.

In the early 1950s it was demonstrated that most of the pup mortality on land occurred by mid-August. Since that time, dead pups have been counted in mid- to late August, whereas the counts during the early 1900s were usually made in conjunction with censuses of live pups

during late July and early August. Therefore, past studies have tended to underestimate the true rate of mortality during 1912-24 when the population was relatively small.

Since 1966, dead pups have been counted by rookery section to increase the accuracy of the pup mortality surveys. Dead pup counts begin about 20 August; six to eight individuals proceed laterally and abreast through each rookery, and each dead pup observed is recorded and marked plainly with lime so that it will not be counted twice. The following are recorded:

1. Obviously a dead pup--recently dead and has full body form but most of the hair and fur may be gone; body has decomposed to little more than skin, skull, and flippers.
2. Identification not obvious--bones and decomposed flesh, dried skin.

An unknown number of dead pups go unnoticed each year during the count due to removal from the rookery by carrion feeders such as foxes and gulls, removal by marine storms which may vary in intensity both during the count and between years, and advanced decomposition, which makes identification difficult or impossible. On the basis of observations in the early 1950s, the actual count has been increased by 5% in our annual reports to account for such losses. The following assumptions are made each year of counting:

1. Most of the pup mortality has occurred by the time dead pups are counted.
2. The same proportion of dead pups are overlooked and not counted.
3. The criteria for identifying a dead pup are constant both within and between years.

COLLECTIONS OF UPPER CANINE TEETH FROM DEAD ADULTS

The rookeries, hauling grounds, and all other accessible beaches are searched between 15 August and 1 September during dead pup counts, for the upper canine teeth of dead fur seals (nonpups). Lower canines are collected if the uppers are missing, and a record of the number of dead adults that have all canines missing is maintained. In the field, snouts are collected using a hacksaw, tree pruners, or 3 lb mall and knife. The upper jaw is removed just anterior to the eye sockets (do not saw or cut into the roots of the canines). Each snout is then thoroughly trimmed of skin and fur in the field and put into a cotton bag which is then placed in a backpack or bucket for carrying the snouts and equipment. Some upper canines can be extracted in the field with pliers, though the collector must be careful not to break the teeth. The collections are identified by rookery-hauling ground complex, rookery section, and by beach area between rookeries. This is most easily done in the field by putting groups of cotton bags containing snouts or teeth into a large plastic bag and attaching a label showing the area of collection.

In the laboratory, process the teeth as follows:

1. Put cotton bags containing teeth or snouts into a large pot, cover with plain water, and boil until teeth can be extracted (3040 minutes).
2. Extract teeth, remove pulp from root canal, and place pairs of teeth into a compartmented tray.
3. Put tray(s) in the pot of water, cover with an empty tray to prevent teeth from boiling out of their compartments, and boil until clean (30 minutes). Historically, trisodium

phosphate powder (about 10 grams per 3.8L of water or per tray of teeth was added to the boiling water to facilitate cleaning, but beginning in 1992, it was considered unnecessary and no longer used. Some scientists believe that this chemical causes erosion of cementum microstructure.

4. Rinse thoroughly in hot water before handling.
5. Remove teeth, shake water from root canal, wipe dry, and transfer to a clean, dry tray for additional drying (dry only long enough to permit numbering)).
6. Number the teeth consecutively and in pairs with indelible pencil beginning with the number 1.
7. Put teeth from a rookery-hauling ground complex or beach area in a cotton bag and attach a label showing area, date, and island of collection.
8. Store in a cool place while awaiting shipment to Seattle so that the teeth will dry slowly and not crack.

Warning

Remove upper jaw fairly close to the eyes so that the roots of the canine teeth will not be cut or sawed off.

COLLECTION OF FECAL MATERIAL FOR MONITORING FUR SEAL FOOD HABITS

The analysis of fecal material (scats) collected on rookery areas is used to monitor the diet of northern fur seals. The prey species information obtained from this work provides an index of the availability of prey on which fur seals forage.

The primary purpose of this project is to assess the food habits of female northern fur seals. To achieve this goal, scats are collected on rookery areas utilized primarily by females and pups. These areas are easily identified and generally include all rookery space, excluding the male haul-out areas. The collection of scats from juvenile males on haul-out areas is also encouraged but is considered a lower priority.

Always attempt to collect as much of an individual scat as possible. Sometimes this necessitates looking in the immediate area (i.e., in between or beside the rock on which the scat is found) for fecal material of the same size, color, shape, and consistency.

Attempts should be made to distribute the collection scats throughout the rookery area. Scats collectors should also strive to collect approximately 100 scats per rookery, but this is not always possible due to the varying numbers of fur seals utilizing different areas. A minimum sample size of 30-50 scats is adequate for some of the smaller rookeries such as Ardiguen or Polovina.

The minimum size of an acceptable scat is approximately 6 cm in length, 1.5 cm in diameter, and 30 g in weight. This is about the size of a roll of “Lifesavers” or “Certs.” Do not collect pup scats. These scats vary in color, so the best key for identification is their narrow diameter which ranges from 0.7 to 1.0 cm in diameter (the width of a pencil).

Scat collectors should wear a pair of rubber gloves during scat collection, and a small bone, stick or spoon is frequently useful when attempting to scrape a soft sample off the rocks and into the collection bag. A 5-gallon bucket is used during scat collecting to carry samples and miscellaneous collecting supplies (e.g.. extra gloves and bags).

Scats are collected in large (~ 10 cm x 30 cm) plastic bags (with a built-in wire tag for sealing, not the plastic zipper type seal) by scooping or placing the sample into the bag, removing as much air space as possible, and closing the top by holding a tab at the mouth of the bag in each hand and flipping (whirling) the bag over on itself several times. Then the two tab ends are turned inward to prevent the sealed end from unrolling.

A single scat is collected per bag. All scats from a single rookery are consolidated in a single collection bag, which is labeled inside and outside with waterproof labels. The date, rookery name or haulout location, and the collector's initials are written in waterproof ink or pencil on each label. Scats from male haul outs are always kept separately from rookery collections.

Large bags of scats from each rookery are stored in the warehouse (Garco Building). These bags are not placed in fiber drums for shipment to the NMML until the day before they are mailed. This reduces the chances of the scat smell penetrating the shipping container and slowing its progress to Seattle while in the hands of the U.S. Postal Service. Also, the smell from the scats is reduced by sealing the lids of the fiber drums with caulking or silicone sealer. Be sure someone is scheduled to receive the containers and place them in the freezer upon arrival in Seattle.

TAGGING PUPS

The tagging of fur seal pups on the Pribilof Islands began in 1940 to obtain age-specific survival rates and rates of immigration or emigration. The techniques and types of tags have changed over the years, reflecting improvements in the methods utilized for this research. Unfortunately, we still do not have a tag which has numbers that are easily read at distances of 100 m and which have a life of 10 to 15 years.

After a hiatus from large-scale tagging activities on the Pribilof Islands from 1966 to 1986, a tagging study was initiated in 1987. The purpose of this study was to evaluate the longevity of a modified monel tag with a rounded post. This study was also designed to assess juvenile male survival and to identify a group of known-age females in the population for long-term natality studies.

Tagging is distributed among the rookeries according to: 1) The proportion of pups born on each rookery as based on estimates from shearing-sampling, or 2) on the average proportion of territorial males with females counted in mid-July during the most recent 5-year period. If, for example, 15% of the total island population of pups or harem males are on Zapadni and 10,000 pups are to be tagged, 1,500 of the tags would be attached to pups on that rookery. The total number of pups to be tagged on each island may vary depending on the purpose of the tagging project and the precision required.

Weight data are collected from at least 10% the pups tagged from each rookery. Those selected for weighing are chosen randomly. The minimum number of pups to be weighed at any rookery is 100.

Crew and Equipment

The minimum crew for pup tagging contains 12 people: 1 or 2 to monitor the behavior of the pups. 1 to load tagging pliers. 2 to apply tags, 1 to record data. 1 to weigh pups. and 6 to physically restrain pups during tag application.

Equipment needed includes a first-aid kit, tags, tagging pliers, two 5-gallon plastic buckets for carrying equipment, ice chest or cooler for use as a work table and for carrying equipment, needle-nose pliers for straightening bent tags, a three-sided aluminum framed barricade (3.5 x 0.7 m), rope, bungi cord leather and cotton gloves, leather welder's sleeve gauntlets, spring scales for weighing pups, light oil base spray lubricant, two weighing buckets or small hoop net for weighing pups, 1 m x 1.3 m x 7 cm plywood board for a platform on which to tag pups, and long-handled noose poles for removing females from inside the barricade.

Methods

When the tagging procedure begins, pups are driven short distances to the tagging locations to reduce the possibility of stress and fatigue. Fifty to 100 pups at a time are rounded up and slowly driven onto a grassy or flat area wherever possible. At the tagging site pups are herded into the three-sided barricade which is located between the pups and the water. On irregular terrain, natural geographic boundaries must suffice as natural barricades- Two tagging stations are positioned on either side of the group of pups. The tag loading station is positioned between the two tagging locations. All stations should be at least 3 to 4 m away from the pod of pups and positioned on the inland side of the barricade. A plywood board is placed on the ground at each tagging station and used as a working platform for handling pups. Care must

be taken to remove all fur seals that are older than pups from the pod before tagging operations begin. Even yearling fur seals have well-developed canine teeth that could cause serious injury.

At least one or two members of the crew are given the responsibility of monitoring the behavior of the pups to insure that none are allowed to climb on top of each other and possibly cause the suffocation of those at the bottom of the group. If pups begin to pile up on each other they should be physically moved toward the edges of the group. If this fails to spread the distribution of pups in the holding area, reduce the number of pups in the group. or abandon the entire group if necessary (pups will disperse rapidly once human presence is no longer detected).

To begin the actual tagging procedure. a pup is lifted by the rear flippers from the center of the barricade. and the sex is determined by looking for a penal opening or a vagina. The pup is then taken to the tagging station where it is restrained on the plywood board. Usually. the most effective way to restrain a pup during tagging is by holding the rear flipper(s) with one hand and the nape of the neck with the other. For large pups, sometimes it is necessary to apply pressure to the pup's back with a knee to inhibit movement. The tagger attaches a tag to each of the pup's foreflippers (double tag). Tags are attached to the fore-flippers approximately 1.0 cm below the hairline. and 1.7 cm in from the posterior edge (Fig- 4). The holder informs the tagger of the pup's sex as the tags are being applied. The tagger then calls the number of the tag and sex to the recorder who immediately calls the Same information back as the information is recorded in the data book. The recorder is responsible for informing the pup holders which pups should be weighed. A pup is weighed by placing it head first into the weighing bucket or net and then suspending it from a spring scale. All weights are measured to the nearest 0.25 kg. Additional measurements (e.g.. length) may be collected from pups during the weighing

procedure. If all pups are not tagged sex information is collected for all remaining pups in the barricade. When finished, the crew modes away from the area and selects another group of pups from another area of the rookery. Care is taken to distribute the tags throughout the rookery as randomly as possible

Occasionally. modified round-post monel tags are not applied correctly due to improper loading of the tag in the applicator or because of debris inside the applicator. This problem is minimized by insuring that the cupped side of the tag is flush with the corresponding jaw of the applicator and keeping the applicator clean and lubricated. The tagger should cheek tags after application to insure the post of the tag is properly secured inside the cupped portion of the tag. Some tags that are applied incorrectly can be repaired with needle-nose pliers by straightening the post and realigning it with the cupped side of the tag. If the tag is not repairable. the tagger must inform the recorder of any tags that are not applied or destroyed. When this occurs. the tagger removes both tags with needle nose pliers and places them in a separate storage container for later confirmation of tags not applied as noted in the data book.

Those involved in this project must also avoid activities that might cause pups or adults to stampede over cliffs. This is achieved by frequently monitoring the area surrounding work activities and avoiding locations where seals are in proximity to cliffs.

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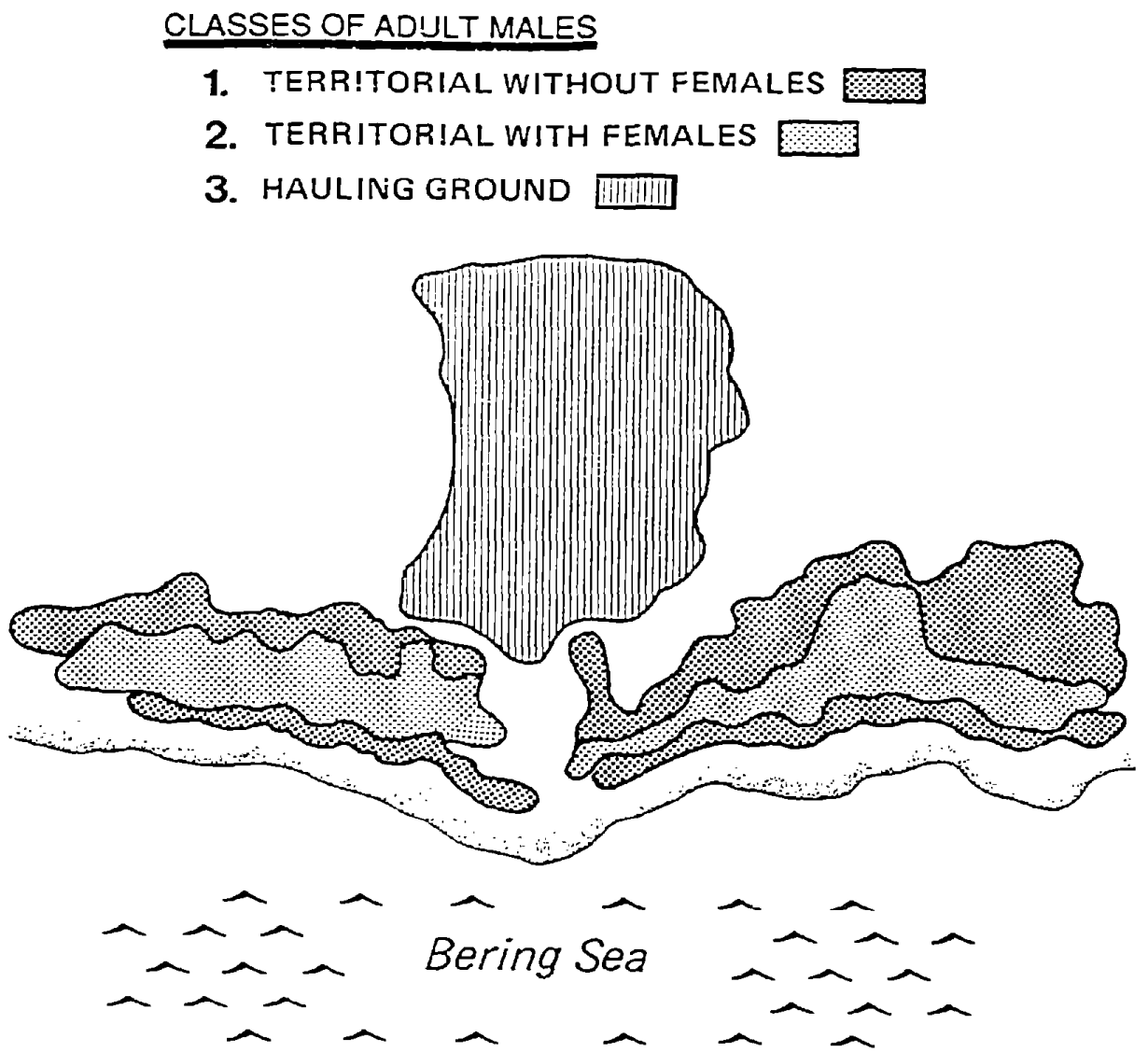

Figure 1 .--General distribution of adult male fur seals on a typical rookery.

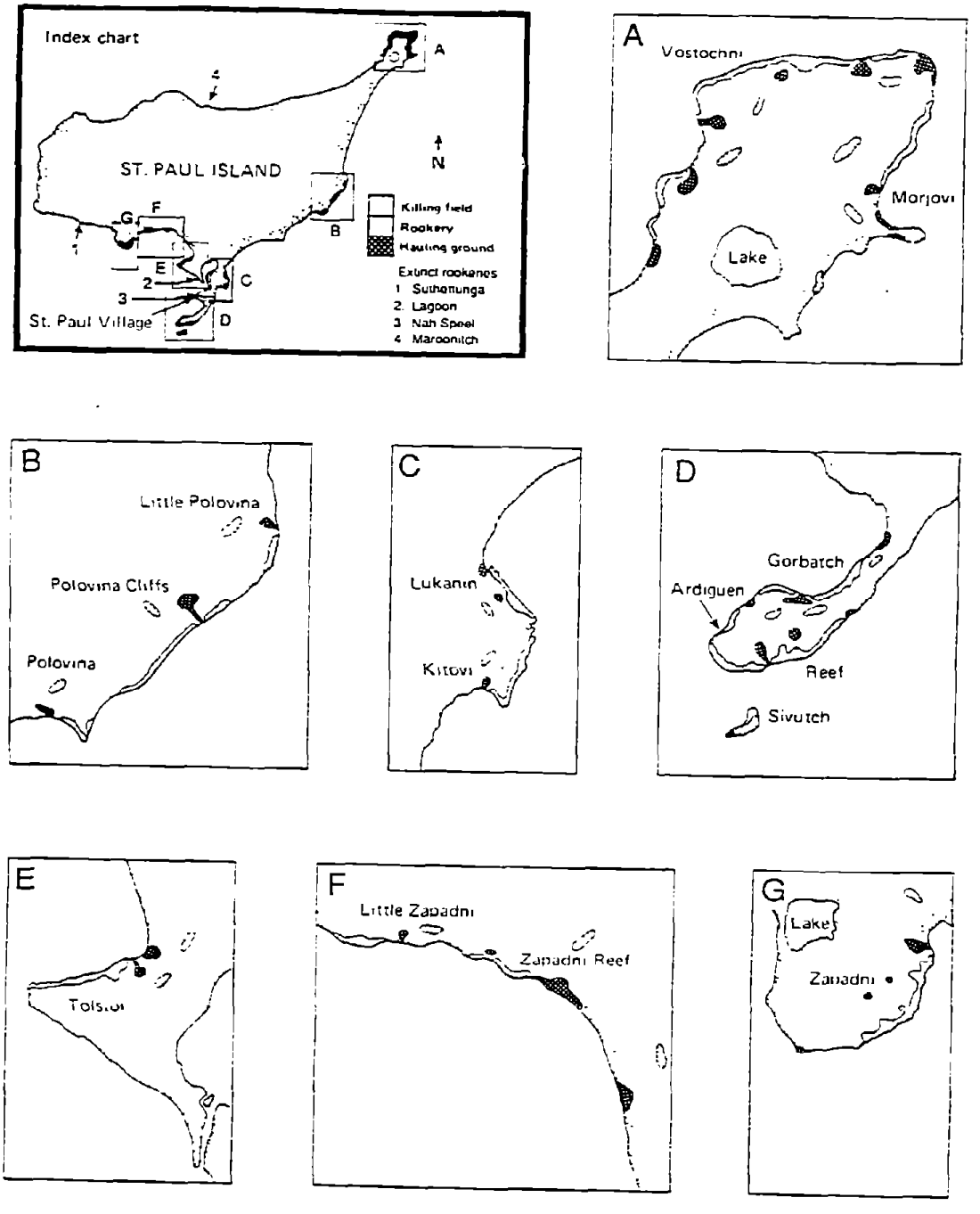

Figure 2.--Location of northern fur seal rookeries (present and extinct), hauling grounds, and harvesting areas, St. Paul Island, Alaska.

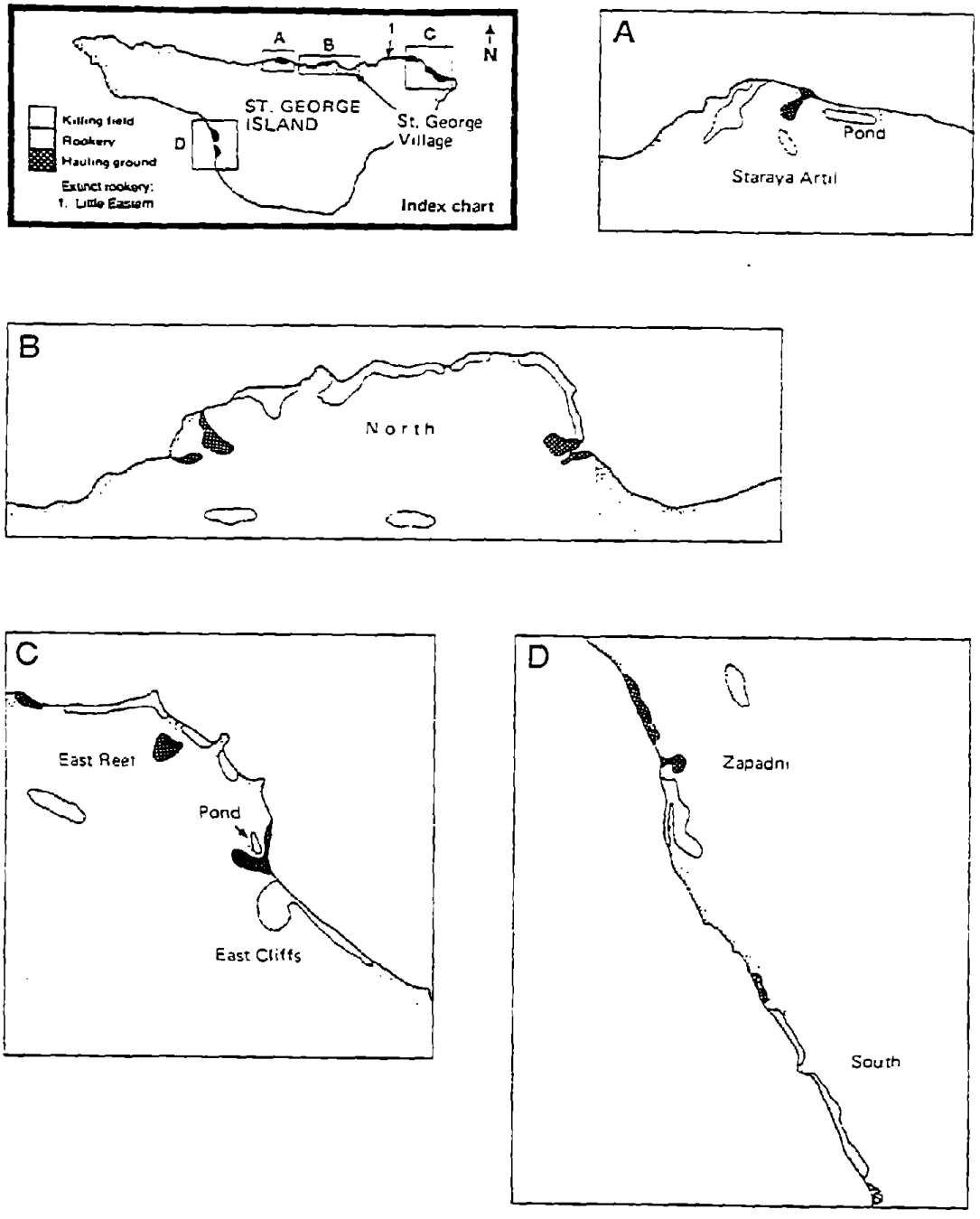

Figure 3.--Location of northern fur seal rookeries @resent and extinct), hauling grounds, and harvesting areas, St. George Island, Alaska.

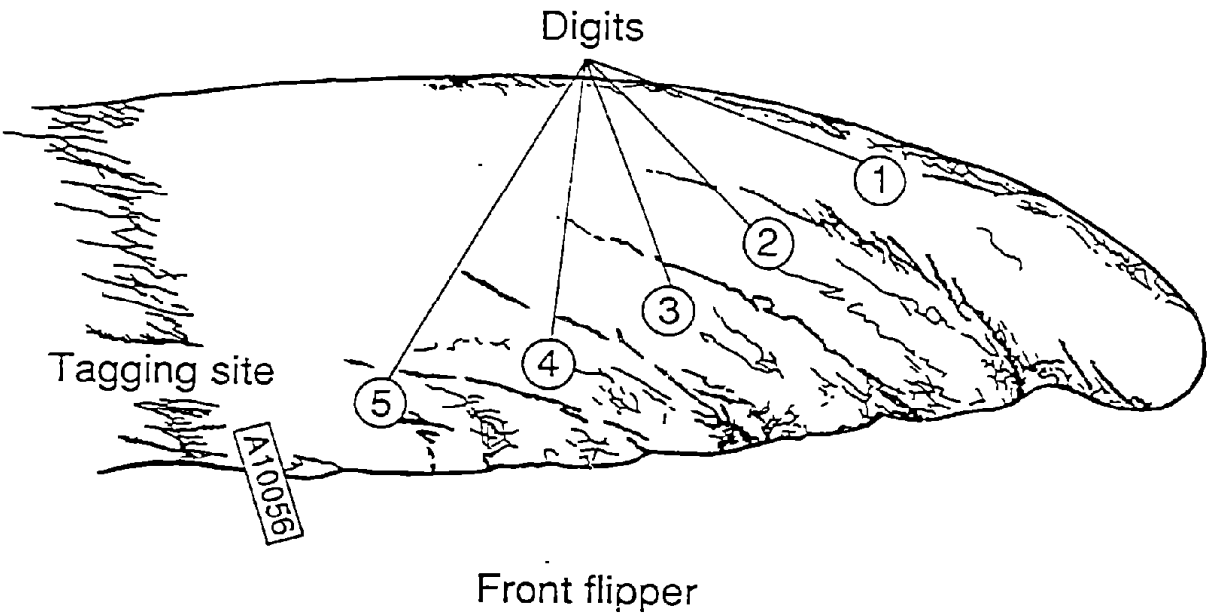

Figure G.--Location on front flipper for application of monel tag.

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