

**AERIAL SURVEY OF CERTAIN ALEUTIAN
SEA OTTER POPULATIONS 19-27 May 1959
AND
ESTIMATES OF THE TOTAL SEA OTTER
POPULATIONS IN ALASKA**

by

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AERIAL SURVEY, WESTERN ALEUTIAN AREA, 1959

INTRODUCTION

Purpose and scope

The purpose of this report is to present the results of our 1959 aerial survey with an evaluation of this survey based on sample boat and shore observations. Only adult and subadult otters are considered. Pups still with their mothers could not be counted from the air. This phase of population dynamics will be discussed in a later report.

Aerial surveys were conducted in the outer Aleutians in 1959 to furnish current information on the distribution of sea otters and the approximate size of island populations in this area. Between 19 and 27 May virtually every Aleutian island west of (and including) Herbert Island, in the Islands of Four Mountains, was surveyed.

Itinerary and personnel

FWS R4D Aircraft N791 itinerary:

Date	Takeoff	Land	Flight hrs.	Area surveyed
17 May	Anchorage	Adak	8.9	None
18 "	Adak	Amchitka	3.5	Practice counts enroute
19 "	(Amchitka (Shemya	Shemya) Amchitka)	9.1	Rat Islands Near Islands
20 "	Amchitka	St. Paul	4.3	(otter transplant)
21 "	St. Paul	Adak	3.6	None (poor weather)
24 "	Adak	Adak	1.0	None (poor weather)
25 "	Adak	Adak	5.1	Andreanof Is. (part)
26 "	Adak	Adak	9.3	Andreanof Is. (part), Delaref Is. and Semisopochnoi
27 "	Adak	King Salmon	10.0	Andreanof Is. (part) and Sequim to Herbert Is. (Is. of Four Mountains)
27 "	King Salmon	Anchorage	2.0	None
Total aircraft hours			56.8	

Personnel:

Mr. Theron Smith, FWS Aircraft Supervisor, Pilot

Mr. Jim Tilford, Bureau of Land Management, Co-pilot

Mr. David L. Spencer, FWS Refuge Supervisor, Observer

Mr. Karl W. Canyon, FWS Biologist, Observer

Mr. Norman J. Wilimovsky, FWS Biologist, Bureau

of Commercial Fisheries accompanied all flights,

primarily to look for herring concentrations.

METHODS OF SURVEY

There are four essential requirements if a census survey of sea otters by aircraft is to be of value: (1) The pilot of the aircraft must be completely cooperative with the observers and must have a considerable experience in survey work. Frequent circling back over areas is necessary and the pilot must, by experience, know exactly how to place the observers in position to best see a certain spot. (2) Two observers are essential. They must divide the area to be viewed in half, each counting all otters on his side of the center line of the aircraft flight path. (3) The observers must have a clear view of all areas directly ahead and on both sides of the aircraft. (4) The observers must be familiar both with aerial survey work and with sea otters.

Fortunately, all of these requirements could be met in the May 1959 aerial survey of the outer Aleutian Islands.

When large groups of otters were found, counts were supplemented by estimates when necessary. In such instances both observers made an independent estimate, then a final figure was agreed upon. In all cases both estimates were similar.

The altitude of flight was sometimes dependent on terrain and wind conditions. For most of the survey an altitude of 300

feet above the water was maintained but under some conditions it was necessary to go briefly to 500 feet. An airspeed of about 120 knots was maintained.

The advantages and disadvantages of aerial, dory and shore surveys are listed in Appendix C. The most nearly accurate estimate of sea otter populations is indicated by considering data obtained by each method. The comprehensive aerial survey reveals otter distribution and relative size of populations. At the same time counts are obtained that present a basis for total population estimates. In 30 hours of flight time an area more than 500 miles in length and containing more than 50 islands was covered in 1959. If such a survey were attempted by boat the undertaking would have required more than two years, many times the expense, and I believe would have yielded less reliable data. Counts made from a dory and from the shore in sample areas furnish data that may be used as a check on aerial counts. They also yield other information which cannot be obtained from the air.

RESULTS AND EVALUATION OF THE SURVEY

Dory counts compared with aerial counts

A sample area 9.5 nautical miles in length along the

the coast of Amchitka, bounded by Crown Reef Point and
Point, counts were made from a dory on five different
(see Appendix B). The number of otters counted in the
The mean of all counts is 157 otters. If the best
chosen, surface counts made under the most favorable
conditions, the total for the area is 193. The aerial
this area is 166. These figures indicate that the aerial
usually as reliable as the dory counts. From the best
counts (total 193) and the aerial count (total 166) a correction
of 1.163 is obtained. When this is applied to the total
aerial count (1,560) the corrected count becomes 1,814.
likewise, the total outer Aleutian aerial count (9,507)
becomes 11,057.

Shore counts compared with aerial counts

In a sample area, Kirilof Point, having a shore line of
approximately 3 nautical miles, five careful counts were made
from the shore during April and May. The high count was 62,
the low 40 and the mean 51. On the aerial survey 38 otters were
recorded for the vicinity of Kirilof Point, about 30 of which would
probably have been in view from the observation areas on land.
In accordance with this data, a correction factor of about 1.7

should be applied to the aerial count; giving an estimated total of $(1560 \times 1.7) = 2,652$ adult and subadult otters at Amchitka. If the correction factor is applied to the total otter count for the survey (9,507) the total becomes 16,162 otters.

Evaluation of counts

We have demonstrated that counts made from a dory and from an aircraft in a sample area at Amchitka may be similar and that shore counts in a sample area may reveal roughly twice the number of otters seen during an aerial count.

Variables enter counting experiments and these are difficult or impossible to evaluate:

1. The dory and shore counts were made over a period of three months. During this period marked fluctuations in the number of otters in any given area were observed. Such fluctuations may occur daily. Therefore, we have no assurance that any of the counts used are comparable.

2. Weather conditions not only cause otters to move from exposed to sheltered areas but interfere with visibility. High winds, causing tears to flow in the observer's eyes, reduce efficiency. Rough water obscures the presence of otters. Precipitation blurs vision through optical instruments.

3. At 120 knots in an aircraft an area that may take days to cover from shore or in a dory is covered in 5 to 10 minutes. Thus the areas chosen for sample surface counts may have been too small. It was difficult to place figures correctly on charts during the aerial survey because the sample areas were covered so quickly.

For purposes of making calculations we can say that during a calm day at any given time approximately 50 percent of the otters in an area are resting on the sea's surface or on rocks and the other 50 percent are feeding. Food diving otters may remain submerged for from 1 to 3 minutes and they remain for an approximately equal period on the surface eating. Thus it is possible that at any given moment 75 percent of the otters in an area could be seen. In practice it is unlikely that this high a percentage would be seen.

After considering the sample counts in comparison with the aerial counts and in view of other considerations as presented above it is concluded that, for the purpose of obtaining an estimate of the population of sea otters in the outer Aleutians, between 50 percent and 75 percent of the otters were counted. The following tabulation presents our aerial enumeration and estimates of the total number of otters in each area surveyed.

**Aerial counts and estimates of otter populations
in the outer Alaskan Islands, 19-27 May 1959**

Date	Area	Otters counted	Estimate of total otters in area ^{1/}		
<u>Near Islands</u>					
19 May	Attu	0	0		
" "	Agattu	0	0		
" "	Aldid	0	0		
" "	Nikhi	0	0		
" "	Shemya	<u>0</u>	<u>0</u>		
Total		0	0		
<u>Ret Islands</u>					
19 May	Buldir	0	0		
" "	Kiska	894	1192	-	1788
" "	Little Kiska	83	111	-	166
" "	Tanaduk and Tanaduk Pass	150	200	-	300
" "	Segula	47	63	-	94
" "	Pyramid-Davidof	33	44	-	66
" "	Little Sitkin	50	66	-	100
" "	Rat	270	360	-	540
" "	Anchitka	1560	2078	-	3120
" "	Semisopochnoi	<u>393</u>	<u>524</u>	-	<u>786</u>
Total		3480	4638	-	6960
<u>Delarof Islands</u>					
26 May	Garofai	41	55	-	82
" "	Unalga	51	68	-	102
" "	Kavalga	275	367	-	550
" "	Ogliuga	112	149	-	234
" "	Shugul-Tag-Ugidak	281	375	-	562
" "	Crump Rock	134	179	-	268
" "	Ilak	49	65	-	98
" "	Ulak	352	469	-	704
" "	Amatignak	<u>102</u>	<u>136</u>	-	<u>204</u>
Total		1397	1863	-	2794

^{1/} Considering that 25 to 50 percent of the otters were not seen.

**Aerial counts and estimates of otter populations
in the outer Aleutian Islands, 19-27 May 1959 (con.)**

Date	Area	Otters counted	Estimate of total otters in area ^{1/}		
<u>Andreanof Islands</u>					
25 May	Tanaga	902	1203	-	1804
25 May	Bobrof	57	76	-	114
25 "	Kanaga	1822	2429	-	3644
25 "	Adak	1718	2291	-	3436
"	Kagalaska	1	1	-	2
"	Little Tanaga	0	0	-	0
(Tana Bight to Comm. on N. side not covered - ca 1/10 of island) ^{2/}					
25 May	Unak	0	0	-	0
(N. side, Cape Ruin to Cape Chalik not covered) ^{2/}					
25 May	Anagakik	0	0	-	0
"	Tagadak & Kana	0	0	-	0
(about 50% covered)					
"	Greater Sitkin	0	0	-	0
"	Igithin (South side only)	0	0	-	0
"	Chugul (" "	0	0	-	0
"	Tagalak (" "	0	0	-	0
"	Fenimore Rock, Ikiginak	0	0	-	0
"	Oglodak (S. side only)	0	0	-	0
27 May	Atha	33	44	-	66
27 May	Kasatochi	0	0	-	0
"	Koniuj	0	0	-	0
27 "	Amila	83	111	-	166
27 May	Sagigik, Tenadak	0	0	-	0
"	Agligidak	0	0	-	0
Total		4616	6155	-	9232

Considering that 25 to 50 percent of the otters were not seen.

These areas covered in naval aircraft in January 1959, no
otters seen.

**Aerial counts and estimates of otter populations
in the outer Aleutian Islands, 19-27 May 1959 (con.)**

Date	Area	Otters counted	Estimate of total otters in area^{1/}		
27 May	Seguam	14	19	-	28
" "	Amakta	0	0	-	0
" "	Chagulak	0	0	-	0
" "	Yunaska	0	0	-	0
Total		14	19	-	28
<u>Islands of the Four Mountains</u>					
27 May	Herbert	0	0	-	0
Total all areas		9507	12665	-	19014

^{1/} Considering that 25 to 50 percent of the otters were not seen.

SURVEYS IN OTHER ALASKAN AREAS PRIOR TO 1959

Between 6 May and 28 September 1957 Mr. Calvin J. Lensink, then a student at Purdue University and a temporary employee of the Branch of Wildlife Research, conducted a sea otter population survey which included Kodiak Island, the south coast of the Alaska Peninsula, its offshore islands and limited areas among the easternmost Aleutians. In addition, Mr. Lensink made shore counts at Amchitka in 1956, and dory and partial aerial counts at Adak and Kanaga in 1957. He was assisted by

a number of Fish and Wildlife Service employees. Using his field counts and miscellaneous counts and estimates from many sources, which cover a period of many years, Mr. Lensink presented population estimates for sea otters in all areas of Alaska. His total estimate for Alaska was 31,850 to 49,750 otters. Of this total the majority (24,825 to 40,950) were considered to be in the Rat, Delarof and Andreanof Island groups from which only fragmentary information of recent origin was available (Lensink, 1958).

We feel that the population estimates of Mr. Lensink for the areas which he surveyed with care in 1957 are adequate. However, the results of our 1959 surveys indicate to us that for the areas which he did not survey his estimates were somewhat optimistic. It has been shown that calculations of marine mammal populations based on other than carefully gathered current field data are liable to be in considerable error (Kenyon et al, 1953).

The most obvious conflict between the basic information gathered by Lensink in 1956 and that gathered during our 1959 aerial surveys is in the counts made at Amchitka. Lensink's shore counts totaled 2,903 otters for extensive, but not entirely complete, shore line counts. His estimate of the total Amchitka

otter population based on these counts is 6,000 to 8,000 otters. Our total count was 1,560 otters for all of Amchitka and our estimate of the total number of otters there is 2,078 to 3,120.

I believe that the following points clarify the vast differences in both counts and estimates:

1. Lensink's 1956 counts were made over a period of many weeks in the late summer and early fall during which frequent changes in weather took place. It has been shown that movements of otters along the coast take place in response to changing weather and are perhaps influenced by seasonal changes that affect food resources. The possibility is therefore suggested that otters which moved to different areas were counted more than once during the survey period.

2. More otters (older than pups with mothers) would be available in late summer and fall than in the spring shortly after the period (March and April) of heavy mortality.

3. The 1959 aerial survey showed that about twice as many otters were distributed around the Eastern half of Amchitka as around the more precipitous western half of the island. An inadequate aerial survey, because of weather, conducted in December of 1957 also revealed a similar pattern of distribution. Lensink's shore counts were concentrated on the Eastern end of

Amchitka.

4. It is possible that because of the sustained high otter population at Amchitka over a considerable period, with attendant food shortages, the population has actually been reduced in recent years.

As a result of all field work to date I believe that, if all adults, subadults and pups are considered, the otter population at Amchitka could not now exceed 4,000 individuals at the end of summer.

**ESTIMATES OF THE TOTAL OF SEA OTTER
POPULATIONS IN ALASKA IN 1959**

As stated in the foregoing section, we believe Mr. Lensink's population estimates for Alaska, other than the areas referred to, are adequate. In addition Mr. Lensink told me that his recent (1959) observations in the Prince William Sound area confirmed his previous estimates (Lensink, 1958). Therefore the following summary is presented:

<u>Survey date</u>	<u>Area</u>	<u>Field counts and estimates of sea otters</u>	<u>Estimates of total</u>
19-27 May 1959	Alutian Islands Attu Island to the Islands of Four Mountains	9507	12665-19014
6 May-28 Sept. 1957	Prince William Sound	475-530	1000-2000
	Kodiak-Afognak	503	750-1500
	Alaska Peninsula to Fox Islands	3503	3900-4950
Total		14088-14123	18315-27464
Round total			20000-30000

Certain areas are in need of further study. These are listed below:

1. Islands of Four Mountains - not surveyed.
2. Fox Islands - inadequately surveyed, and indicated movements of otters in need of study.
3. Alaska Peninsula, Sandman Reef and Shumagin Islands - studies of population dynamics and movements needed.

SUMMARY AND CONCLUSIONS

1. The 1959 aerial survey (19-27 May) of the outer Aleutians was successful in revealing sea otter distribution and

the order of magnitude of sea otter populations. Favorable weather during the observation period contributed in large degree to the confidence we place in our observations.

2. The FWS R4D as piloted by Mr. Theron Smith was found to be highly adequate for making sea otter surveys in the remote Aleutian area.

3. Counts made from a boat and from the shore in sample areas at Amchitka furnished data that confirmed the order of magnitude of the aircraft counts and furnished approximate limits for estimating the total population from aerial counts, i. e. 50 to 75 percent of the otters present in survey areas were seen.

4. The areas of heaviest sea otter populations are (a) Western Andreanof Islands (Tanaga, Kanaga, Adak), 4,499 counted; (b) Rat Islands, 3,480 counted; (c) Delarof Islands, 1,397 counted.

5. Otters were not seen and are considered as absent or extremely scarce in (a) the Near Islands; (b) the central Andreanof Islands; (c) from Amukta Island to Herbert Island, inclusive, and probably in the remainder of the Islands of Four Mountains which have not been surveyed.

6. Previous estimates based on partial counts and old counts of otters had placed the otter population in Alaska at

from 32,000 to 50,000 animals. Estimates for all of Alaska based on the best up-to-date surveys now available place the figure at 20,000 to 30,000 otters.

7. Continuing studies of population dynamics and movements of sea otters, using primarily aircraft observation, supplemented by shore and boat counts and shore based detailed studies, should be continued.

LITERATURE CITED

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APPENDIX A

Maps showing locations and numbers of otters counted
in 1959 aerial surveys.

Counts of otters made from a dory in a sample area of
Amchitka Island plus aerial counts for the same area:

All usable dory counts - 1959

26 Feb.	Constantine Harbor to Ivakin Point - direct ^{1/}	21
" "	" " " " " "	14
2 Mar.	" " " " " "	<u>12</u>
Total		47
Average		15.7 = 16 rounded

^{1/} Direct indicates offshore areas, as opposed to those counts
made very close to the shore.

26 Feb.	Ivakin Point to East Cape (excluding East Cape) - direct	17
2 Mar.	" " " " " "	<u>31</u>
Total		48
Average		24

26 Feb.	At East Cape	60
2 Mar.	" " "	<u>16</u>
Total		76
Average		38

27 Feb.	Constantine Harbor to Crown Rooster Pt. -direct	7
10 Mar.	" " " " " "	33
" "	" " " " " "	13
23 Apr.	" " " " " "	13
" "	" " " " " "	<u>24</u>
Total		90
Average		18

27 Feb. Constantine Harbor to Crown Reef Pt. - 66
shoreline

27 Feb. At Crown Reef Point 12

18 Mar. " " " 12

23 Apr. " " " 25

Total 49

Average 16

2 Mar. Constantine Harbor to Ivakin Point - 57
shoreline

26 Feb. Ivakin Point to East Cape - shoreline 62

2 Mar. " " " " " 52

Total 114

Average 57

Summary, average surface counts

Aerial
counts

Constantine Harbor to Ivakin Point - direct (average of 3 counts)	16	
Constantine Harbor to Ivakin Point - shoreline (1 count)	57	69
Ivakin Point to East Cape - direct (aver. 2 counts)	24	
" " " " " shoreline (" " " ")	57	26

Total 154 86

Constantine Harbor to Crown Reef - direct (average 5 counts)	18	
Constantine Harbor to Crown Reef - shoreline (1 count)	66	85

Total 84

Grand total 238

At East Cape (average 2 counts)	38	150
At Crown Reef (average 3 counts)	16	21
Total for 13.5 miles coast line, including Crown Reef Point and East Cape	292	342

APPENDIX C

Advantages and disadvantages of three methods of censusing sea otters.

Advantages of aerial surveys

1. Survey is made rapidly.
- Errors introduced by movements of otters from one area to another are eliminated.
2. Hundreds of miles of otter habitat may be covered in a few hours of flight time.
3. The expense per unit of area covered is low.
4. The distribution and relative magnitude of sea otter populations over a large area are easily and quickly obtained.

Disadvantages of aerial surveys

1. Weather conditions must be ideal. In most Alaska areas delays caused by bad weather may be considerable.
2. Considerable danger is involved in low flight over water and rugged isolated areas.
3. Only adult and subadult otters can be enumerated. Pups with mothers are difficult to see.
4. Otters beneath the surface on feed dives are missed because of the rapidity of flight.

Disadvantages of aerial surveys (con.)

5. Sea birds, other sea mammals and certain species of kelp (Nereocystis) may cause confusion.

Advantages of dory surveys

1. Areas may be covered thoroughly, both inshore and offshore more rapidly than by a shore survey.
2. Food diving otters usually appear on the surface while in the range of vision from the boat, giving a fairly complete coverage.
3. Pups with mothers are easily seen and counted.

Disadvantages of dory surveys

1. Much time is necessary in order to cover an extensive area.
2. Changing weather conditions may interrupt surveys causing inaccuracies in censusing because of movements of otters from one area to another.
3. If large areas are to be covered the considerable time involved with attendant crew maintenance costs is considerable.
4. The distance of visibility from a boat is limited necessitating time consuming inshore and offshore trips through the same area.

Advantages of shore survey

1. Through the use of telescope and binoculars the most nearly complete coverage of a unit of area is possible at a given time.
2. Counts of adults, subadults, and pups is probably most accurately obtained.
3. Observations additional to population counts may be carried on.
4. Sample counts may be obtained repeatedly from established observation points.

Disadvantages of shore survey

1. This is the most time consuming of methods considered. It is very laborious to count food diving otters when many are in a limited area.
2. Interruption of observations by changing weather causes the results to be unreliable. Movements of otters from exposed areas to more sheltered areas are influenced by weather conditions.
3. Some areas cannot be viewed because offshore rocks limit visibility and rugged precipitous coastal areas are inaccessible to the observer.

APPENDIX D

Sample shore and dory counts extended to all of Amchitka.

Shore counts were most frequently and carefully made along the 3 mile coast line of Kirilof Point. The mean of five counts made in January, February and March is 20 (extremes

16 and 26). If the mean is applied to the 120 miles of shore line, the total estimate for Amchitka becomes approximately 800 otters. The mean of 5 shore counts made in April and May is 51 (extremes 40 and 62). The mean applied to the 120 mile shore line gives an estimate of 2040 otters for all of Amchitka.

The purpose of including this information is to demonstrate that such sample shore counts must be evaluated with considerable care and in the light of many other observations.

These shore counts demonstrate that movements of otters in response to weather and food availability may introduce considerable variability in the results of such counts.

Since otters tend to concentrate around points, care must be taken when generalizing on the basis of sample shore counts.

The average of individual counts, made on four days of counting otters from the dory, have been combined (Appendix B). The total obtained in this way from (and including) East Cape to (and including) Crown Reefer Point is 292. When this 13.5 mile stretch is considered a sample area and applied to the distance around Amchitka of 82 miles^{1/}, the estimated otter

^{1/} At our request the U. S. Coast and Geodetic Survey office in

Seattle measured the highly irregular shore line of Amchitka and gave us the approximate distance of 120 nautical miles. In this report, however, distances are measured along the track of the surveying aircraft over the water. By using this method the distance around Amchitka is 82 nautical miles. For the purpose of applying corrections obtained from sample dory surveys to aerial counts this method of distance measurement is more satisfactory. Inaccuracies caused by the extremely irregular coast line of Amchitka are otherwise difficult to evaluate.

population becomes 1,772. This figure is surprisingly close to our total aerial count of 1,560 otters.

Excluding East Cape and Crown Reef Point (areas of otter concentration) from dory counts and using 12.5 miles coast line for the counted sample, then 238 otters are included. Applying this figure to the total Amchitka coastal strip of 82 miles gives a total population estimate of 1,561 otters at Amchitka -- a surprising coincidence.

It is axiomatic that not all otters could have been seen on any count. The similarity of the aerial and surface counts in the sample area must not therefore be regarded as proof that these

counts exactly represent the number of otters in this area.

However, we believe that because of the care that was exercised in making all counts, we now have a reasonable representation of the order of magnitude of otters found in the areas surveyed.