SEA OTTER STUDIES - 1969

by
Karl Schneider

SEA OTTER STUDIES - 1969

This report is a compilation of a number of short reports written for the marine mammals staff files. While it serves some of the purposes of a segment report, it was compiled for the use of the staff only. Many of the conclusions and ideas expressed are tentative and based on incomplete analysis of the data.

The contents of the report are as follows:

In addition to the work presented here, much time was spent on a sea otter transplant, observing the effects of nuclear testing at Amchitka and collecting information on pelt sales. Analysis of much information and specimens collected since 1967 is still incomplete and will be written up at a later date.

STATE: Alaska

JOB TITLE: Sea Otter — JOB NO.: G-2

NAME AND TITLE OF PRINCIPAL INVESTIGATOR: Karl Schneider, Study Leader

NAME AND ADDRESS OF FISH AND GAME AGENCY: Alaska Department of Fish and Game, Subport Building, Juneau, Alaska

JOB DESCRIPTION:

OBJECTIVES: 1. To determine trends in distribution changes of sea otter populations in areas where repopulation of former habitat is incomplete.

2. To determine the effectiveness of aerial, surface and photographic counts as census tools.

3. To obtain information relating to molt, breeding biology, population sex and age composition, growth and food habits of the sea otter in selected parts of its range.

4. To evaluate the use of reproductive rates, pup survival rates, sex and age composition and food habits as tools for measuring the effects of harvesting sea otter populations.

PROCEDURES: 1. Aerial counts will be made in areas where low density populations are believed to exist and in areas where unoccupied habitat adjoins areas with relatively high populations. In April, a count will be made of the entire south side of the Alaska Peninsula and Unimak Island using a twin engine aircraft. Similar counts will be made in the Kodiak, Prince William Sound and Kenai Peninsula areas with available aircraft in conjunction with other work. Aerial counts will be made in Southeast Alaska in June and boat counts will be made in areas where concentrations appear to be established.

2. Duplicate counts from fixed-wing aircraft, helicopter, boats and shore will be made when possible, to determine the degree of variability to be expected with each method and to compare methods. Experiments with fixed-wing aircraft will be conducted in conjunction with the April count. Helicopter counts will be used only when helicopters are made available by other agencies such as the U. S. Navy at Adak. Boat, shore and aerial counts will be made and compared in Southeast Alaska. Boat and shore counts will be made on Amchitka in July and probably sometime during the winter depending on AEC activities. A boat count of the Delarof Island will be made in August.

Experiments to test the feasibility of photography for counting sea otters will be conducted on all of the counts. Different types of film including infrared will be used under different conditions of visibility and on different concentrations of animals.

3. Pelt samples, female reproductive tracts, testes, skulls, teeth, stomach contents and body measurements will be collected from animals harvested in August and from any other animals that become available throughout the year. Specimen material will be analysed as time permits between October and May. Reproductive tracts will provide information on breeding biology. Skull and body measurements will provide information on growth. Age determination by cementum layers in teeth will provide information on populations age structure and be correlated with reproductive and growth information. Pelt samples will provide a better understanding of the time and nature of the molt. Stomach contents will be analysed for food habits information.

4. Surface counts will be conducted in proposed harvest areas prior to the harvest. These counts will include numbers of adults, numbers of pups and a rough determination of the geographical distribution of sexes. These counts will be conducted in islands accessible by air in July and on less accessible islands in August immediately prior to harvesting. Information gained from the analysis of specimen material from harvests and from the composition counts will be correlated with that collected from other years and from other islands. Complete analysis of this information will not be possible until information is available for several years from the same islands.

WORK SCHEDULE:
1. April 15 to June 30
2. July 1 to August 31
3. August 1 to May 31
4. July 1 to August 31

ESTIMATED MAN DAYS REQUIRED:
1. Leader and Game Biologist I - 60 man days
2. Leader and Technician - 40 man days
3. Leader and Game Biologist II - 330 man days
4. Leader and Technician - 35 man days

LOCATION OF WORK:
1. Coastal waters of Southeast Alaska and from Prince William Sound to Unimak Pass.
2. Coastal waters of Prince William Sound to the Rat Islands.
3. Western Andreanof, Delarof and Rat Islands and Anchorage.
4. Western Andreanof, Delarof and Rat Islands.

WORK ASSIGNED TO: Karl Schneider, Study Leader

PROGRESS REPORT DUE: January 31, 1970

JOB DURATION: July 1, 1969 to June 30, 1970 Cost: Federal Share $ 22,250
State Share 8,750

AERIAL COUNT OF SEA OTTERS
ALEUTIAN ISLANDS, ALASKA PENINSULA AND SHUMAGIN ISLANDS

April, 1969

Between April 8 and April 22, 1969 an aerial count of sea otters was made in the Delarof Islands, central and eastern Andreanof Islands, Islands of Four Mountains, Fox Islands, the north side of the Alaska Peninsula from Bechevin Bay to Moffet Point and the Shumagin Islands.

An Aero Commander 500B aircraft (N6392U) chartered from the Bureau of Land Management was flown around each island slightly off shore at altitudes ranging from 150 to 250 feet and an airspeed of 100 to 120 mph. The aircraft was piloted by Cal Ward of BLM. Karl Schneider and James Faro of the Alaska Department of Fish and Game served as observers. Schneider sat next to the pilot on the inshore side of the aircraft and counted animals directly ahead and to the right of the aircraft. Faro sat behind the pilot and counted to the left (offshore). An attempt was made to follow the shore as closely as possible. Previous counts made by the U.S. Fish and Wildlife Service used a DC-3 aircraft which is considerably larger and less maneuverable than the Aero Commander. For this reason, the present count probably provided better coverage of animals close to shore and in bays. However, the DC-3 makes it possible to position more observers to cover off shore areas. Counts made with both types of aircraft appear to be of a similar order of magnitude indicating that the segment of the population counted may be different but of a similar size with each count.

A number of factors affect the size of counts. Recent experiments indicate that fixed-wing aircraft counts tend to be lower than helicopter counts and all aerial counts tend to be lower than those made from a skiff. Experience from harvests and transplants indicate that many animals are missed by all of the techniques used so far.

The shape of a shore line will affect the advantages of one method over another and the percentage of animals seen probably varies on different islands even when all other conditions are equal.

Experience and ability of the pilot and observers is always a factor. Turbulence affecting the aircraft particularly on the downwind side of islands can affect the altitude, airspeed and distance from shore at which the aircraft must be flown. Extreme turbulence can distract the observers.

While sea otters are relatively easy to identify from the air, large numbers of seals and sea lions in the water can be confusing and cause sea otters to be missed. This was most noticeable at Seguam and Akutan on the present count.

In some areas, such as the Shumagin Islands, sea otters tend to be wary and dive well ahead of the aircraft. Animals seen ahead of the aircraft often disappear before positive identification can be made. This factor did not appear to be a problem in the Aleutian Islands where otters are relatively tame.

Visibility can be affected by a number of factors; however, waves and light reflection are the most critical. Only five days out of 14 had conditions of visibility that were acceptable for any type of counting. None were ideal.

Choppy waves, surf and glare from sunlight on the water restrict visibility. Glare and chop, individually and in combination, create a variability in conditions which seriously limits the effectiveness of aerial counts.

Another important factor is the distribution of animals. When most of the animals are resting in pods ranging up to several hundred animals, the counts tend to be much higher than when the same number of animals is scattered and feeding. This is particularly true under less than ideal conditions of visibility. The distribution of sea otters can be influenced by time of day, tide conditions, present weather conditions, weather for the past few days, etc. Counts made in the Shumagin Islands were made under unfavorably conditions of visibility; however, many of the animals remained in pods of 20 to 40 all morning making the counts higher than would normally be expected. By afternoon the animals had scattered and the counts were lower. Another example is the area north of Unimak Island and Izembek Bay where a very high count was made in 1965 by the USFWS when the animals were in large pods near shore after several days of strong winds. The present count was made after several days of calm weather and the animals were scattered over a 1000 square mile area. The number counted was considerably lower than the 1965 count.

Many other factors such as distribution of kelp have lesser effects on the counts.

In general, the variability in factors influencing this type of count is so great that the results are not reliable for population estimates or for determining short-term fluctuations in dense populations. However, aerial counts should be useful to determine general distribution and abundance and to follow large changes in population size. Such changes are occurring where relatively dense populations are expanding into habitat that is either unoccupied or sparsely occupied. Aerial counts are also the quickest way to familiarize new personnel with large areas of habitat.

The following is a list of definitions of terms used to describe counting conditions. Application of these terms is completely subjective and based on the writer's experience.

Excellent - Surface of water relatively calm. Usually overcast with little surface glare. Single animals easy to spot at a distance.

Very good - Surface may be slightly choppy, but not enough confusing reflection to prevent spotting of animals off shore.

Good - Off shore animals may be difficult to spot but single animals near shore and in kelp beds and small pods everywhere are readily spotted.

Fair - Usually choppy or surface glare. Single animals in kelp beds or in the lee of rocks or shore and most groups of animals relatively easy to see. Other single animals and some pods in deep bays, in the shadow of cliffs or off shore may be missed.

Poor - Single animals difficult to spot and many pods may be missed, but conditions still good enough to get a rough idea of the distribution of animals.

Description of Conditions During April, 1969 Aerial Count of Sea Otters

4/10 Kanaga - 15 to 25 knot wind, water choppy, broken overcast, surface glare, conditions poor. Started count at Round Head at 9:13 a.m. Stopped count because of poor conditions on Pacific side.

Little Tanaga, Umak, Asuksak, Tanaklak, Aziak - (10:00 to 10:55 a.m.) Conditions better than at Kanaga but deteriorating. Water choppy on the south sides creating poor visibility. Surface glare on north side with fair visibility.

4/11 Kanu Island - (9:15 a.m.) Water choppy, broken overcast with surface glare, frequent rain and snow squalls. Conditions poor, attempts to count nearby islands abandoned.

4/12 Delarof Islands - (9:45 - 11:45 a.m.) Wind about 5 knots at Adak but probably 20 to 30 knots over water. Heavy surf and squalls prevented count of most of Gareloi. Bad chop on the south sides and surface glare on the north sides made conditions around Unalga, Kavalga, Ogliuga, Skagul and Ilak Islands fair to poor. Heavy surf on the west sides of Amatignak and Ulak created very poor conditions. The east sides had fair visibility.

4/13 Great Sitkin - (8:40 a.m.) Conditions poor on west and north side and good on east and south sides, but with some surface glare.

Kanu, Tagadak, Igitkin, Ulak, Chugul, Umak, Anagaksik, Little Tanaga, Tagalak, Ikiginak and Oglodak - (1:00 - 11:00 a.m.) Surf on exposed southeast sides, some glare on northeast sides. Conditions poor in spots but generally good.

Atka and Amlia - (1:15 - 4:30 p.m. Conditions good to very good on north sides with light ripples and little glare except large squalls prevented count east of Pinacle Rock on Amlia Surf, surface glare and squalls created conditions that were generally fair on the south side, but some areas were poor.

4/14 East tip of Amlia - (10:10 a.m.) Bad surface glare.

Sequam - (10:15 a.m.) Light ripples on surface. Glare bad. Many sea lions in water making identification of heads difficult and many sea otters may not have been counted. Conditions generally fair.

Islands of Four Mountains - (11:00 - 12:20 p.m.) Conditions similar to Sequam but worse in spots. Large numbers of birds prevented count of Chagulak

Akutan and Akun - (4:00 - 6:00 p.m. Conditions similar to Sequam, but worse on south sides. Many seals and sea lions in water.

4/15 Rootok, Avatanak, Tigalda, Ugamak, Baby Islands and Unalga - (7:25 - 9:00 a.m.) Conditions good on north sides. Heavier chop on south sides creating fair conditions.

Umnak and Samalga - (10:40 - 12:15 noon) Conditions fair near shore but choppy and poor off shore. Heavy surf on Pacific side of Samalga. Counts were concentrated on points and rocks. Sandy beaches were counted at high speed.

Unalaska - (12:30 - 1:30 p.m.) Did not count into deep bays concentrated on points and groups of rocks. Visibility ranged from fair to good.

Unimak to Izembek Bay and Amak Island - (2:40 - 5:45 p.m.) Conditions ranged from fair to very good west of Amak. Calmer 8 to 10 miles off shore than near shore. Light chop and surface glare hindered visibility in certain directions. Most of animals scattered. Visibility very good and animals in groups of 5 to 10 on return half of transect just west of Amak. Conditions from Amak east deteriorated to poor.

4/16 Big Koniuji, Little Koniuji, Simeonof, Southeast side of Nagai, Turner, Bendel, Spectacle and Near Island - (10:00 - 12:50 p.m.) Sky clear. Very bad surface glare, light chop or ripples, depending on location. Single animals difficult to see although many remained in small pods all morning. Animals very often dove well ahead of airplane. Many heads dove before identified and were not counted, but most were probably otter. Much of count would have been very poor if animals were scattered.

Northwest side of Nagai, Bird, Chernabura and Andronica Islands and the Haystacks - (3:00 - 4:40 p.m.) Wind picked up, water rougher than a.m. Glare still bad and animals more scattered. Conditions generally poor. Even large groups of otter may have been missed.

No attempt was made to count shallow areas off shore.

AERIAL COUNT OF SEA OTTERS APRIL, 1969

ISLAND	COUNT	DATE	PARTIAL OR COMPLETE COUNT	VISIBILITY
Delarof Island				
Gareloi	5	4/12	Partial	Poor
Unalga	9	4/12	Complete	Fair
Kavalga	118	4/12	Complete	Fair to Poor
Sea Otter Pass	36	4/12	Complete	Fair
Ogliuga & Skagul	105	4/12	Complete	Fair
Ulak	55	4/12	Complete	Poor
Amatignak	68	4/12	Complete	Very Poor
Ilak	6	4/12	Complete	Poor
Andreanof Islands				
Kanaga	153	4/10	Partial	Poor
Great Sitkin	343	4/13	Complete	Poor to Good
Aziak	4	4/10	Complete	Poor to Fair
Tanaklak	4	4/10	Complete	Poor to Fair
Asuksak	7	4/10	Complete	Poor to Fair
Kanu	20	4/11	Complete	Poor
Kanu	35	4/13	Complete	Fair
Tagadak	21	4/13	Complete	Fair
Igitkin	190	4/13	Complete	Fair
Ulak	15	4/13	Complete	Fair
Chugul	119	4/13	Com plete	Fair
Umak	116	4/10	Complete	Poor
Umak	164	4/13	Complete	Fair to Good
Anagaksik	0	4/13	Complete	Fair to Good
Little Tanaga	139	4/10	Partial	Poor
Little Tanaga	203	4/13	Complete	Poor to Good
Tagalak	68	4/13	Complete	Fair
Fenimore Pass & Rocks	42	4/13	Complete	Fair
Ikiginak	33	4/13	Complete	Fair
Oglodak	9	4/13	Complete	Fair
Atka Pass	7	4/13	Complete	Fair
Atka	464	4/13	Partial	Fair to Good
Amlia	140	4/13	Partial	Fair
Seguam	97	4/14	Complete	Poor
Islands of Four Mountains				
Amukta	0	4/14	Partial	Fair
Chagulak	0	4/14	Partial	Fair
Yunaska	0	4/14	Partial	Fair
Herbert	0	4/14	Partial	Fair
Carlisle	0	4/14	Complete	Fair
Chuginadak	0	4/14	Partial	Fair
Kagamil	0	4/14	Complete	Fair
Uliaga	0	4/14	Complete	Fair

Aerial Count of Sea Otters, April 1969 (Cont.)

ISLAND	COUNT	DATE	PARTIAL OR COMPLETE COUNT	VISIBILITY
Fox Islands				
Samalga & Cape Sagak	27	4/15	Complete	Fair to Poor
Umnak	9	4/15	Partial	Fair to Poor
Unalaska	6	4/15	Partial	Fair to Good
Baby Islands	0	4/15	Complete	Fair to Good
Unalga	0	4/15	Complete	Fair to Good
Akutan	1	4/15	Complete	Fair
Akun	3	4/15	Complete	Fair
Rootok	2	4/15	Complete	Fair
Avatanak	0	4/15	Complete	Fair
Tigalda	49	4/15	Complete	Fair to Good
Ugamak	0	4/15	Complete	Fair to Good
Aiktak	0	4/15	Complete	Fair to Good
N. Side Unimak to Izembek Bay	482	4/15	Partial	Poor to Very Good
Shumagin Islands				
Castle Rk.	0	4/16	Complete	Poor to Fair
Big Koniuji	296	4/16	Complete	Poor to Fair
Peninsula	15	4/16	Complete	Poor to Fair
Little Koniuji	232	4/16	Complete	Poor to Fair
Atkins	58	4/16	Complete	Poor to Fair
Simeonof	329	4/16	Complete	Poor to Fair
Nagai	232	4/16	Complete	Poor to Good
Near	150	4/16	Complete	Fair
Turner	6	4/16	Complete	Fair
Bendel	27	4/16	Complete	Fair
Spectacle	8	4/16	Complete	Fair
Bird	76	4/16	Complete	Poor
Chernabura	6	4/16	Complete	Poor
Andronica & The Haystacks	75	4/16	Complete	Poor to Fair

Discussion of Results

Delarof Islands

The 1969 count was somewhat lower than the 1965 count. It is probable that the population has been declining as the Amchitka population did, however, the difference in these two counts may be entirely due to poor counting conditions. The count was continued under these conditions to familiarize personnel with the area and should not be interpreted further.

Andreanof Islands

The Kanaga count was stopped because of poor conditions. In the area covered, 153 were counted. In 1968, one hundred and three were counted in the same area under better conditions of visibility, but with different observers and possibly a different distribution of animals. Approximately 200 animals had been removed from this area during a harvest conducted between the two counts. The fact that the 1969 count was higher when one might expect it to be lower illustrates how the many variables can reduce confidence in such counts as census tools.

Great Sitkin, Umak, Little Tanaga and the nearby islands appear to have had a reduction in sea otter numbers since 1965. Some of the reduction in the counts was probably due to the fact that a number of large groups were counted in 1965 while in 1969 the animals were more scattered. However, there was a very substantial increase in sea otter numbers from Igitkin Island to the west end of Atka indicating that many of the animals have moved eastward following the same pattern of expansion into sparsely populated habitat that has been demonstrated by USFWS counts in the past. Populations in the Little Tanaga-Great Sitkin area remain dense.

Sea otters were found on the north side of Atka for the first time. This area was last surveyed in 1962. There was also an increase on the western half of the south side. These animals on both sides almost certainly have moved in from the islands to the west. The population from Cape Tadluk to Amlia Pass may have expanded somewhat since 1965, however, there is no indication of significant movements of large numbers of animals. No animals were seen in Nazan Bay, however, residents of Atka report occasional animals near the village.

No significant change is indicated in the Amlia population by the counts. Some animals have moved around the east end to the north side of the island, however, there does not appear to be any significant populations on the north side at this time.

There was a substantial increase in the count on Seguam Island even with poor visibility. It is possible that a number of animals have moved from Amlia, but it is more likely that the differences are due to reproduction and variability inherent in the counting techniques.

Islands of Four Mountains

No sea otters were seen in this island group on this or any previous survey. However, John Klingbeil, an ADF&G pilot, reports seeing about a dozen sea otters

Islands of Four Mountains (Continued)

near Chuginadak, Carlisle and Kagamil Islands in March, 1969. This is probably a reliable report and indicates that a small number have crossed over from the small Samalga Island population. This does not appear consistent with the patterns of expansion that are being observed in the Andreanof Islands. However, it is consistent with what appears to be a different pattern emerging in the Fox Islands.

Fox Islands

Samalga Island and the western tip of Umnak Island have supported a small population for a number of years. Sightings have usually involved 10 to 14 animals and there has been no indication of an increase. The 1969 count of 27, the discovery of small concentrations near Kigul Island and the western tip of Unalaska plus reported sightings in Makushin Bay on Unalaska and in the Islands of Four Mountains indicate that the population of these islands may be expanding with small numbers scattering considerable distances to become established in small areas which appear to be the best pieces of sea otter habitat in the area. It is possible that the Samalga population has served as a nucleus for this expansion. The information is too sparse to determine conclusively whether this is the pattern. The total numbers of animals are undoubtedly small, and it is questionable whether repopulation in large numbers will occur in this manner before the large populations to the east expand into these areas.

What appears to be a similar situation exists in the Krenitzin Islands. A small population exists near Tigalda Island. The 1969 count is the highest yet, however, none of the surveys are comparable so it is a matter of speculation as to whether this population is increasing or not.

Scattered individuals were seen around the other islands in the area. Ed Caliese of Unalaska, who has hunted seals in the area, reports that the only sea otter he has seen recently in the area was in Beaver Inlet on Unalaska. The 1969 count and reports from individuals indicate that the Tigalda population is the only concentration in the area and the other animals probably have wandered from this population.

Unimak Island to Moffet Point

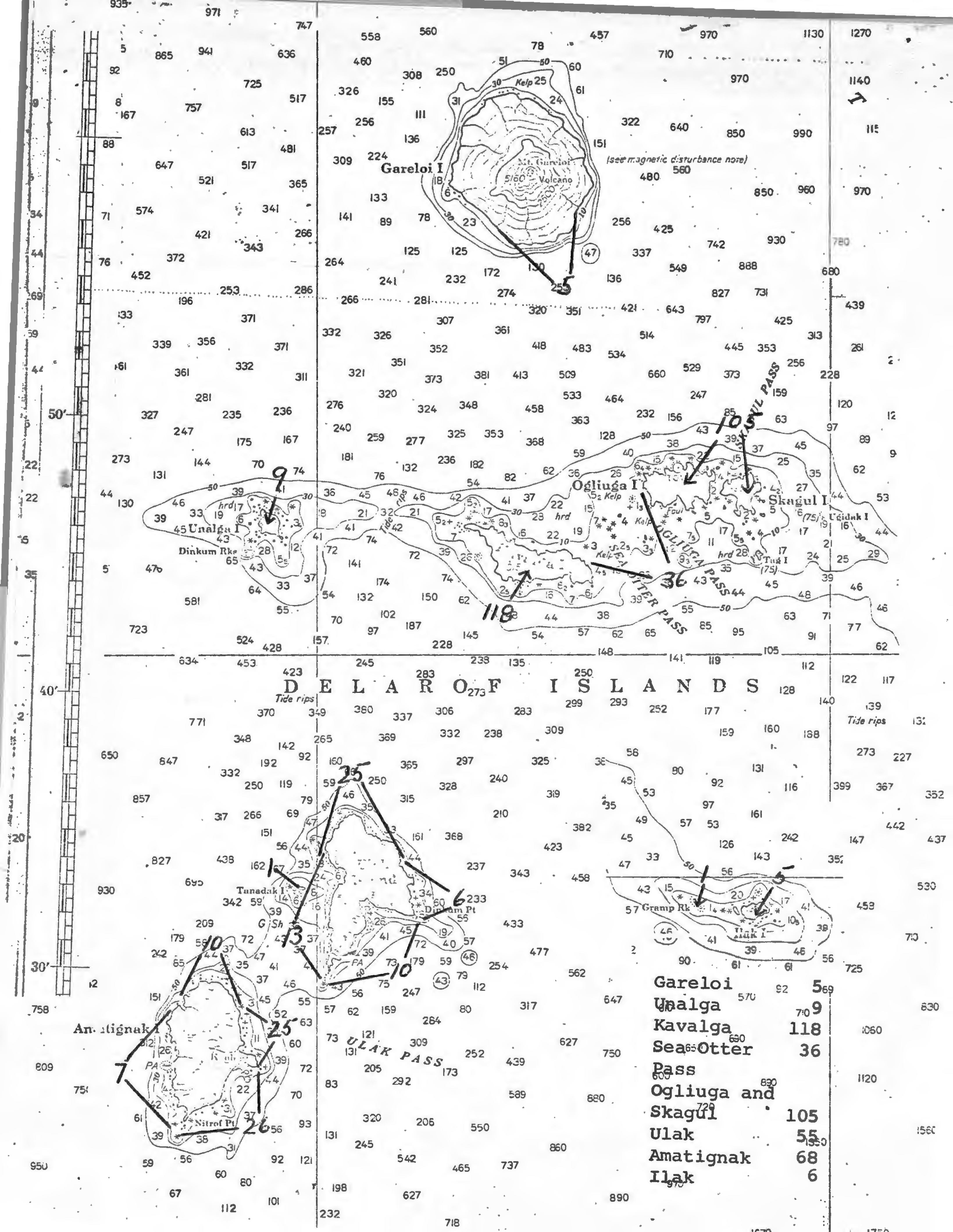
A large and somewhat unique population exists in the large shallow area north of Unimak Island and the Alaska Peninsula to Port Moller. This population apparently remains off shore and the animals seldom haul out on land. Because of the vast area occupied by the animals, no attempt was made to get a total count. Efforts were directed toward delineating the area being used. In 1965, approximately 2,500 sea otters were seen in the area covered by the 1969 survey. In 1969, four hundred and eighty-two were counted. The difference in numbers is probably due to a more complete coverage in 1965 and the fact that the animals were in large groups in 1965, whereas they were widely scattered in 1969. In 1965, the count followed several days of strong northerly winds. The 1969 count followed several days of very calm weather. This indicates a strong influence on otter distribution by weather preceding the count with a corresponding influence on the number counted.

Unimak Island to Moffet Point (Continued)

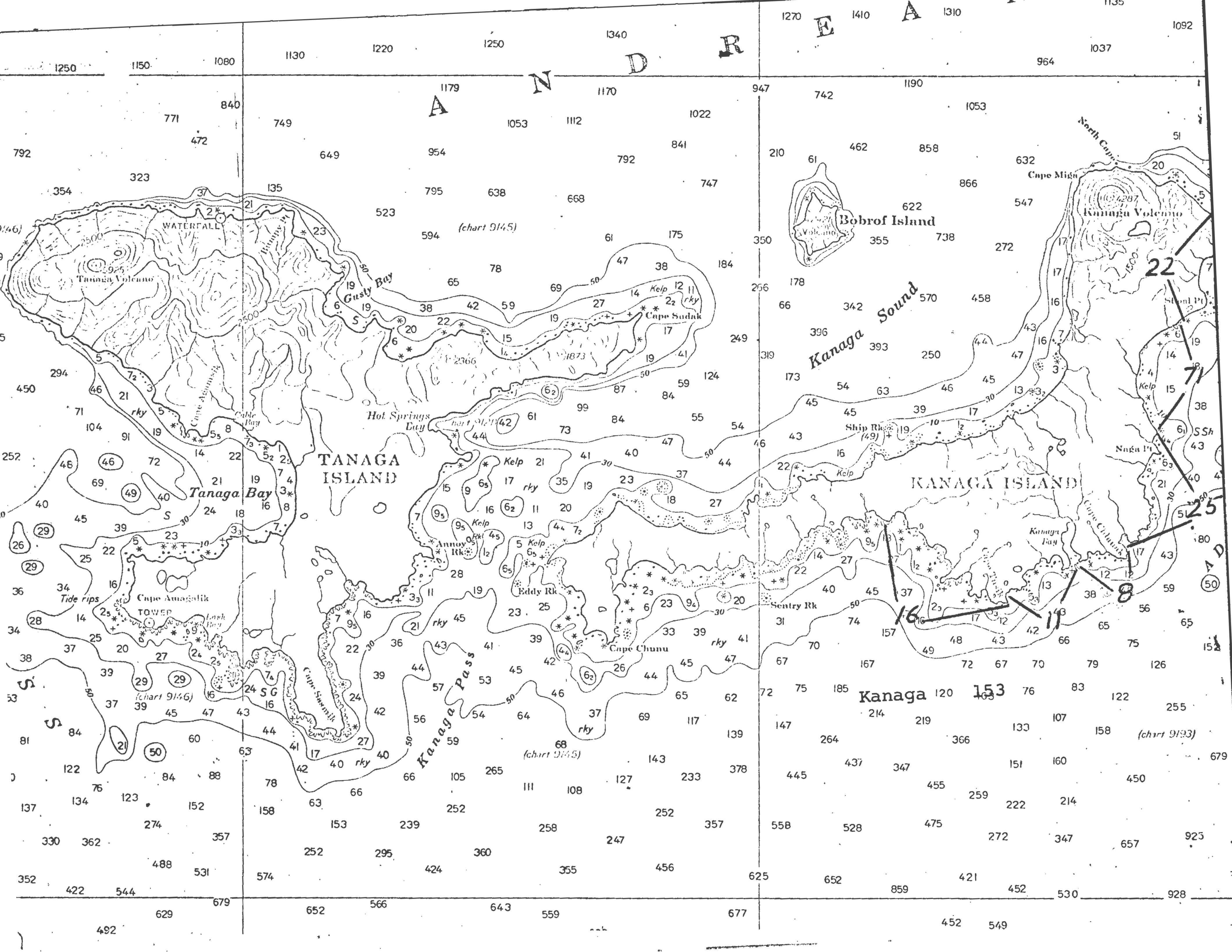
In 1965, many sea otters were seen beyond the three mile limit although most were within the limit. In 1969, almost no sea otters were within the three mile limit and in one area none were seen within 10 miles of shore. Flight lines were extended off shore until no more animals were seen. In general, the outer limit of the animals was around the 40 fathom curve. One flight line was extended 30 miles from shore. The last sea otters were seen 26 miles from shore. The otter appeared to be feeding on invertebrates and presumably were regularly diving in at least 40 fathoms of water. The bulk of the animals were within a 1,000 square mile area.

Shumagin Islands

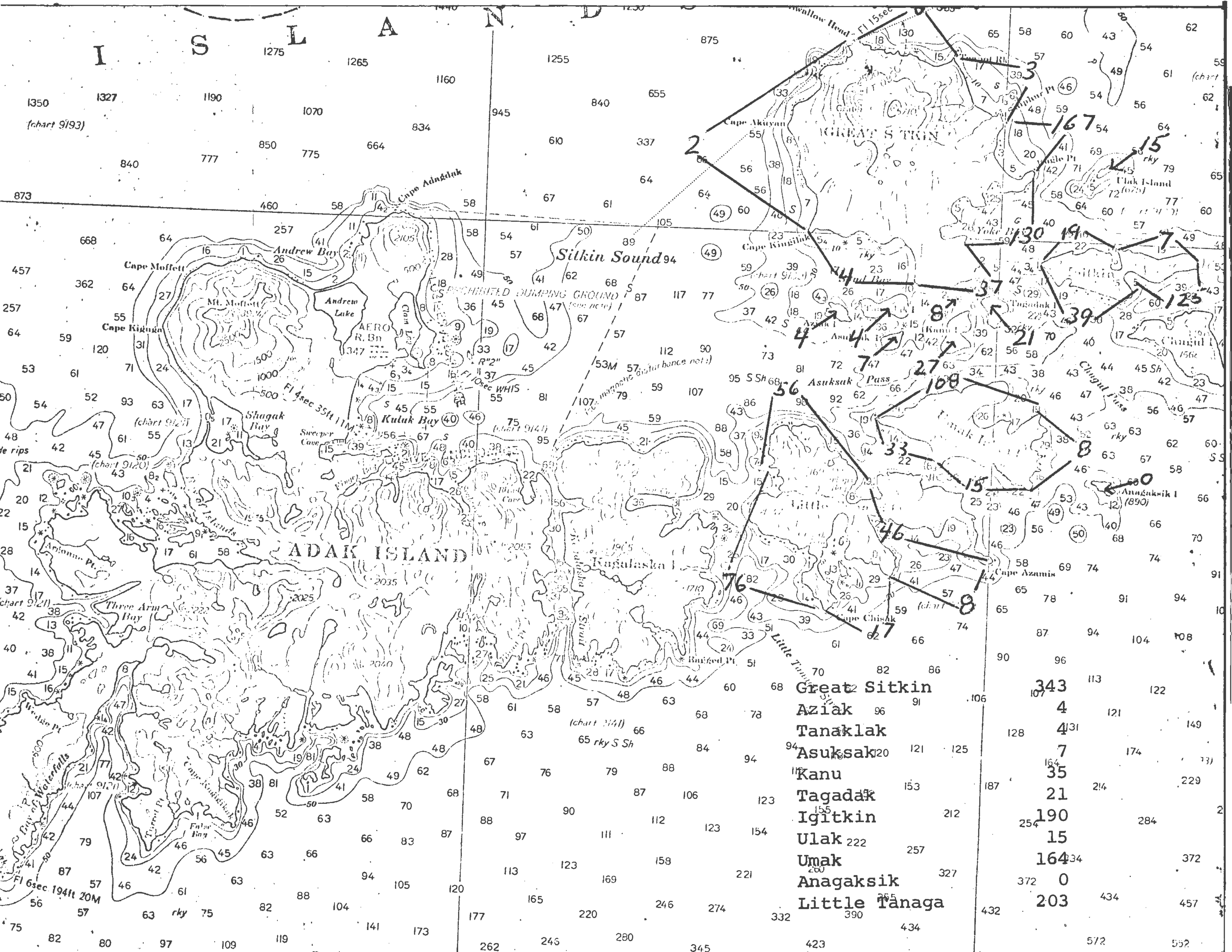
There was no definite change in the populations of the islands counted from the 1962 USFWS survey. The animals evidently move back and forth between the islands. The southern islands still support a substantial population. Reports from residents of Sand Point indicate that the populations are increasing in the northern Shumagins, however, weather conditions prevented counts on these islands.

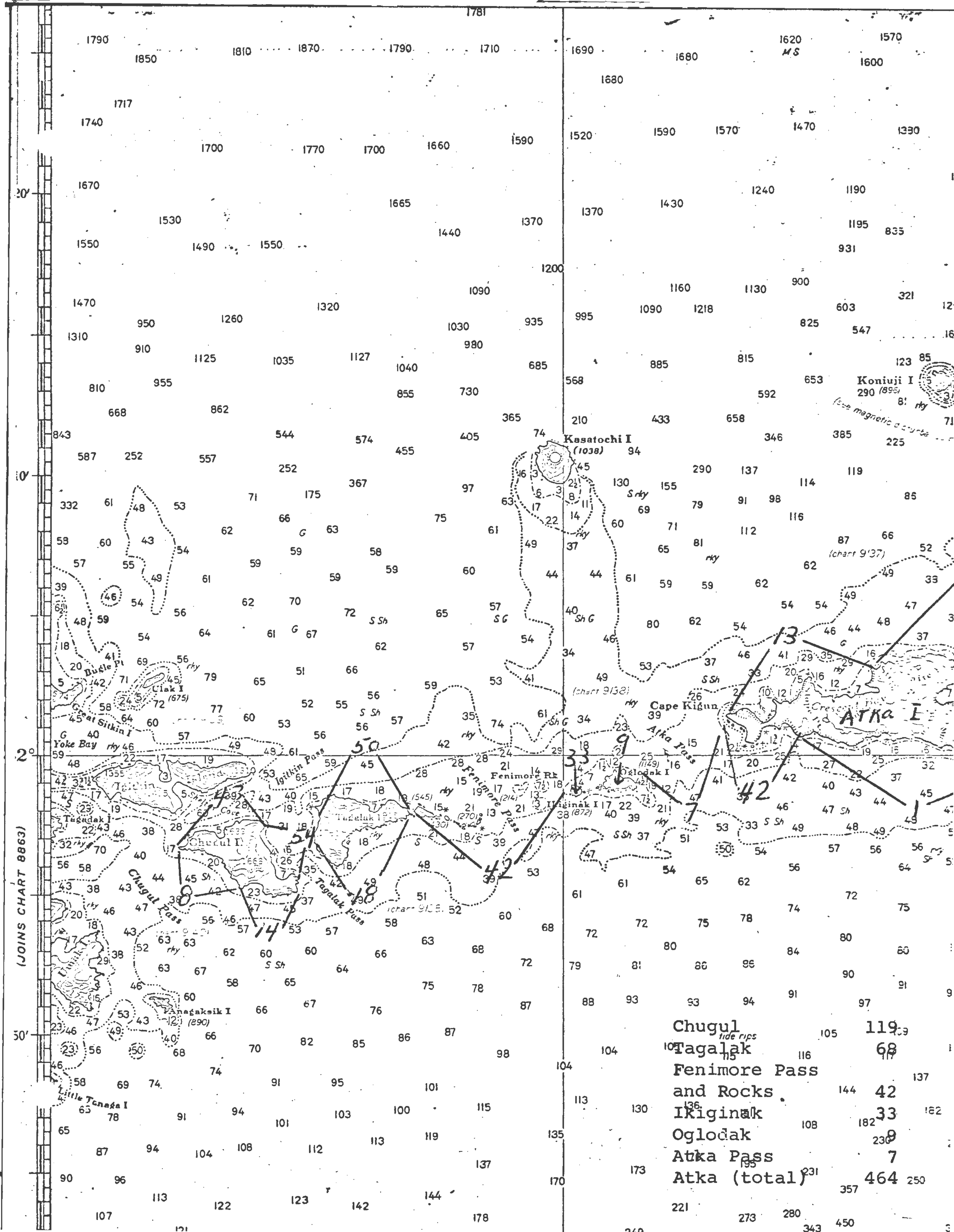


Gareloi	5
Unalga	9
Kavalga	118
Sea Otter Pass	36
Ogliuga and Skagul	105
Ulak	55
Amatignak	68
Ilak	6

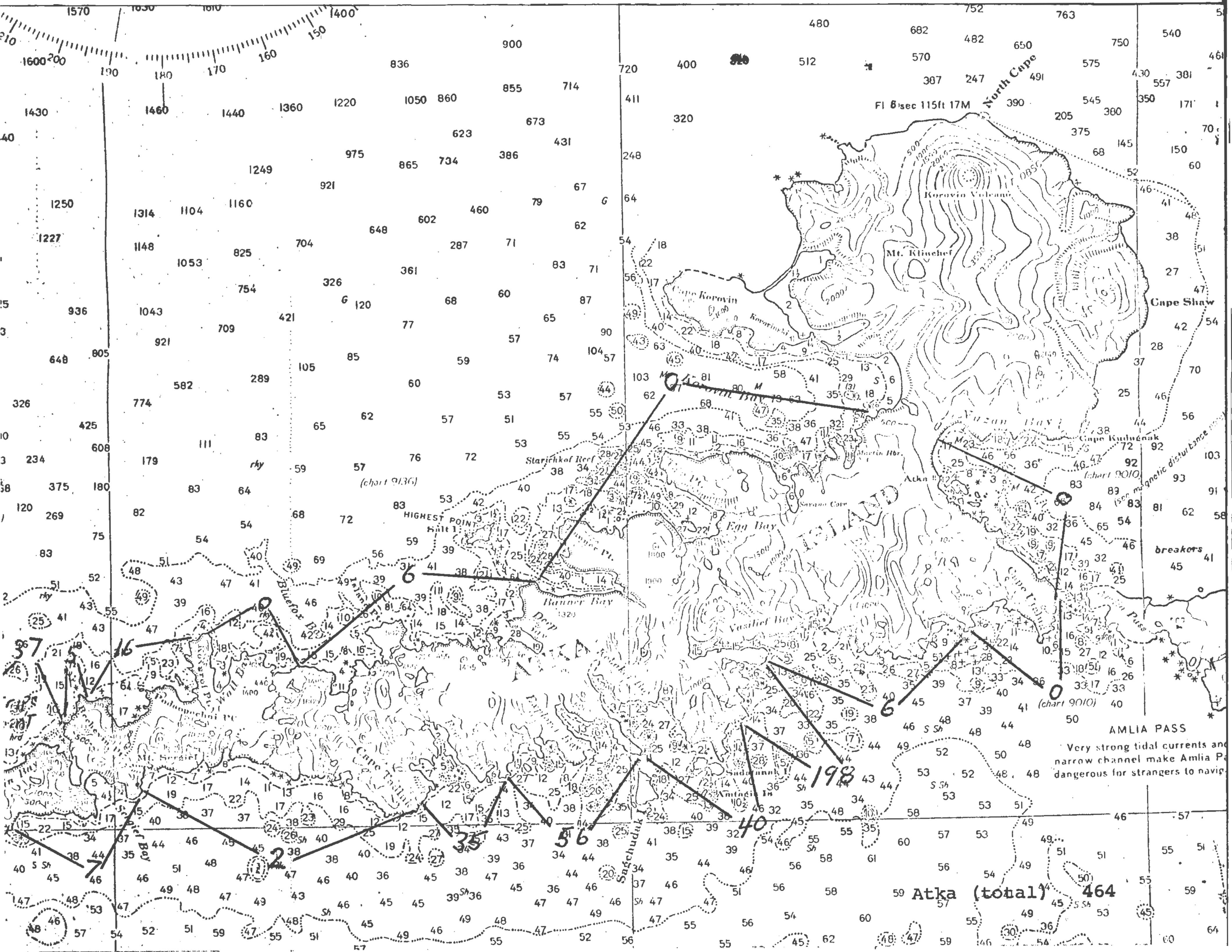


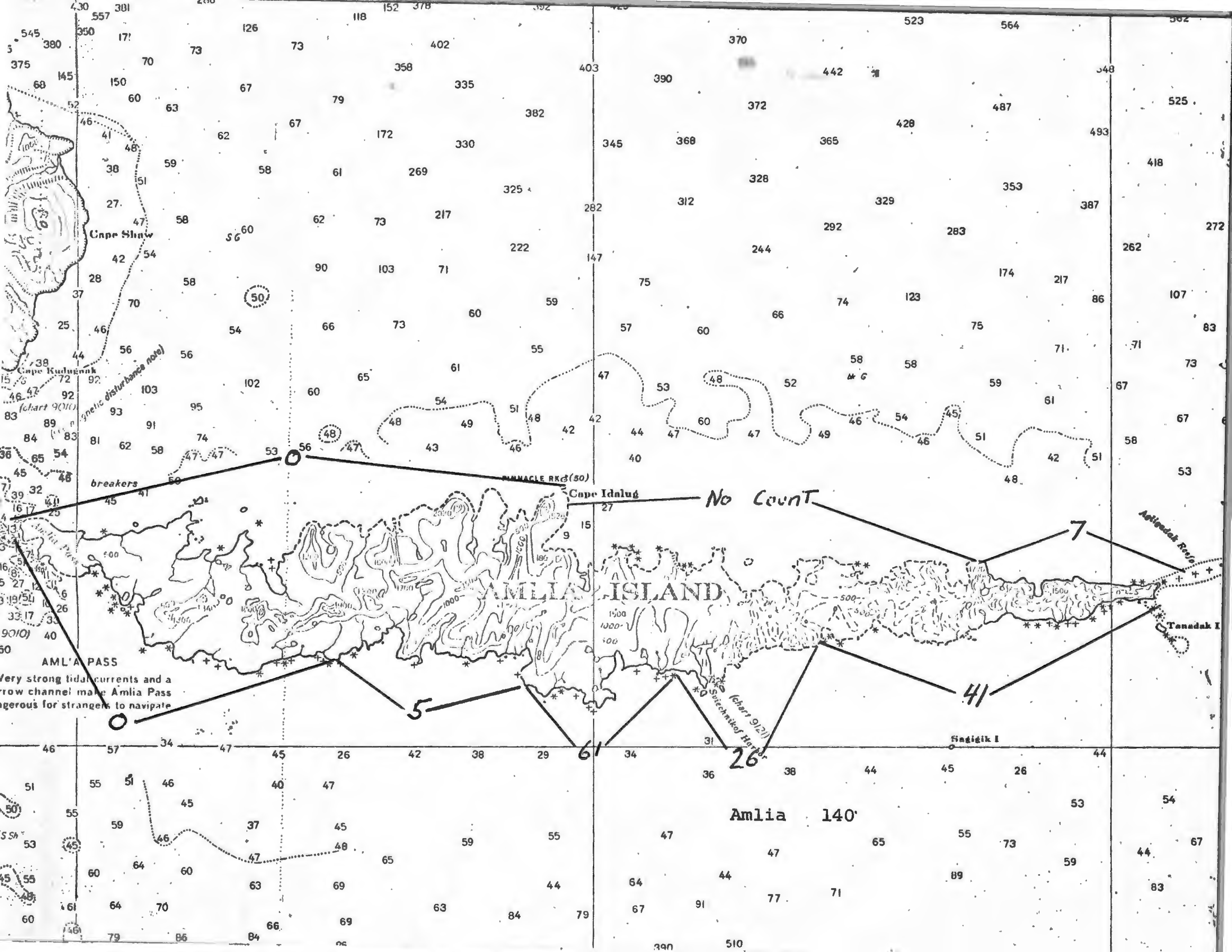
TANAGA ISLAND
KANAGA ISLAND
Bobrof Island
Kanaga Sound
Kanaga Pass
Kanaga
Tanaga Bay
Gusty Bay
Hot Springs Bay
Cable Bay
Tanaga Volcano
Kanaga Volcano
WATERFALL
Cape Sudak
Cape Amagalik
TOWER
Cape Chunu
Cape Miga
North Cape
Naga Pt
Kanaga Bay
Ship Rk
Sentry Rk
Eddy Rk
Annoy Rk
Tide rips
Kelp
rky
(chart 9145)
(chart 9146)
(chart 9193)


I S L A N D
(chart 9193)
Sitkin Sound
PROHIBITED DUMPING GROUND
Cape Adagdak
Andrew Bay
Cape Moffett
Mt. Moffett
Andrew Lake
Cape Kiguga
AERO R. Bn
Shagak Bay
Kuluk Bay
Sweeper Cove
ADAK ISLAND
Kagalaska I
Three Arm Bay
Cape Akuyan
Cape Kiigilak
GREAT SITKIN
Ulak Island
Asuksak Pass
Chugul Pass
Tanak I
Anagaksik I
Cape Azamis
Cape Chisak
Little Tanaga
Fl 4sec 35ft 11M
Fl 6sec 194ft 20M
Great Sitkin 343
Aziak 4
Tanaklak 4
Asuksak 7
Kanu 35
Tagadak 21
Igitkin 190
Ulak 15
Umak 164
Anagaksik 0
Little Tanaga 203

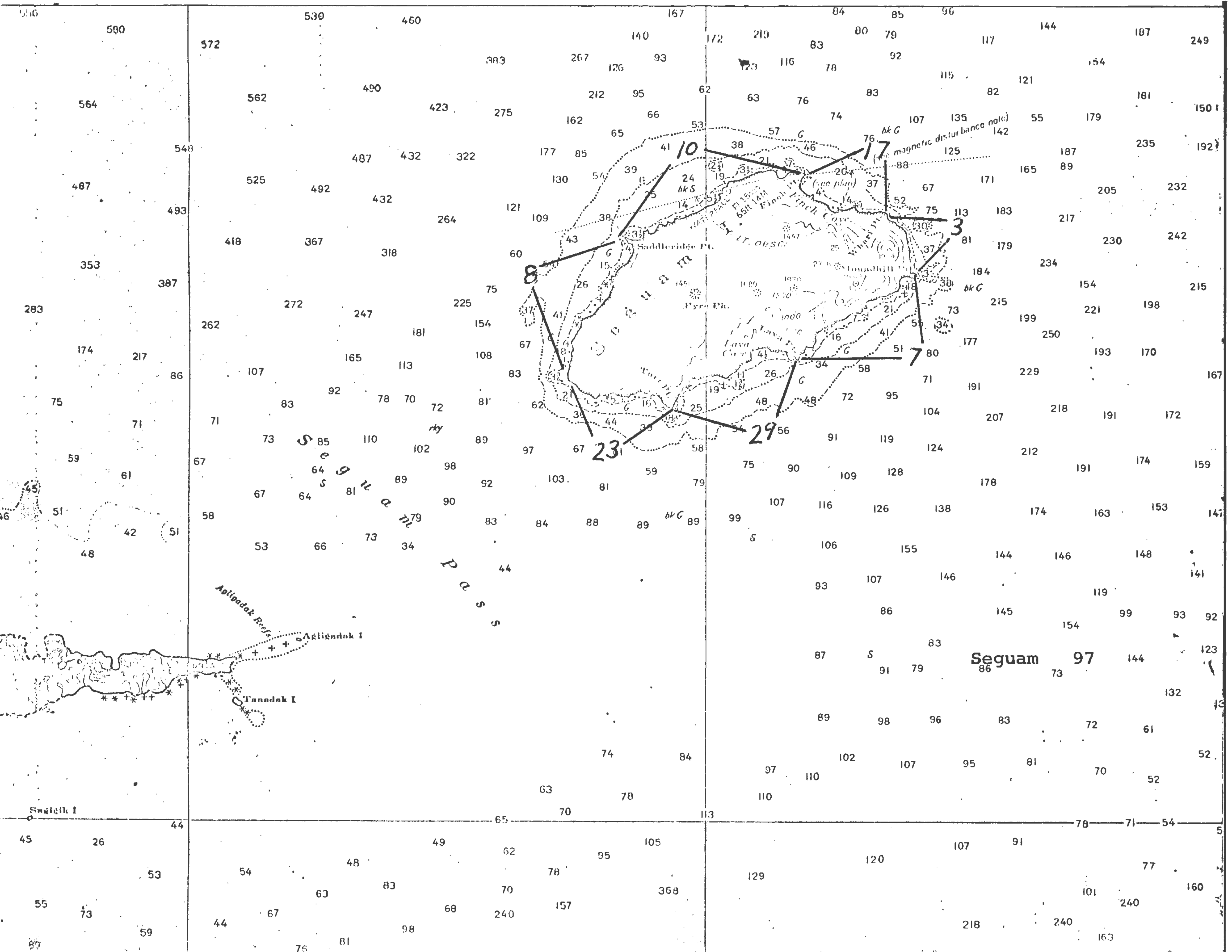


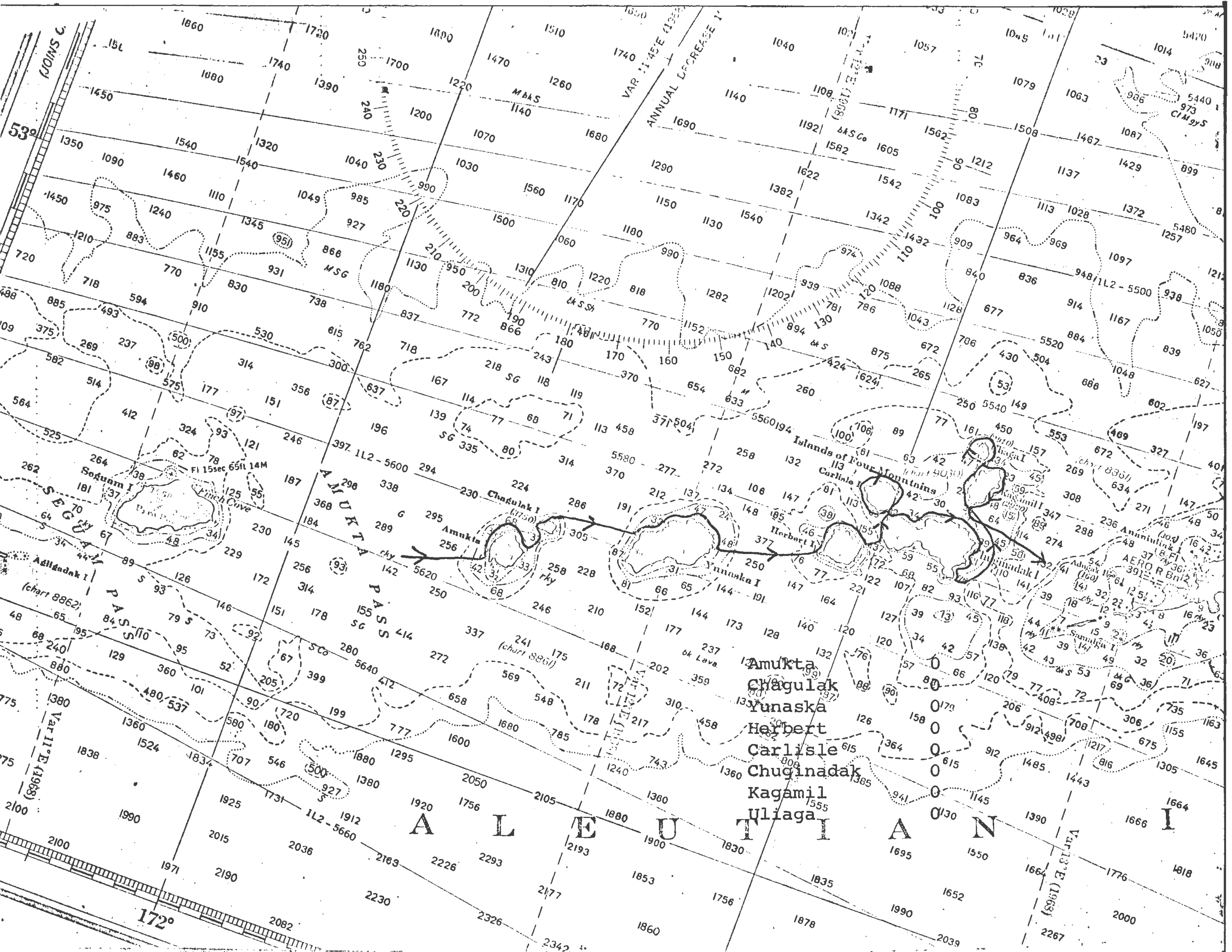
Chugul	119
Tagalak	68
Fenimore Pass and Rocks	42
Ikiginak	33
Oglodak	9
Atka Pass	7
Atka (total)	464


North Cape
Fl 6sec 115ft 17M
Korovin Volcano
Mt. Kliuchef
Cape Shaw
Cape Korovin
Korovin Bay
Cape Kudugnak
(chart 9010)
(chart 9136)
Starichkof Reef
HIGHEST POINT
Banner Bay
Egg Bay
Vasilief Bay
breakers
AMLIA PASS
Atka (total) 464



Cape Shaw
Cape Kudugnak
(chart 9010)
magnetic disturbance note
breakers
PINNACLE RK
Cape Idalug
No Count
7
Asligadak Reefs
AMLIA ISLAND
Amlia Pass
AML'A PASS
Very strong tidal currents and a
rrow channel make Amlia Pass
ngerous for strangers to navigate
0
0
5
61
26
41
Sviechnikof Harbor
(chart 9121)
Tanadak I
Sagigik I
Amlia 140


Seguam I
Seguam Pass
Saddleridge Pt
Finch Pt
Finch Cove
Pyre Pk
Lava Pt
Lava Cove
(see plan)
(see magnetic disturbance note)
Agligadak Reefs
Agligadak I
Tanadak I
Seguam 97
10
17
3
7
29
23
8



Amukta
Chagulak
Yunaska
Herbert
Carlisle
Chuginadak
Kagamil
Uliaga
0
0
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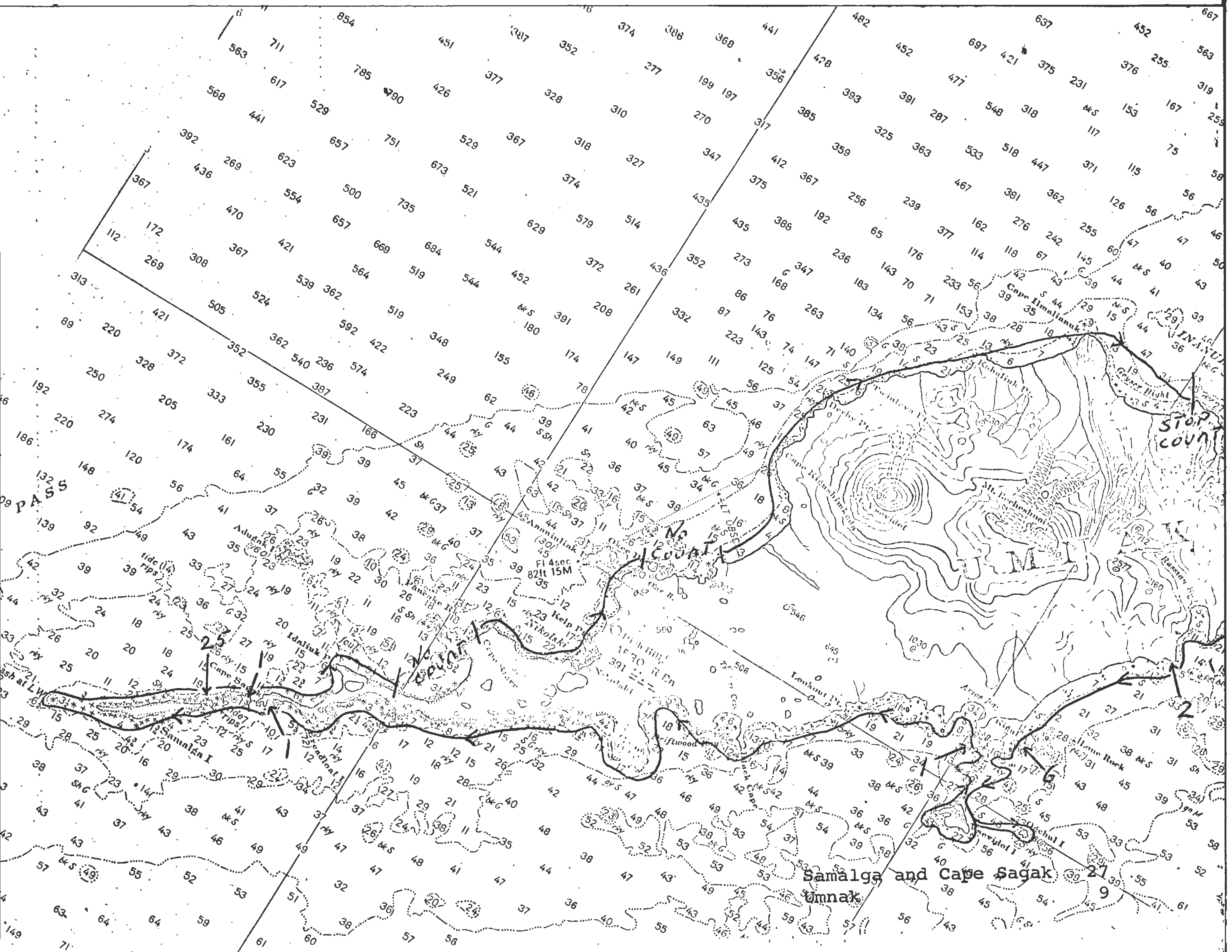
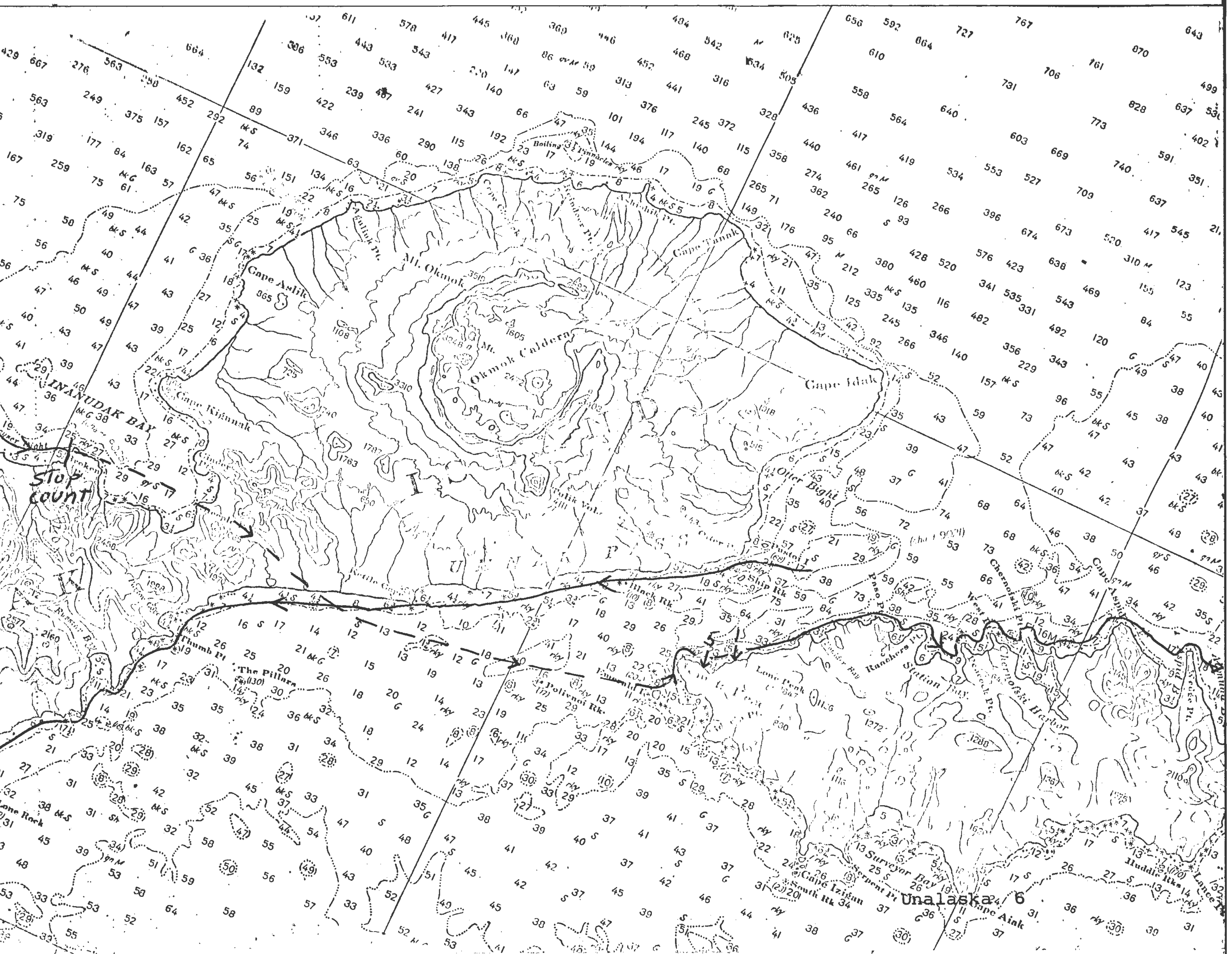
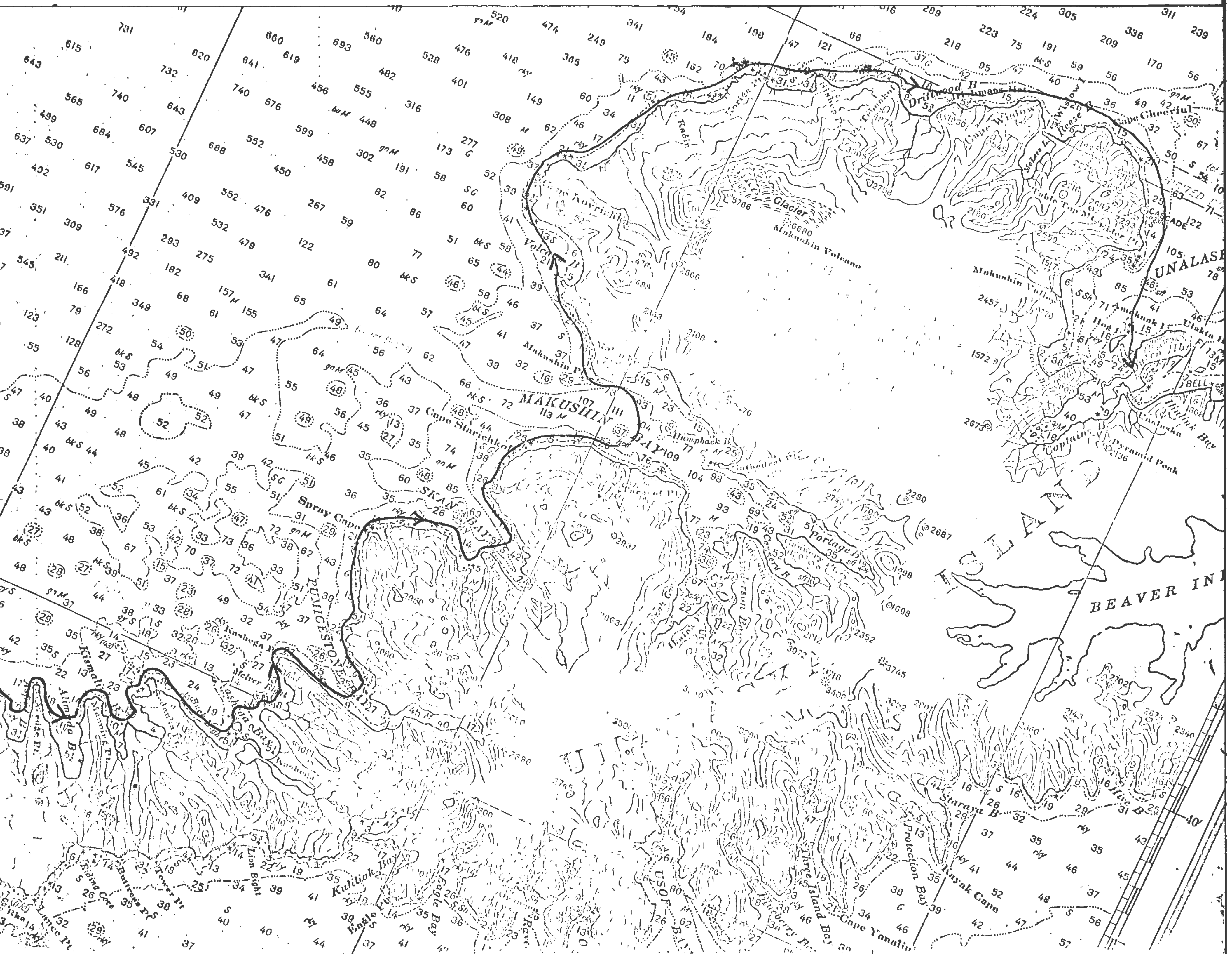
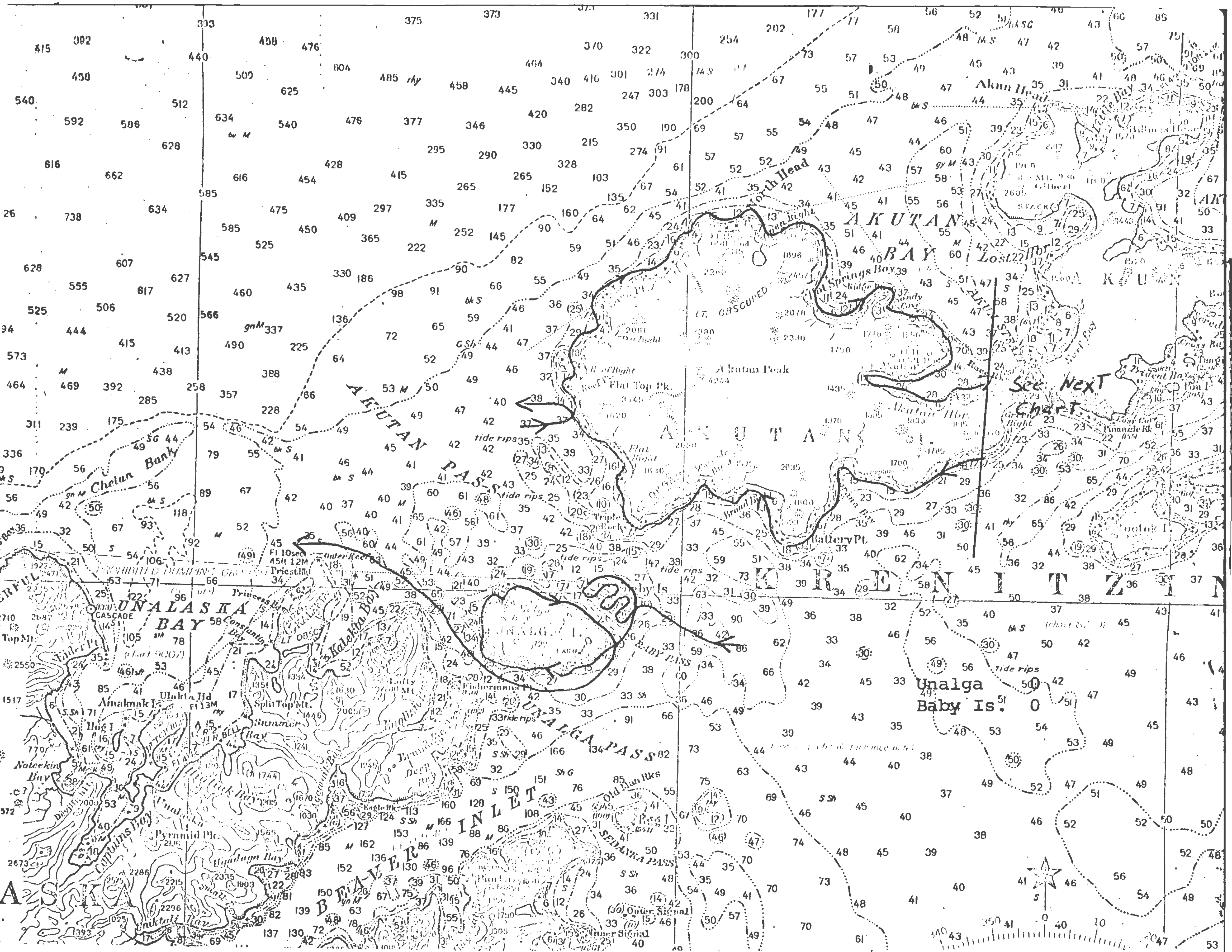
0
ALEUTIAN I
AMUKTA PASS
SEGUAM PASS
Islands of Four Mountains
Amukta
Chagulak I
Yunaska I
Herbert I
Carlisle I
Uliaga I
Kagamil I
Chuginadak I
Seguam I
Finch Cove
Amlia I
Agligadak I
Samalga I
Fl 15sec 65ft 14M
AERO R Bn
(chart 8862)
(chart 8861)
(chart 8860)
53°
172°
VAR 11°45'E (1968)
ANNUAL DECREASE 1'
Var 11°E (1968)
Var 13°E (1968)


PASS
Samalga I
Cape Sagak
Kelp Pt
Lookout Pt
Driftwood Bay
Cape Ilmalianuk
Geyser Bight
Mt. Recheshnoi
Ogchul I
Lone Rock
Fl 4sec 82ft 15M
No COUNT
STOP COUNT
Samalga and Cape Sagak
Umnak
27
9

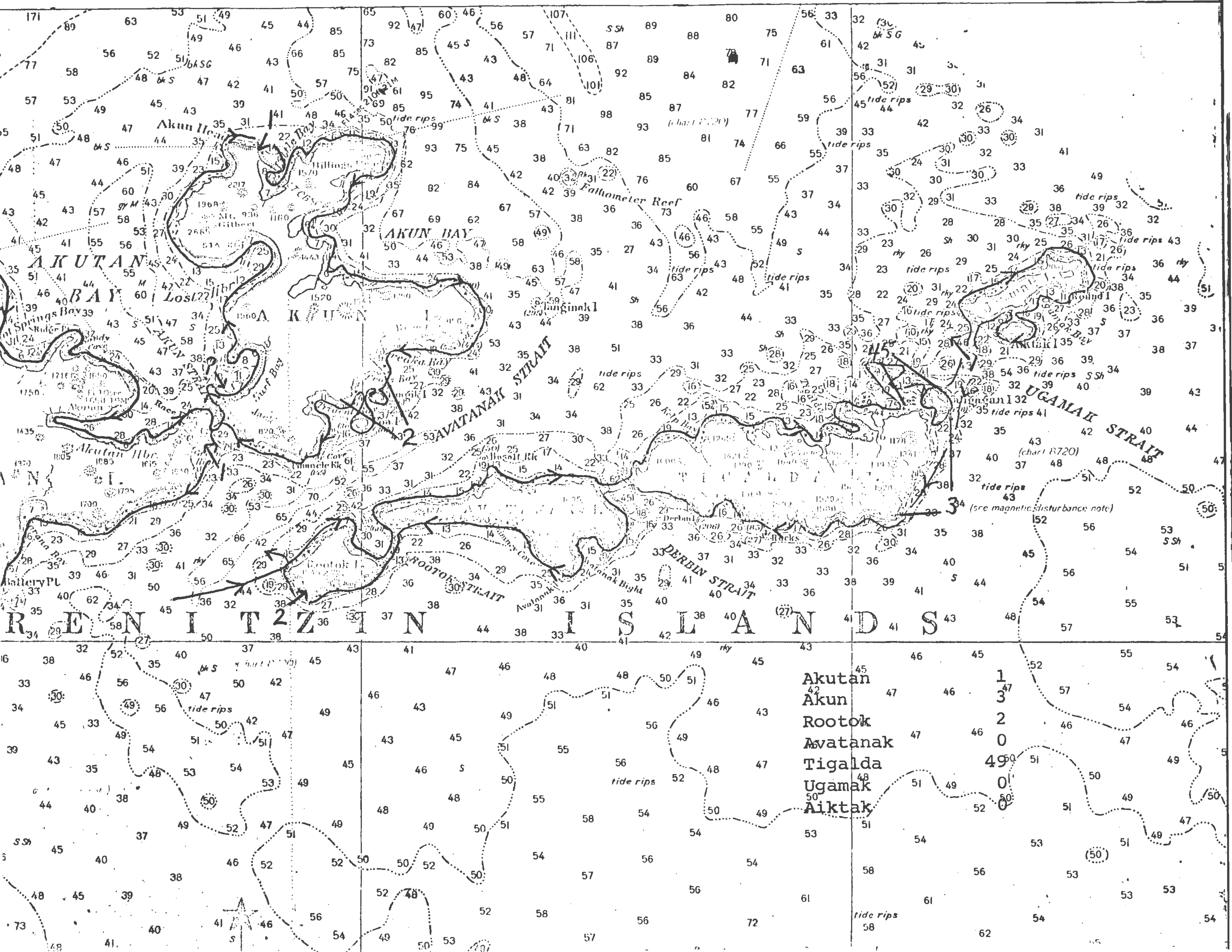


Stop count
INANUDAK BAY
Cape Kigunak
Cape Aslik
Mt. Okmok
Okmok Caldera
Boiling
Pinnacles
Cape Tanak
Cape Idak
Tulik Vol.
Otter Bight
Black Rk
Ship Rk
Thumb Pt
The Pillars
Polivnoi Rk
Lone Peak
Station Bay
Ranchers Pt
Chernofski Harbor
Chernofski Pt
Cape Aspid
Surveyor Bay
Serpent Pt
Cape Izigan
South Rk
Cape Aiak
Huddle Rks
Lone Rock
Unalaska 6

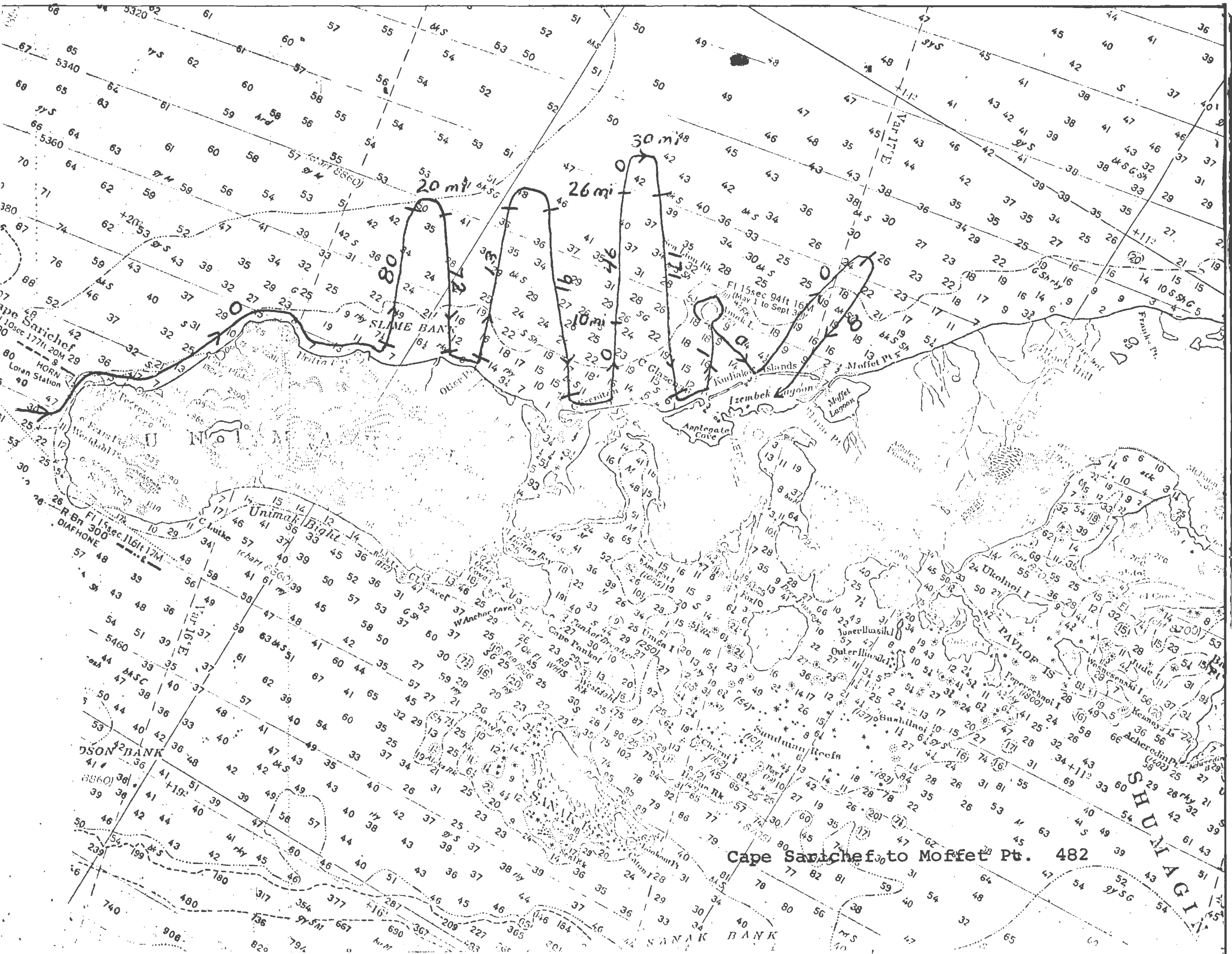

MAKUSHIN BAY
SKAN BAY
PUMICESTONE BAY
BEAVER IN
UNALASE
Makushin Volcano
Glacier
Cape Kovrizhka
Driftwood B.
Cape Cheerful
Reese B.
Makushin Valley
Amaknak I.
Hog I.
Captains Bay
Pyramid Peak
Humpback B.
Portage Bay
Spray Cape
Makushin Pt.
Kashega Pt.
McIver Bight
Staraya B.
Hive B.
Kayak Cape
Protection Bay
Three Island Bay
Kuliliak Bay
Eagle Bay
Eagle Pt.
Lion Bight
Tower Pt.
Buttress Pt.
Riding Cove
Lance Pt.
USOF BAY



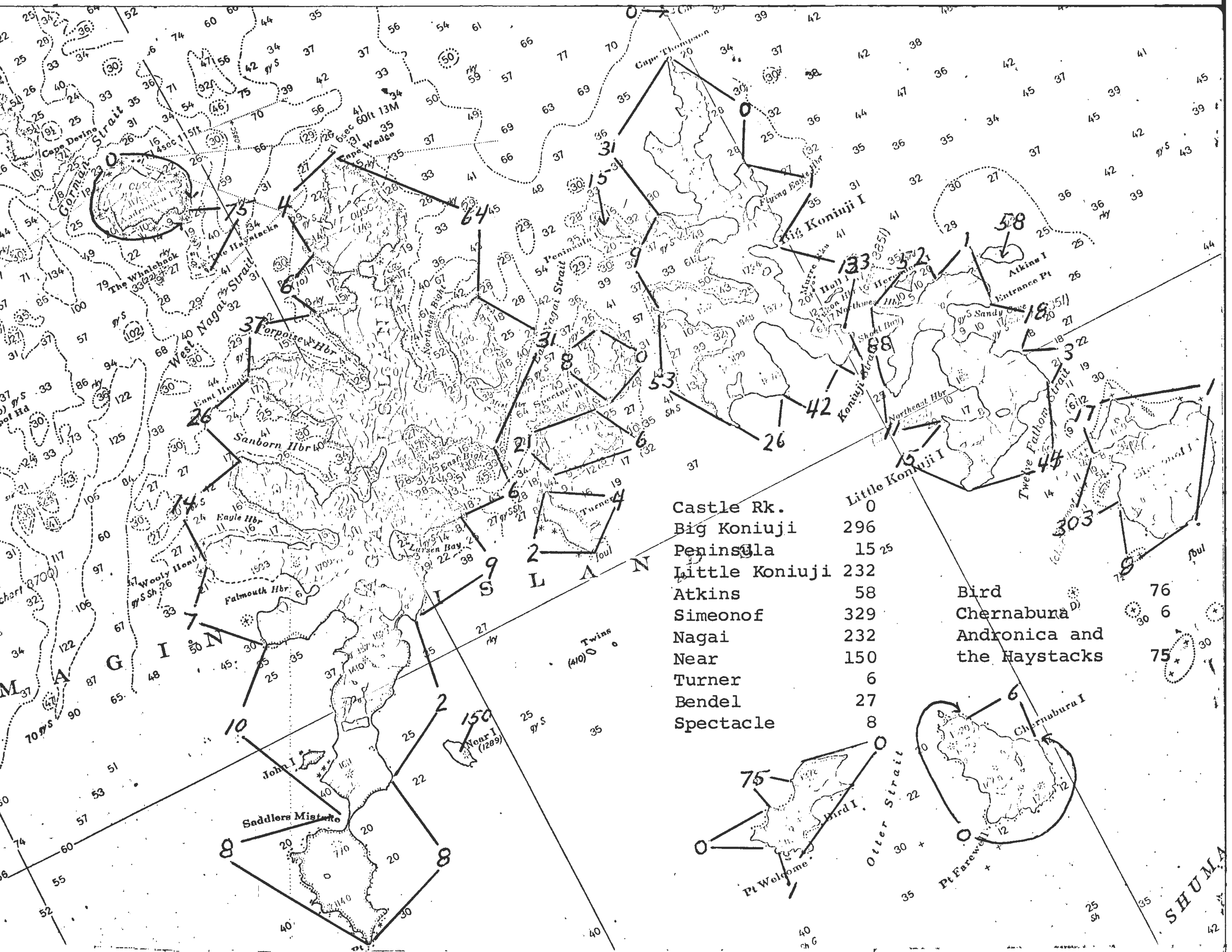
AKUTAN BAY
AKUTAN PASS
AKUTAN I.
Akutan Peak
Flat Top Pk.
North Head
Hot Springs Bay
Akutan Hbr.
Akun Head
Lost Hbr.
Battery Pt.
Triple Rocks
tide rips
Chelan Bank
UNALASKA BAY
Constantine Bay
Kalekta Bay
CASCADE
Top Mt.
Priest Rk
Outer Reef
Ulakta Hd
Amaknak I.
Hog I.
Nateekin Bay
Captains Bay
Summer Bay
Split Top Mt.
Fisherman Pt.
Pyramid Pk.
Ugadaga Bay
UNALGA PASS
BABY PASS
KRENITZIN
BEAVER INLET
SEDANKA PASS
Old Man Rks
Egg I.
Outer Signal
Inner Signal
See Next Chart
Unalga 0
Baby Is. 0



Akutan	1
Akun	3
Rootok	2
Avatanak	0
Tigalda	49
Ugamak	0
Aiktak	0



Cape Sarichef to Moffet Pt. 482
20 mi
26 mi
30 mi
10 mi
SLIME BANK
Unimak Bight
Izembek Lagoon
Moffet Lagoon
Applegate Cove
Kudiakof Islands
Moffet Pt
HORN
Loran Station



Castle Rk. 0
Big Koniuji 296
Peninsula 15
Little Koniuji 232
Atkins 58
Simeonof 329
Nagai 232
Near 150
Turner 6
Bendel 27
Spectacle 8
Bird 76
Chernabura 6
Andronica and the Haystacks 75
Cape Thompson
Big Koniuji I
Flying Eagle Hbr
Atkins I
Entrance Pt
Sandy Cove
Little Koniuji I
Koniuji Strait
Northeast Hbr
Twelve Fathom Strait
Cape Wedge
Cape Devine
Gorman Strait
The Whaleback
The Haystacks
West Nagai Strait
Porpoise Hbr
Sanborn Hbr
Eagle Hbr
Wooly Head
Falmouth Hbr
Northeast Bight
East Bight
Larsen Bay
East Nagai Strait
Peninsula I
Spectacle I
Turner I
Twins
Near I
John I
Saddlers Mistake
Bird I
Pt Welcome
Otter Strait
Chernabura I
Pt Farewell
S H U M A
M A G I N I S L A N

SEA OTTER SURVEY - SITKA TO CAPE SPENCER

June 13 - 19, 1969

On June 13, 1969 an aerial search for sea otters was conducted from Sitka to Torch Bay near Cape Spencer. A Cessna 206 was flown at an altitude of 150 to 200 feet around the outside of Kruzof Island, the Khaz Peninsula, and Yakobi Island. Most small islands and rocks on the outside coast were covered. Observers were Karl Schneider and Jerry Deppa. Visibility was fair with a few good spots. The sky was clear and there was a light chop on the surface of the water. Surface glare was moderate to bad.

Three sea otters were seen on the east side of the Granite Islands nearKhaz Bay and two were seen south of Cape Bingham on Yakobi Island.

Weather prevented a search of the Biorka Island, Heceta Island and Barrier Island release sites.

Between June 15 and June 19, Schneider and Deppa made a trip by skiff from Sitka to Klag Bay and back. Originally it was intended that the entire coast from Sitka to the north end of Yakobi Island would be searched from the skiff. However, fog and rough water limited the effective search to the area between Khaz Point on the west side of the Khaz Peninsula to Cape Edward on Herbert Graves Island.

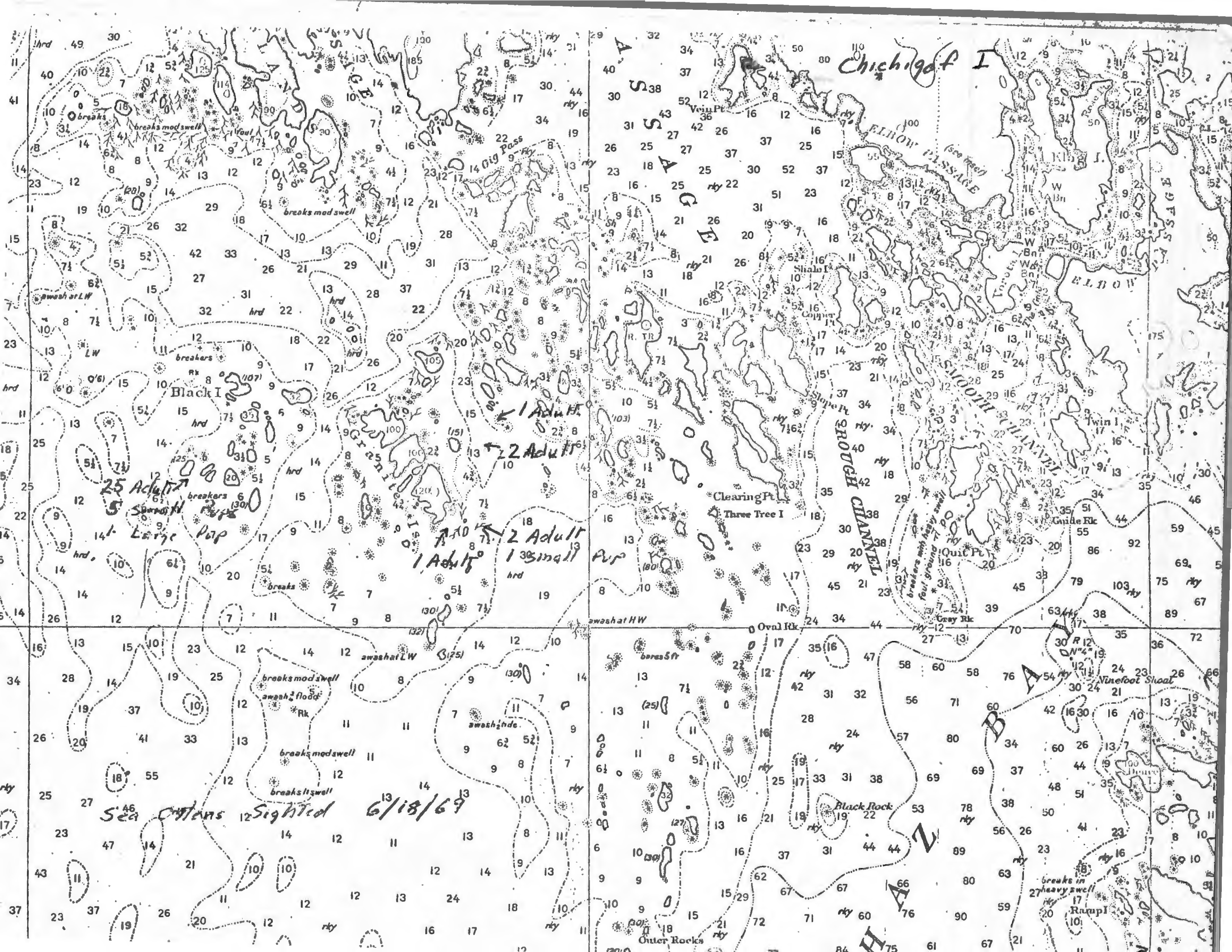
The following sightings of sea otters were made:

6/16 13 (approximately) adults + at least 1 pup in the rocks immediately south of Black Island

6/18 6 adults + 1 small pup scattered around the Granite Islands
25 adults and sub-adults, 5 small pups and 1 large pup in a ~~pool~~ pod south of Black Island
1 adult near Ramp Island on the south side of Khaz Bay

The location of the animals sighted on 6/18/69 are shown on the map. The aerial and surface sightings represent a minimum of 41 animals. These are

Cape Bingham	2 adults
Black I.- Granite I.	31 adults, 7 pups
Ramp I.	1 adult



Chichagof I
ELBOW PASSAGE
Vein Pt
Gig Pass
Shale I
Copper Pt
Slope Pt
SMOOTH CHANNEL
ROUGH CHANNEL
Twin I
Clearing Pt
Three Tree I
Guide Rk
Quiet Pt
Gray Rk
Oval Rk
Ninefoot Shoal
Black Rock
Outer Rocks
Ramp I
Black I
breakers
breaks mod swell
breaks in heavy swell
awash at LW
awash at HW
foul ground
1 Adult
2 Adult
25 Adult
1 Large Pup
2 Adult
1 Small Pup
1 Adult
Sea Otters Sighted 6/18/69

Sea Otter Survey - Klag Bay Area

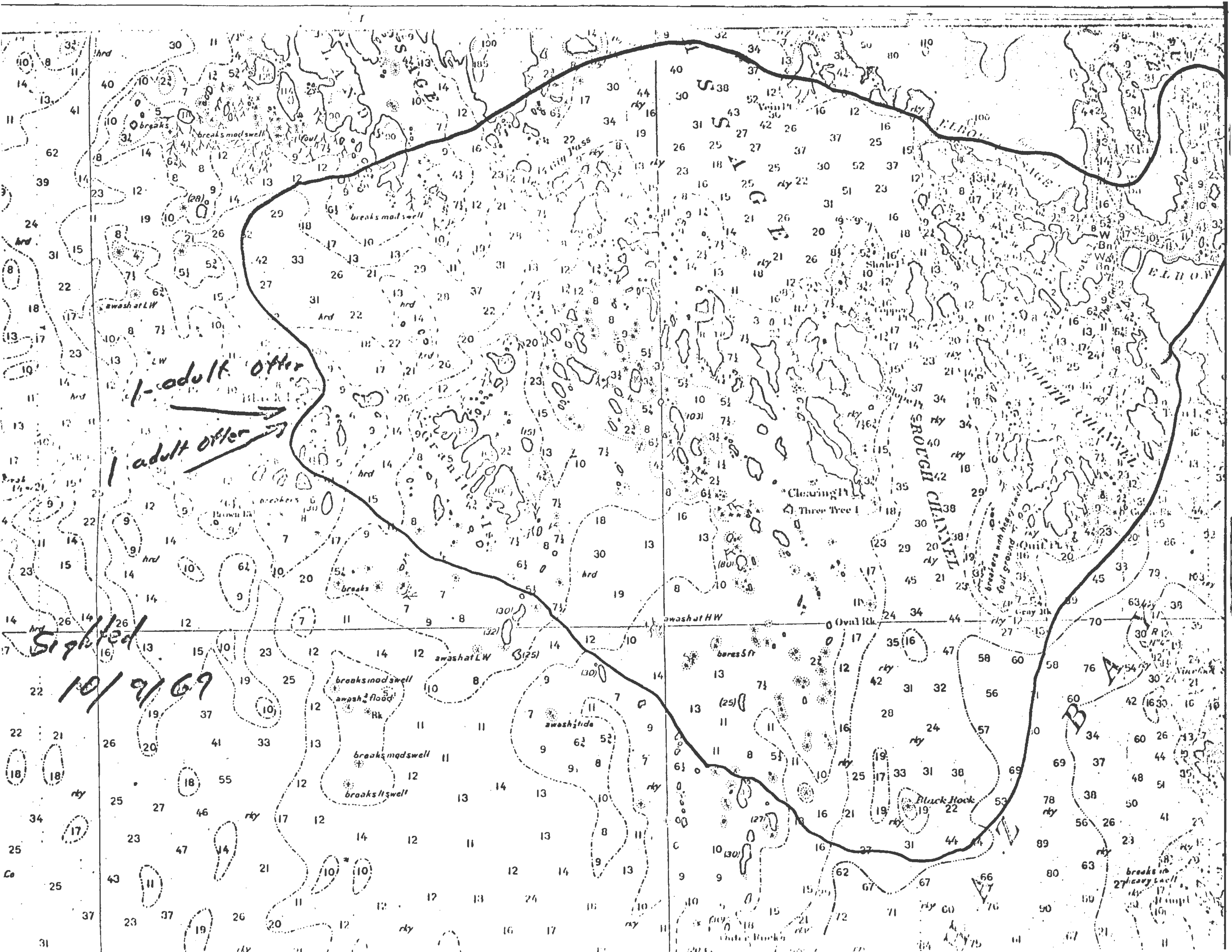
October 8-9, 1969

On October 8 and 9 a search for sea otter was made in the Klag Bay area utilizing a 16 foot skiff. Observers were John Vania and Don Strode. Weather and water conditions were extremely poor. The sky was overcast with low-hanging clouds. There were intermittent rain showers. The sea had very large swells with a bad chop.

Two otter were sighted off Black Island. No other otter were seen. The otter were adults.

The area covered is circled on the attached map.

The survey was very poor because of weather conditions. The results in no way indicate what the true status of the transplanted population is. More surveys under much better conditions will have to be conducted.



1-adult otter
1 adult otter
Sighted
10/9/69
ROUGH CHANNEL
Clearing I
Three Tree I
Oval Rk
Black Rock
awash at HW
awash at LW
breaks mod swell
breaks
hrd
rky

Sea Otters in Yakutat Bay

In 1966, 10 sea otters were released in Yakutat Bay. Since that time, there have been one or two uncomfirmed reports of sea otters there, however, no surveys have been made in the area.

Walter Puckett, a guide, reported seeing the following between October 1 - 8, 1969:

South of Knight I	6 or 7 in a group
East of Dolgoi I	4 or 5
Haenke I	"several"
Total	about 15

He had more sightings, but believes he saw the same individuals. There were about 15 different individuals. He has seen about 4 or 5 a year for the last 3 years, but never saw any before that. These reports were not confirmed, but his descriptions were accurate and he has seen sea otters before near Montague Island in Prince William Sound.

FORM FG-74
(REV. 2-67)

MEMORANDUM

State of Alaska

DEPARTMENT OF FISH AND GAME

TO: Karl Schneider
Game Biologist
Anchorage

FILE NO:

DATE: May 23, 1969

FROM: James Faro
Game Biologist
Anchorage

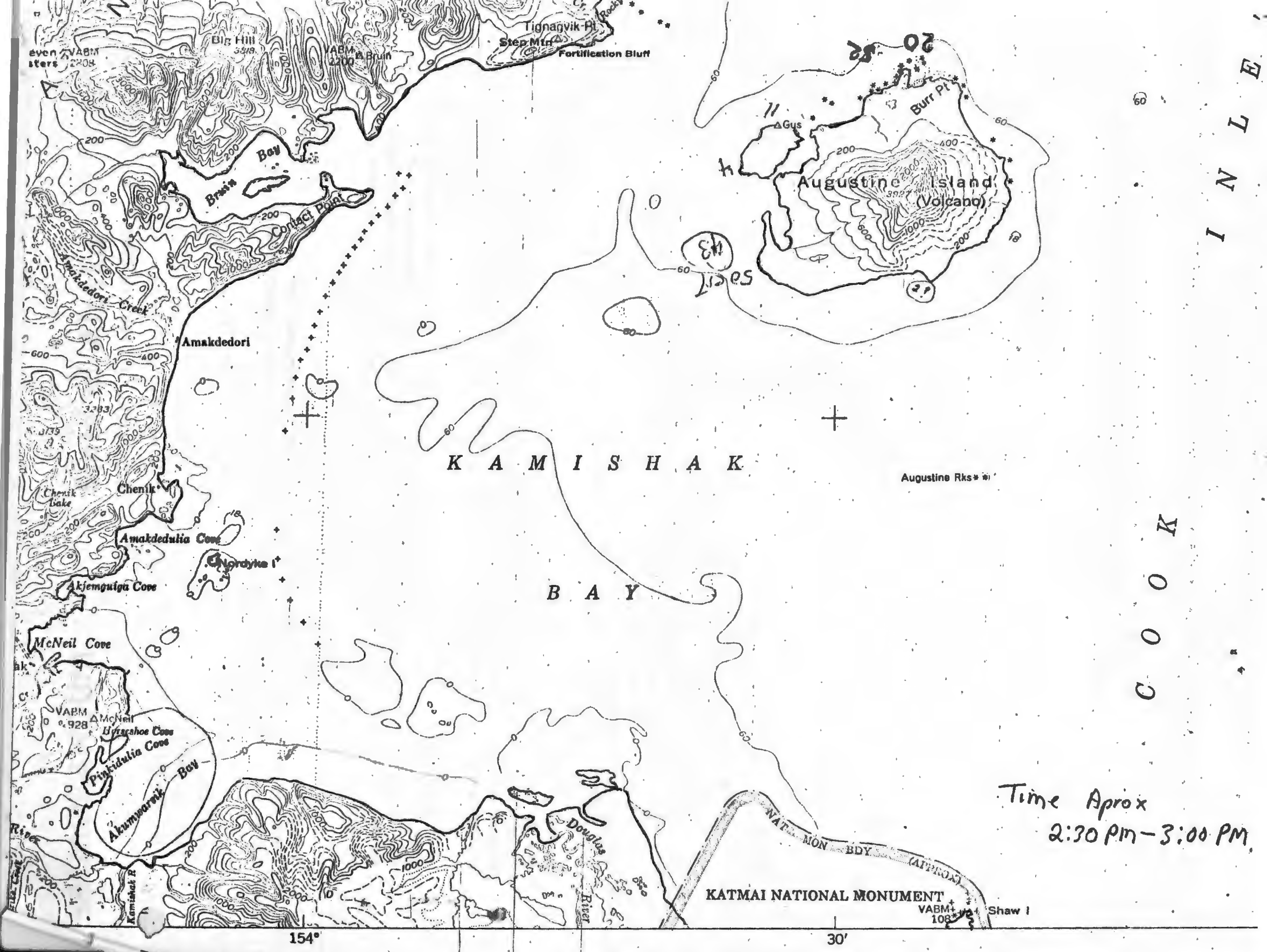
SUBJECT: Survey of Augustine Island - Kamishak Bay

No sign of oil pollution was observed during a reconniassance flight made to Augustine Island - Kamishak Bay on May 22. Sea birds, ducks, and seals were common and no sign of recent mortality or oil stains were observed on the beaches. Unfortunatly because of the low tidal conditions we were unable to land for closer inspection.

Although conditions for a count were not ideal, I personally tallied 130 sea otters off the western half of Augustine Island. A probable two additional otters were observed off the eastern half. The above figure is minimal as additional otters were reported by the pilot that I did not observe. Conditions of the count were:

Date: May 22, 1969
Type of Aircraft: Cessna 180 on floats
Pilot: Jack Lee
Wind: Southeast, light
Sky: High broken overcast
Sea: Light chop and swell, occasional white cap
Glare: Moderate
Time: Approximately 2:30-3:00 PM
Observers: Faro and Divinyi

JF:dxg



Tignagvik Pt
Step Mtn
Fortification Bluff
Big Hill
VABM 2200
Bruin
Bruin Bay
Contact Point
Amakdedori Creek
Amakdedori
Chenik
Chenik Lake
Amakdedulia Cove
Nordyke I
Akjemguiga Cove
McNeil Cove
VABM 928
McNeil
Horseshoe Cove
Pinkidulia Cove
Akumwarvik Bay
Kamishak R
Douglas River
KAMISHAK BAY
Augustine Island (Volcano)
Gus
Burr Pt
Augustine Rks
COOK INLET
NAT MON BDY (APPROX)
KATMAI NATIONAL MONUMENT
VABM 108
Shaw I
154°
30′
Time Aprox
2:30 PM-3:00 PM

Harvests And Transplants

No sea otter harvest was conducted in 1969. However, a total of 251 animals was removed from Amchitka. Fifty-eight of these were transplanted to Khaz Bay on Chichigof Island, 29 to British Columbia, 29 to Washington and 4 to the Tacoma Zoo. One hundred and seventeen died during the transplant and 14 died during Battelle Memorial Institute's studies associated with the nuclear test "Milrow".

Table 1 summarizes the number of sea otters removed from various populations from 1951 to 1969. This includes all animals legally removed dead or alive by the USFWS, ADF&G and valid permit holders. It does not include illegal kills which are not known to exceed more than a few animals at any time or place nor does it include beach dead animals.

The numbers on Table 1 do not always agree with harvest numbers listed in previous reports. These other numbers are numbers of pelts obtained. Some are beach dead animals and some small pup pelts were worthless and were not saved.

Table 2 summarizes the numbers of sea otters transplanted to various areas. This includes all transplant attempts up to 1969 regardless of their success.

A total of 961 sea otters were removed from Amchitka between 1967 and 1969. This is an average of 320 per year which may represent a 10 percent annual removal. However, it should be noted that virtually all sea otters removed from Amchitka since 1951 have come from the southeastern half of the island. A very high percentage of these came from the area between Ivakin Point and Crown Reefer Point. In 1969, there were noticeably fewer sea otters in this area, however, they continued to be abundant elsewhere.

Table 1. Numbers of Sea Otters Removed from Alaskan Populations 1951-1969[1].

		1951	54	55	56	57	59	60	62	63	65	66	67	68	69
Amchitka Is.	USFWS Studies	35	22	37	26	21	39				2				
	ADF&G Transplant													476	237
	ADF&G Harvest								180	311			205		
	Other												5[2]	24[3]	14[3]
	Total	35	22	37	26	21	39		180	311			210	500	251
Kanaga Is.	ADF&G Harvest													318	
Adak Is.	ADF&G Harvest												300	194	
Shumagin Is., Sanak & Unimak Is.	USFWS Studies							14						2	
Hinchinbrook Is.	ADF&G Transplant										41				
	ADF&G Studies													1	
Montague & Green Is.	ADF&G Transplant											39			
	ADF&G Studies													1	

1. Includes all animals that were harvested, died during studies and transplant attempts or were transplanted to other areas or zoos. Does not include natural mortality or illegal kills.

2. Woodland Park Zoo.

3. Battelle Memorial Instutute.

Table 2. Numbers of Sea Otters Transplanted 1955-1969.

		1955	1956	1959	1965	1966	1968	1969
Aleutians	Attu I.		5					
Pribilofs	Otter I.	19[1]						
	St. Paul I.			7				
	St. George I.						57	
Southeast Alaska	Yakutat Bay					10		
	Khaz Bay (Chichigof I.)				23	20	93	58
	Yakobi I.						30	
	Biorka I.						48	
	Barrier Is.						55	
	Heceta I.						51	
	Cape Spencer						25	
British Columbia								29
Washington								29[2]

1. None believed to have survived.

2. At least 13 died shortly after release.

Note: 1955 to 1959 by USFWS, 1965 to 1969 by ADF&G. In some cases one or two of the above animals died near the time of release.

SEA OTTER AGE DETERMINATION

(Methods and Interpretation used on 1967 and 1968 Teeth)

December 29, 1969

METHODS

Some layering can be found in the cementum of all sea otter teeth. The upper I_3 and upper and lower PM_1 have the most distinct and regular layers. The lower PM_1 is usually the best, particularly for locating the first two or three layers near the root tip. Longitudinal sections from the center of the tooth are best as it is often necessary to look at the entire rooth from gum to root tip. Sections cut at an angle or away from the center of the tooth have less distinct layers.

Geismsa's stain is usually better than hematoxylin or Paragon Multiple Stain for Frozen Sections. It produces a lighter background with sharper lines. It is often advantageous to have several sections stained to different degrees.

Formic and nitric acids were tried for decalcification of the teeth but 3% HCl proved to be the most satisfactory. Sections stored in 1% formalin produced poorer slides than those stored in Loess' solution.

Whole, undecalcified teeth should be stored in Loess' solution to prevent drying of the cementum which produces dark edges when stained.

Teeth pulled from raw skulls seemed to produce sharper lines and the edges were definitely easier to read than those pulled after the skull was cooked. It may be difficult to pull teeth from adult jaws without breaking the root. If they are allowed to rot for several days, most teeth will come out easily. On older animals, it is necessary to chip bone away from the tooth to prevent breaking the bulb-like tip of the root which is important for reading the tooth.

Sections are read with a variable-power, stereo scope. The sections are scanned at 40 to 60 X, then more readable areas are selected and examined under 100 to 120 X. Varying the magnification and light intensity help. Often it is easier to separate major lines from intermediate lines at a lower power ans subdued light. A fluorescent illuminator produces a soft uniform light that makes sections easier to read.

It is important to count layers at different places on the tooth (Fig. 8, 9, 10). Near the gum line (Section A, Fig. 7-8) the cementum appears dense and layers tend to be very even and regular. However, on some teeth, there are many intermediate lines which may be impossible to separate from major lines. The first one or two lines may blend with the interphase. On older animals (eg. 8+), the outer layers may not be laid down this high on the tooth (Fig. 13). However, this area often provides a good check to compare with other areas and on some teeth it is the only place where distinct layers can be seen.

The sides of the root (Section B, Fig. 7, 8, 9, 11, etc.) vary considerably, some lines may not be distinct. Occasionally, very sharp, regular lines can be seen and it appears that the precise age can be determined. However careful examination of other areas may turn up more outer layers. Some inner lines may disappear in this area (Fig. 6).

The best area to count is usually the area near the tip of the dentine where the tooth curves in before forming the bulb of cementum at the tip (Section C, Fig. 7, 10, & 12). This is most pronounced on the anterior side of the section (directly below the cusp of the tooth). At this point the layers fan out and are easier to distinguish. It is the best and often only point at which the first two or three layers can be sorted out. It is also often the only area where outer layers on animals over 10 can be found.

The layers in the bulb at the root tip (Section D, Fig. 7) are not sharp. However, broad bands are laid down and it is often possible to check the count from another area against the alternating lighter and darker bands found here.

INTERPRETATION

With light transmitted through the section from below there are fine dark lines separated by broad light bands. For the purpose of counting, each dark line is considered to be one year. There is an area of doubt here because the first line is not necessarily laid down when the animal is one year old. The width of the band before line one varies (Figs. 1 and 2). Because the animal may have been born at any time of year, a possible error of several months may occur here.

On younger animals (less than 5 or 6) a band at the outer edge beyond the last line was often written as a + indicating that the final year was not yet complete (Figs. 8-10). On older animals where layers are narrow the outer edge was counted as the last year.

Some lines may not be sharp enough to be counted. Cementum may not be deposited in thick enough layers after 10 years or so to be counted. Intermediate lines may be counted inadvertantly.

The exact age can seldom be set with certainty. For many purposes it will be necessary to lump animals into age groups. For example, the uncertainty of counting outer layers may require lumping all animals 10 or over even though many can be set at older ages with certainty.

The following is a description and interpretation of each line.

Line 1: This line may blend in with the interphase on the sides of the tooth (Fig. 4). It is easiest to see around the tip of the root (Figs. 1-2). A considerable amount of cementum is laid down in the "bulb" and the first line is sharpest just above the bulb. This is usually easy to see on lower PM_1 but difficult on other teeth. In some cases, there is no sharp line, only a slight change in coloration (density?) of the cementum.

Line 2: The band between 1 and 2 is usually broader than between the interphase and 1. Line 2 is seldom sharp (Fig. 4) and is often visible in only one or two places. In some cases it may be necessary to assume the existance of line 2 on the basis of the pattern of other lines and the width of the light band after line 1 (Fig. 3).

Line 3: The band between 2 and 3 is usually about the same width as between 1 and 2 (Fig. 4), but may have many fine irregular lines in it. Line 3 may be faint and mixed in with irregular lines and the 4th line will be the first sharp line (associated with sexual maturity ?).

Line 4: Sometimes the first sharp line. The band between 3 and 4 is usually similar in width to subsequent bands and thinner than the previous two bands. The cementum often appears denser beyond line 3. The spacing from 4 to line 8 or 10 (occasionally farther) is fairly regular and the lines are fairly sharp. However, some lines will be sharper than others, some will run together in places (Fig. 6) and some may be double lines (Fig. 14).

Lines 8 or 10+: Usually around line 10 the lines may become irregular and only visible in a few points. Apparently less cementum is deposited after this. In some cases the 10th line may actually represent several years. There are exceptions when there is an actual increase in cementum deposition and broad irregular bands are formed. Most of the teeth which have been read to 15 or more are of this type. Normally, it is rare to be able to distinguish more than 12 to 14 lines. Ages of 10 and above should be considered minimal.

DECALCIFICATION, SECTIONING AND STAINING OF SEA OTTER TEETH

Upper I_3 or PM_1, or lower PM_1, decalcified in 3% HCl until soft. Time required for sufficient decalcification will depend on volume of acid used, number of teeth decalcified in this volume, temperature, and size and "age" of tooth. When 50 teeth were placed in individual capsules and decalcified in approximately 1 liter of acid solution incisors softened after 18 to 24 hours and premolars after 8-24 hours. Teeth were rinsed for a minimum of half day in constant exchange of tap water and then stored in water in refrigerator.

Attempt was made to section teeth directly after water rinse. If teeth must be stored for longer periods before sectioning, Loess' solution was found to be the most acceptable preservative. Teeth in Loess' solution must be soaked in water prior to sectioning to avoid incomplete freezing in cryostat.

Longitudinal sections 32 microns thick are cut on IEC cryostat at -14° C. These sections may be stained immediately or placed in Loess' solution for future use. Incisor crowns were trimmed before sectioning. Premolars were sliced untrimmed.

Working solution of Giemsa stain is made up in small amounts and discarded when signs of heavy precipitation occur (usually after 30 minutes). For 25cc of working stain:

23.5cc distilled HOH

1.0cc Giemsa buffer solution pH 6.5 (Paragon) (PO_4 buffer ?) (Giemsa buffer pH 6.8 also usable)

0.5cc Giemsa stock stain (Paragon)

Small amounts of stain (approximately 5cc) poured in small Petrie dish. Tooth sections taken out of Loess' solution, rinsed in HOH, and placed in covered staining dish for 10-12 minutes. Sections taken out of stain, rinsed off quickly in water and placed on slide for viewing. Slide is then air dried vertically for 16-18 hours. Slides are then placed in Copeland jar containing xylene for final dehydration and clearing, after which they are dried with Kim Wipes, Permounted and protected with a coverslip.

AGE STRUCTURE

1968 Harvest

The age structure of the 1968 harvest is presented by area and sex in Figs. 1 and 2. Pups less than 1 year old were handled separately and are not presented here. In many cases, a possible error of a year or two exists in the estimation of age. The tendency is probably to underestimate the age of older animals.

From Fig. 1 there appears to be a relatively even distribution of ages of females. The distribution probably is typical of an unhunted population with a low rate of natural mortality other than that associated with age. Natural mortality in the first year of life would not be visible on these graphs.

The age structure of males (Fig. 2) brings up some interesting points. All the males in the Adak samples are between 7 and 14 years old. There were also a number in their first year of life which are not shown here. This illustrates the geographical segregation of certain sex and age classes.

Geographical Segregation of Sex and Age Classes

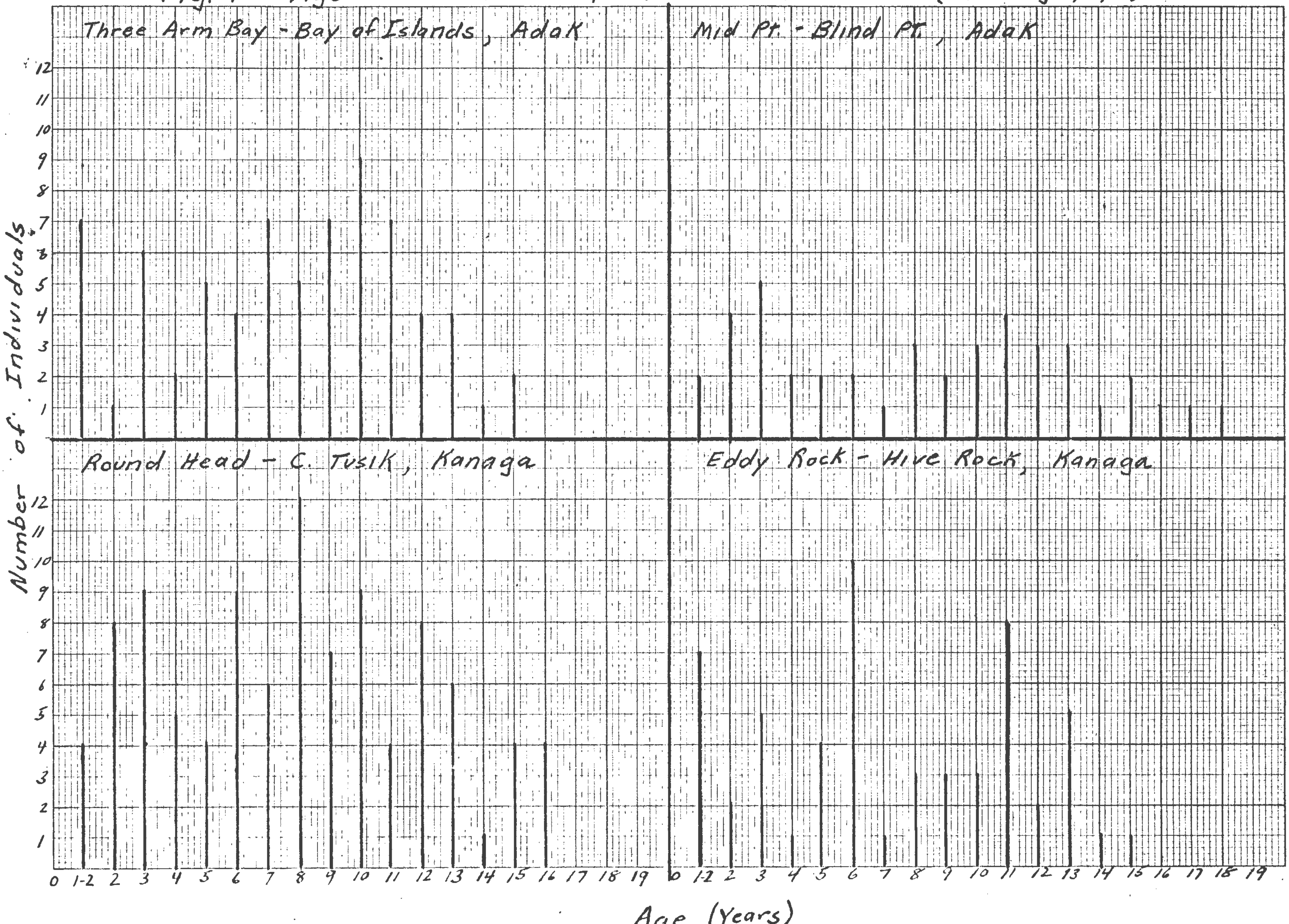
Both areas on Adak are so called "female areas". Once males are weaned they apparently leave these female areas and only return to breed. The information would imply that males are not sexually mature until seven years of age. The possibility that they are capable of breeding before that age, but are unable to compete with older animals should be investigated. Sea otters rarely fight in the wild, however, a large male in the Tacoma Zoo regularly harassed a young male in the presence of three females. Whether such competition is responsible for keeping younger males out of the female areas or whether other, less crowded areas are simply more attractive is not known. One would expect competition for food to be greater in the heavily populated female areas.

The Kanaga samples are from larger sections of the island including female areas and those that are male or "single animal" areas. These latter areas tend to be off-shore particularly off major points and in passes between islands. Females without pups as well as males are found in these areas. A particularly large percentage of young males was found in Kanaga Pass. These are included in the Eddy Rock to Hive Rock sample.

Male areas are often mentioned and large pods of sea otters without any pups are often considered to be all males. After harvesting and netting sea otters on a number of islands, it appears that these groups are usually at least half females which do not happen to have pups. Only a few very restricted areas are almost all male areas. There are usually well off the tips of major points. They are very few in number and very restricted in extent.

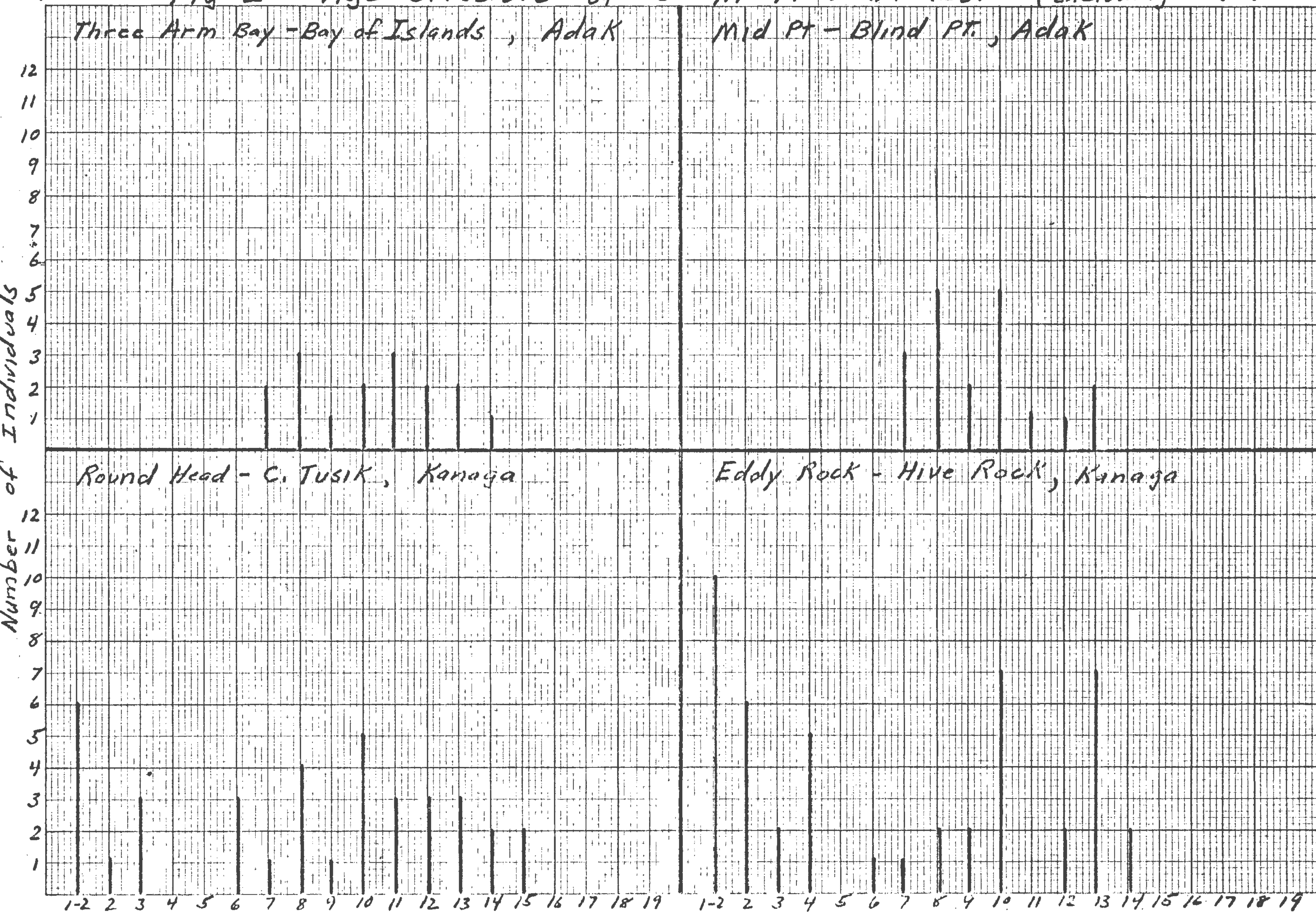
Some small sections of beach appear to be male hauling areas, however, many animals in the water near these hauling areas are females.

Fig. 1 Age Structure of ♀ in 1968 Harvest (excluding pups)



VERNON ROYAL LINE R 2470-20 20 Squares to the inch

Fig 2 Age Structure of ♂ in 1968 Harvest (excluding Pups)



Age (Years)

In summary, "female areas" are usually more protected areas where females with pups tend to congregate. These are important breeding areas and large males enter these areas for breeding. Young males and some females without pups tend to move out into more exposed areas presumably where food is more available.

Adult males may have a seasonal fluctuation in sperm production and leave the female areas when sperm production is reduced, or sperm production may be relatively constant and certain individuals may remain in these areas all year. Presumably, some breeding activity takes place in all areas, so it would not be necessary for males to enter "female areas" for opportunities to mate. However, the opportunities to mate are probably greater in major female areas, particularly if females tend to wean their pup then mate again before moving out of these areas.

The marked segregation of males in the Adak samples suggests that some form of territoriality may exist among breeding males. If territoriality does exist it may be flexible and other breeding age males may be tolerated.

In order to determine these things, it will be necessary to examine the testes of males and note the location where all types of animals are collected more precisely than has been done in the past.

The segregation of sex and age classes is certainly not a total thing. It appears to be greatest where geographical boundaries such as bays, points and kelp beds are well defined. Females with pups are found off-shore particularly in good weather. Stretches of relatively even shore line with no deep bays may have certain areas where a particular type of animal is found, but the segregation is not as pronounced as in areas such as the Bay of Islands.

<u>1968 Transplant</u>
Fig. 3 presents the ages of the sea otters that died during transplant activities. There is a fairly heavy mortality among animals of both sexes less than 2 years old. Dependent pups are not caught as often as might be expected and the numbers that died were a fairly large percentage of those caught. Yearling otter may be more susceptible to capture so the large number that dies may not be entirely due to an inability to withstand handling.

Other than the younger animals there doesn't seem to be any indication of a greater susceptibility of any age group to injury and death due to handling of the females.

The age distribution of males is curious in that no animals over 9 years old died. There are several possible reasons for this distribution of ages. First it may be a result of the small sample and tooth reading technique. Outer cementum layers are not always visible and several of the 9 year olds may actually be older. Second, relatively few large males are caught in nets. The technique may be selective for younger animals.

VERNON ROYAL LINE R 2470-20 MADE IN U.S.A. 20 Squares to the inch

Fig. 3 Age Structure of 1968 Amchitka Transplant Mortality

Longevity

The age distribution in Figs. 1, 2 and 3 indicates that females regularly live to be 15 years old and individuals may approach 20 years. No males were believed to be over 15 years old. Females may tend to live longer than males, but it is possible that a larger sample would turn up older males. Another possibility is that older males may cease to breed as a result of physiological changes or an inability to compete with younger animals. These older males might then tend to move to areas which are less populated and be less susceptible to hunting or netting.

GROWTH

The growth information discussed here is presented in Figures 1-20. This information has not been analysed completely and the discussion is based on general observations on the graphs.

Weight - Female The growth curves for Amchitka, Kanaga and the west side of Adak (Figures 1, 3, 4, and 5) are all quite similar. They increase rapidly for the first two years then gradually until age five or six where it levels off at an average of about 45 lbs. There is gradual increase to an average of 50 to 55 lbs. at age 12 or 13 then there appears to be a slight decline.

The weight curve of the females on the east side of Adak (Figure 2) is quite different. The weight increases rapidly to well over 50 lbs. at age three then levels around 55 lbs. by age five. There appears to be a gradual decline after that. The apparent decline is probably deceiving. This area was relatively unpopulated until 1965. Sea otters older than 8 or 9 probably moved into the area from heavily populated areas on the other side of the island. These animals went through the main period of growth under greater competition for food. The younger animals were probably born in the area and have h d abundant food since birth.

The other samples (Figures 1, 3, 4, and 5) are from areas that have supported large populations for many years.

The rate of growth appears to be much greater under better habitat conditions. The maximum size may be greater, but in females this difference is not as striking as the increased rate of growth.

Weight - Male The weight curves of males (Figures 6 - 10) are of a different shape than those of females. Males continue to gain weight at a comparatively rapid rate which is almost linear. There is little sign of leveling off until age 12. Because the curves are almost linear differences in the average maximum weight for each area reflect difference in growth rates. At the west end of Kanaga average males reach about 65 lbs. (Figure 9). The growth at Amchitka is similar but the sample lacks older animals (Figure 10). Males on the east side of Kanaga and west side of Adak are larger, about 75 lbs. (Figure 6 and 8). Those on the east side of Adak are the largest, averaging about 85 lbs. (Figure 7). These differences are consistent with the past history of the areas. Males in areas which have supported large populations longer are a full 20 lbs. lighter than those from recently populated areas.

Total Length - Females The total length curves for females (Figures 11-15) are similar to the weight curves except that the leveling off is more abrupt and only a slight increase in length occurs after this point. The differences between areas are similar to those reflected in weights. Females from Amchitka and western Kanaga (Figures 14 and 15) level off at 6 years of age at a length of approximately 128 cm. Females from eastern Kanaga and western Adak (Figures 11 and 13) begin to level off around 6 years but the length continues to increase to an average of about 135 cm. Those on the eastern side of Adak (Figure 12) grow more rapidly and level off at about 135 cm. at an age of 3 to 4 years. Again the older animals probably came from other areas and the younger animals may eventually become larger.

Total Length - Males The differences in total lengths of males (Figures 16-20) again reflect the differences between areas although the differences are less than found in the weight curves. Males reach their full length at 6 to 8 years, probably slightly sooner on the west side of Adak (Figure 17) however, the growth part of this curve is missing. Again Amchitka and western Kanaga animals are smaller (140 cm) while those in the other areas are progressively larger from west to east.

Use of Growth Curves Total length and weight curves appear to reflect differences in habitat quality. This is probably due to differences in food availability and quality. Because of these differences, length and weight may be useful as management tools to determine the status of a population.

Other measurements, such as long bone size, skull measurements, etc., should be investigated for this purpose.

UNIVERSITY BOOKSTORES GRAPH NO. 4 UNIVERSITY OF MINNESOTA

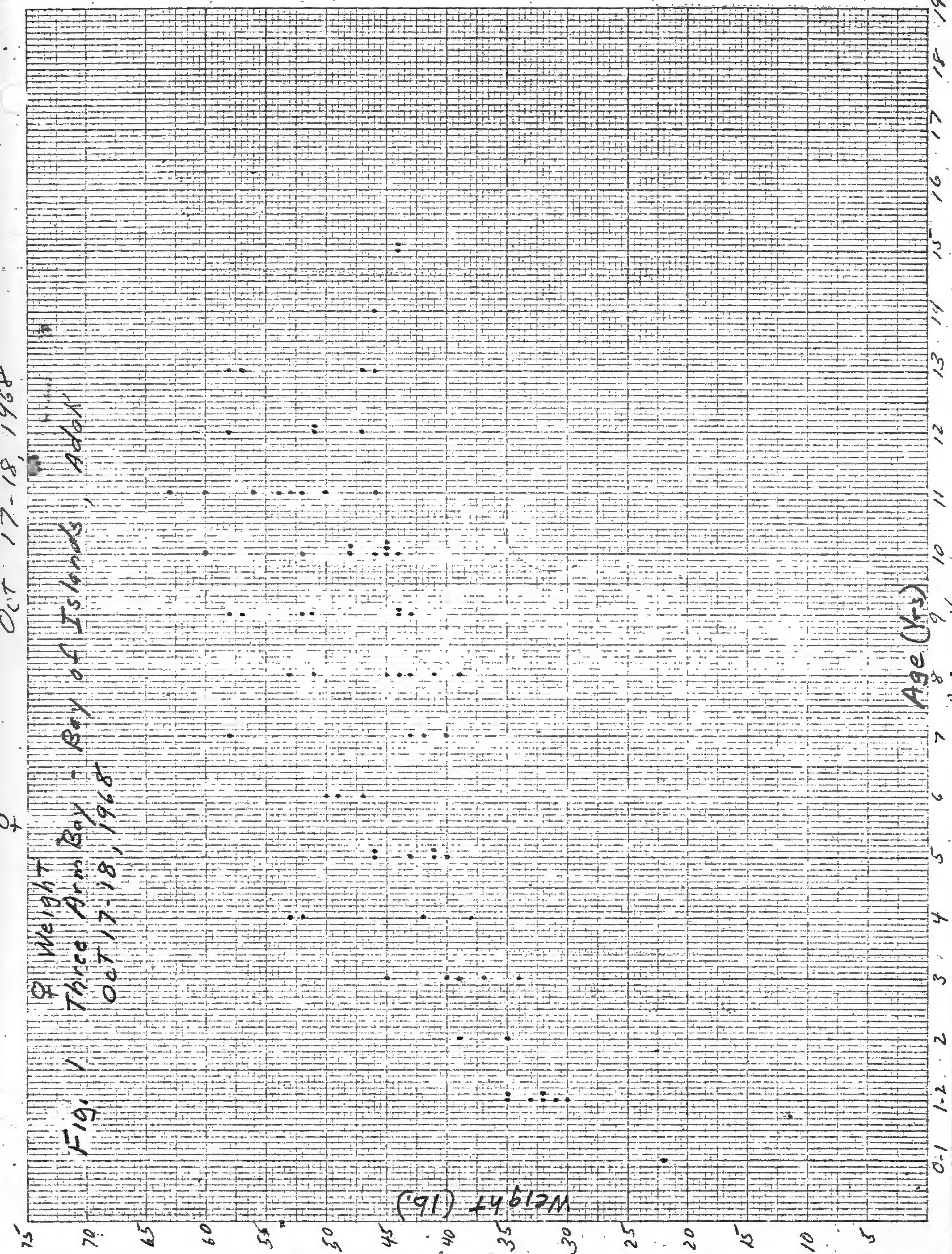


Fig. 1 ♀ Weight Three Arm Bay - Bay of Islands, Oct 17-18, 1968

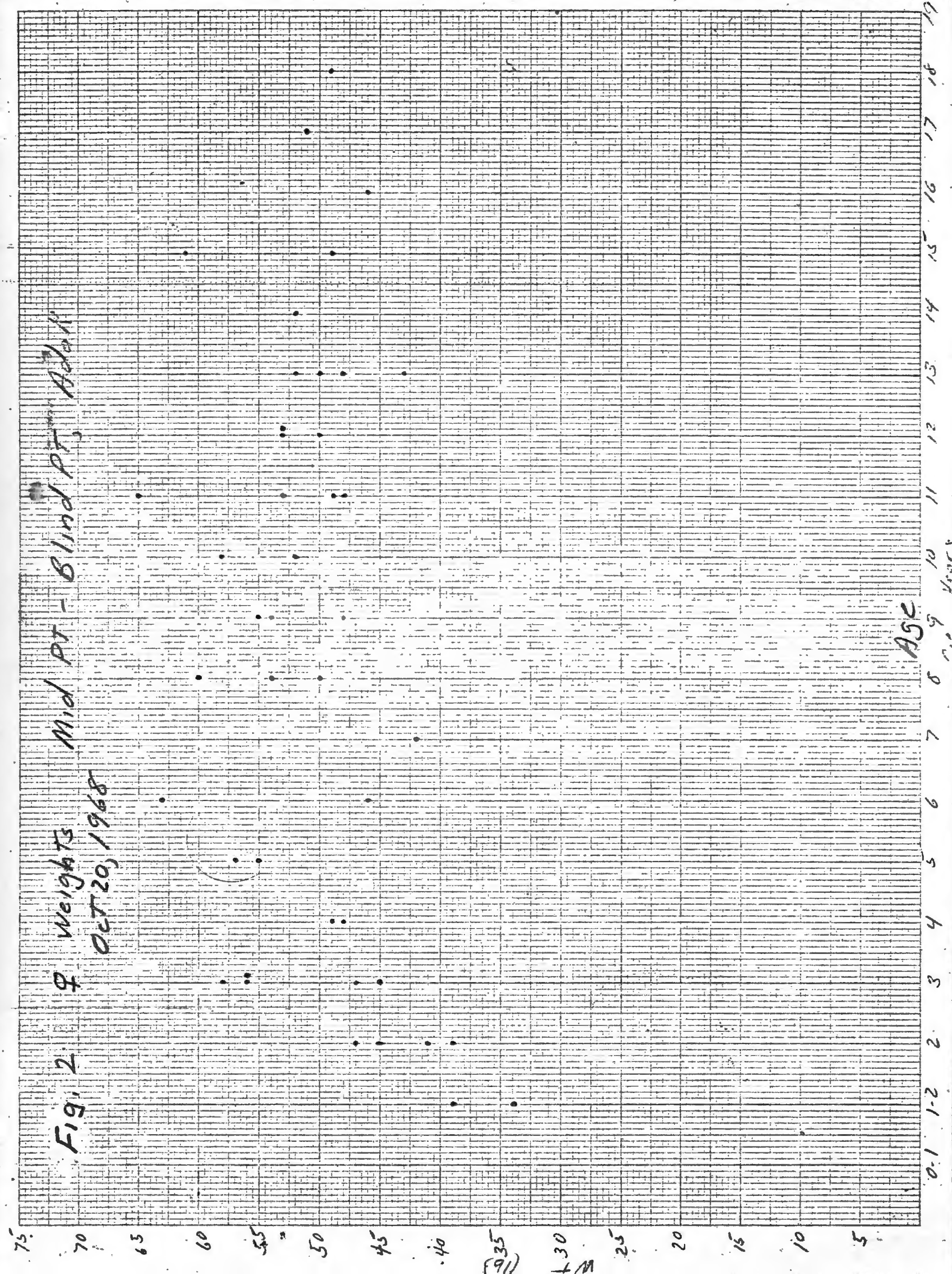
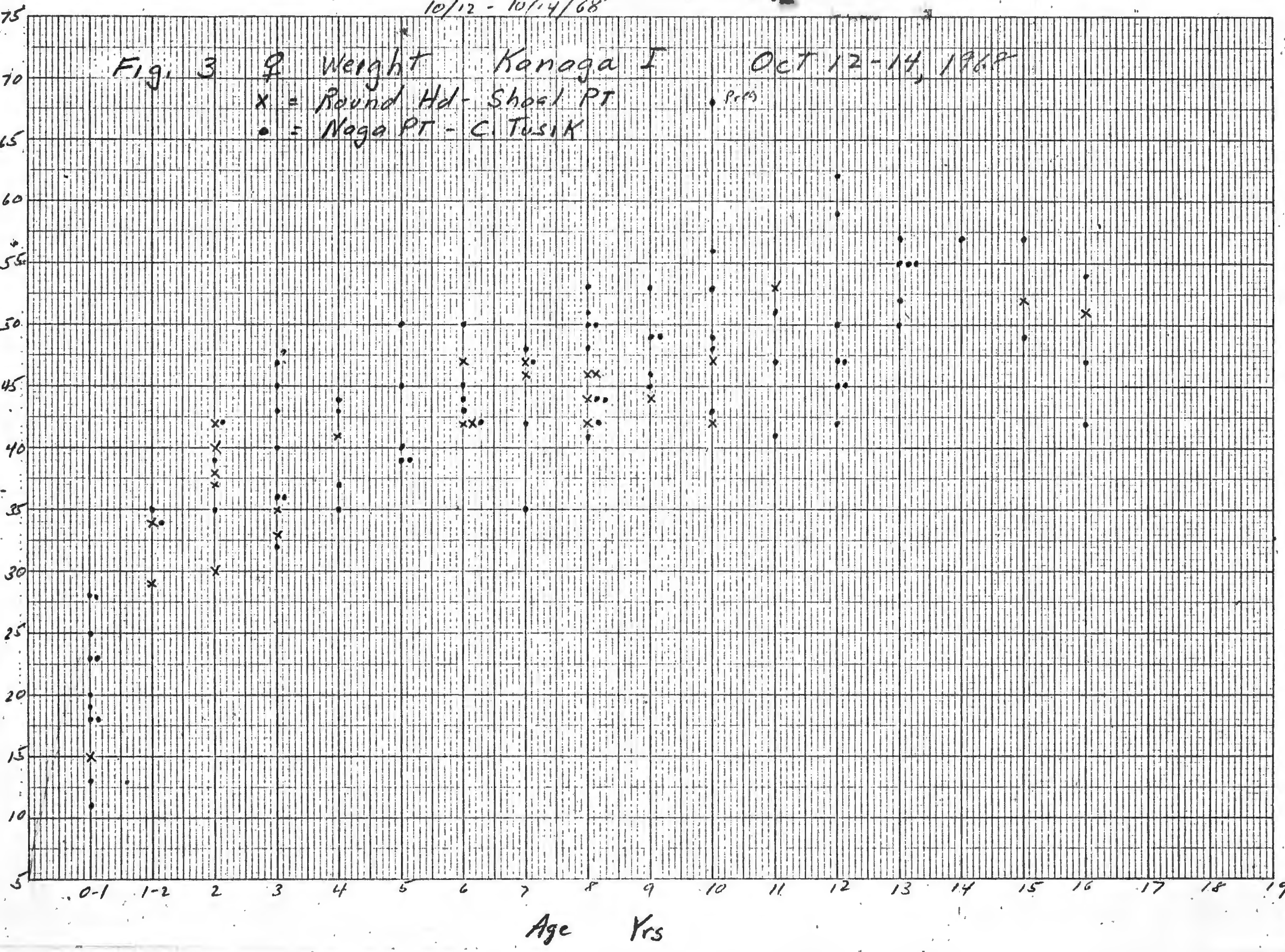


Fig. 2 ♀ Weights Mid pt - Blind pt, Adult
Oct 20, 1968
Age
years
0.1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
Wt

♀ Kanaga
10/12 - 10/14/68

x = Round head to Shoal PT
• = Noga PT to C. Tusik



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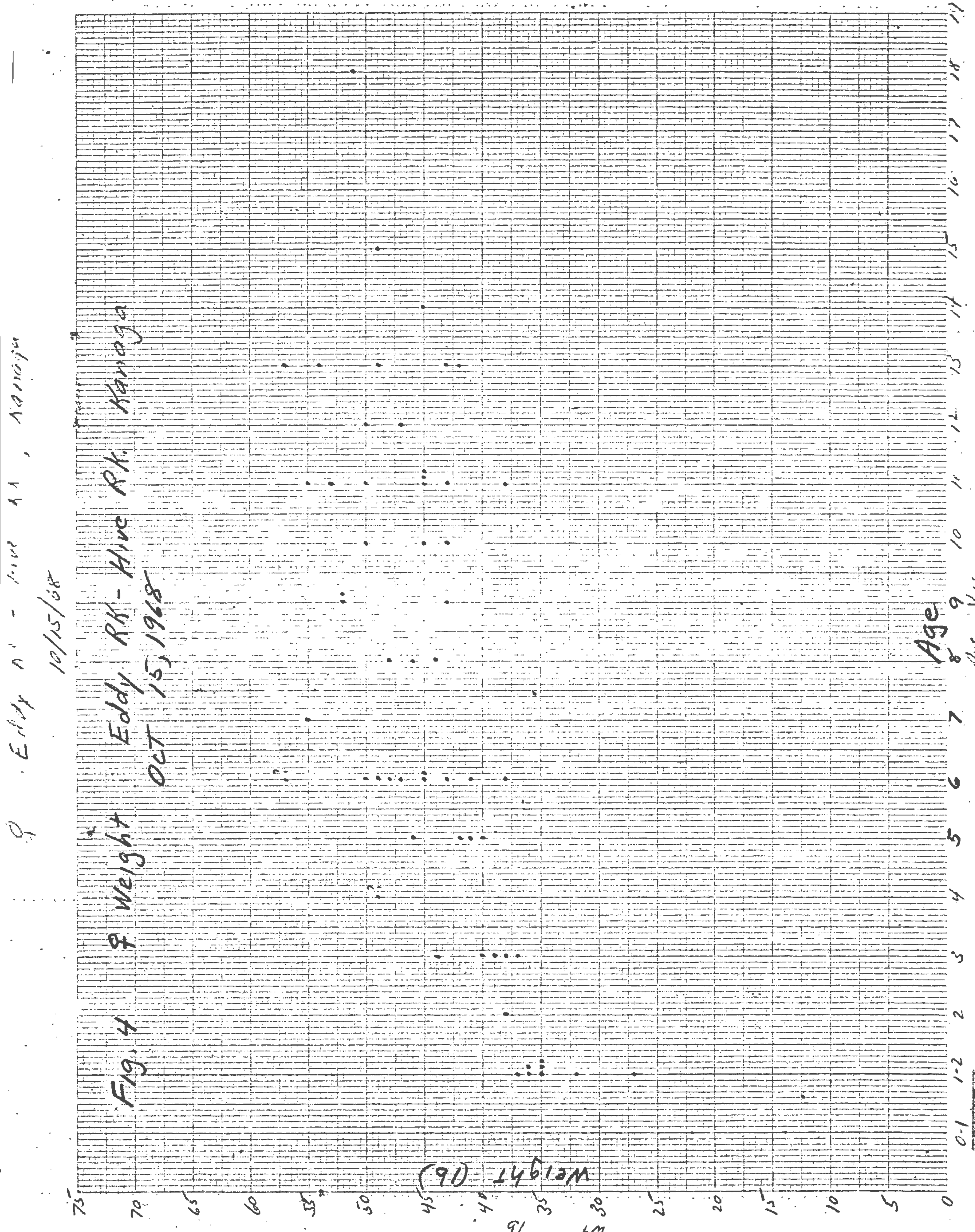

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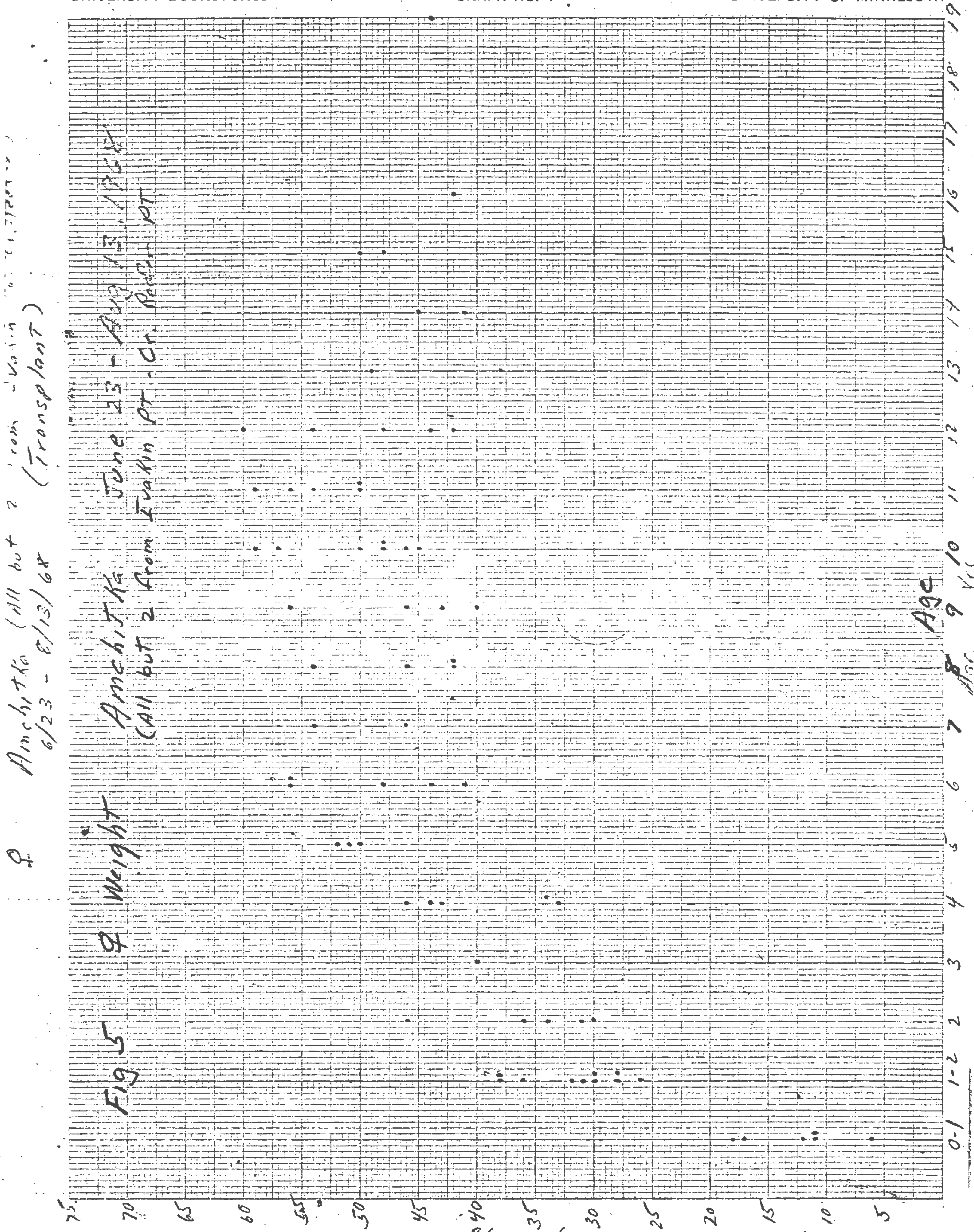

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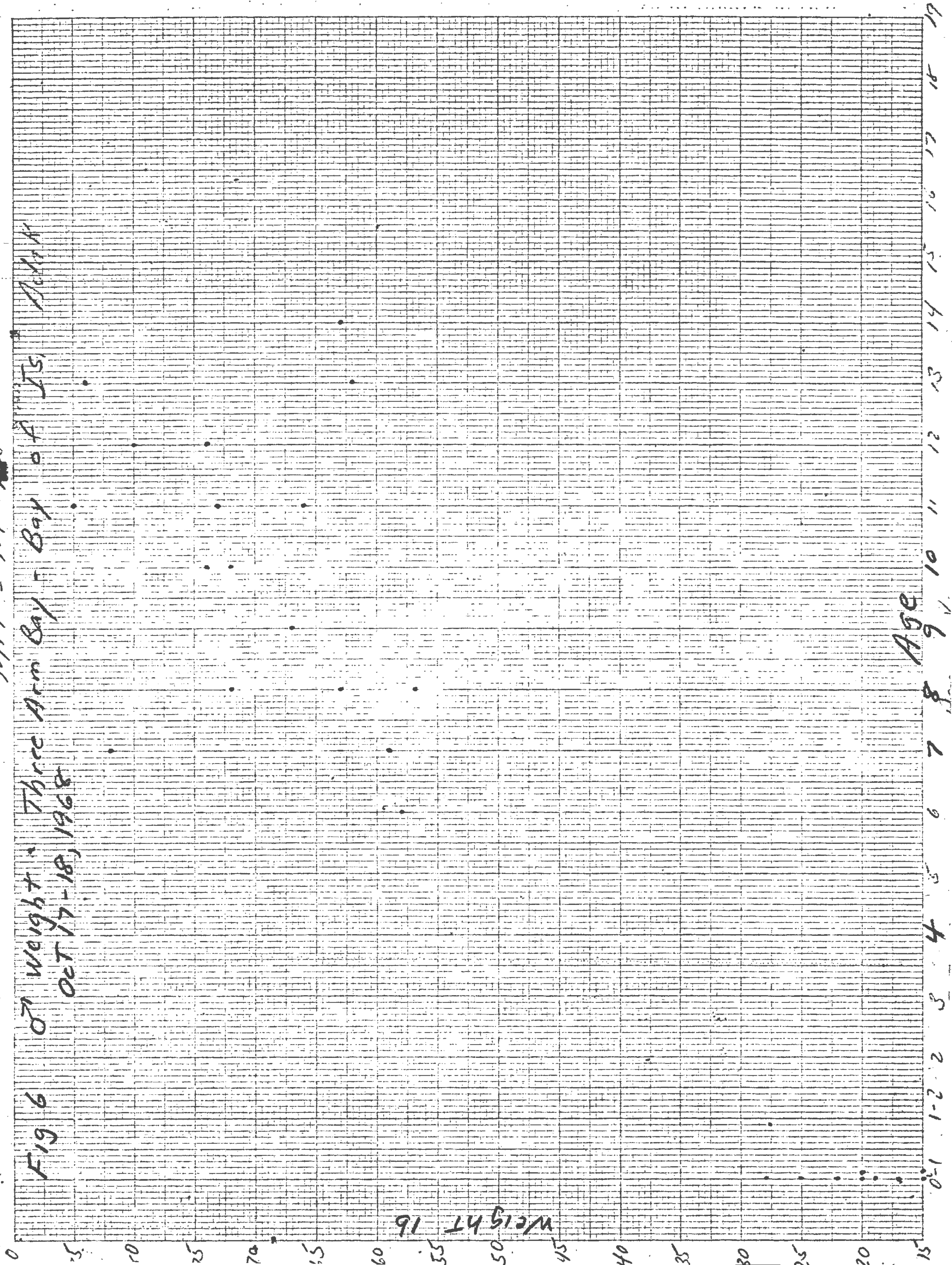


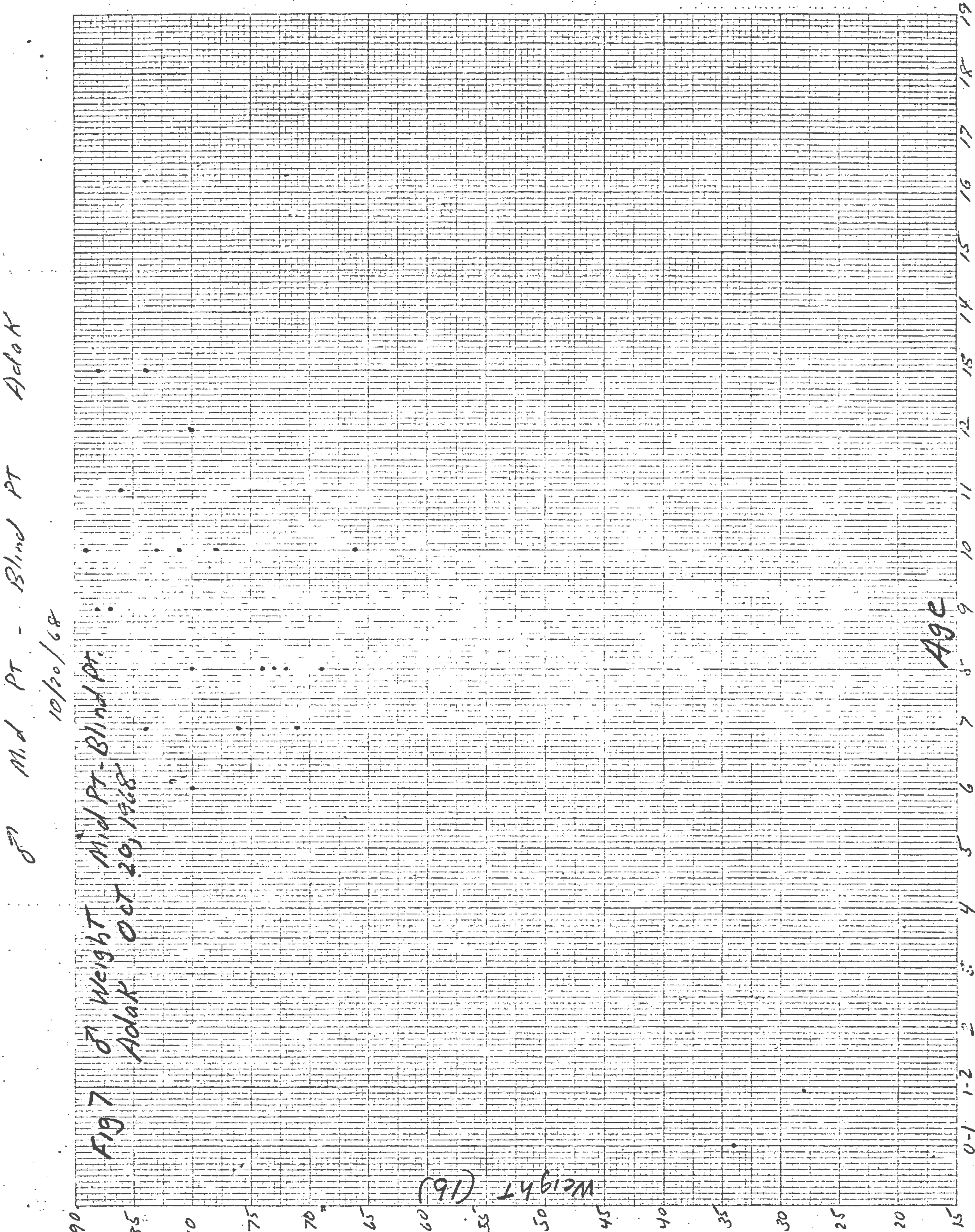
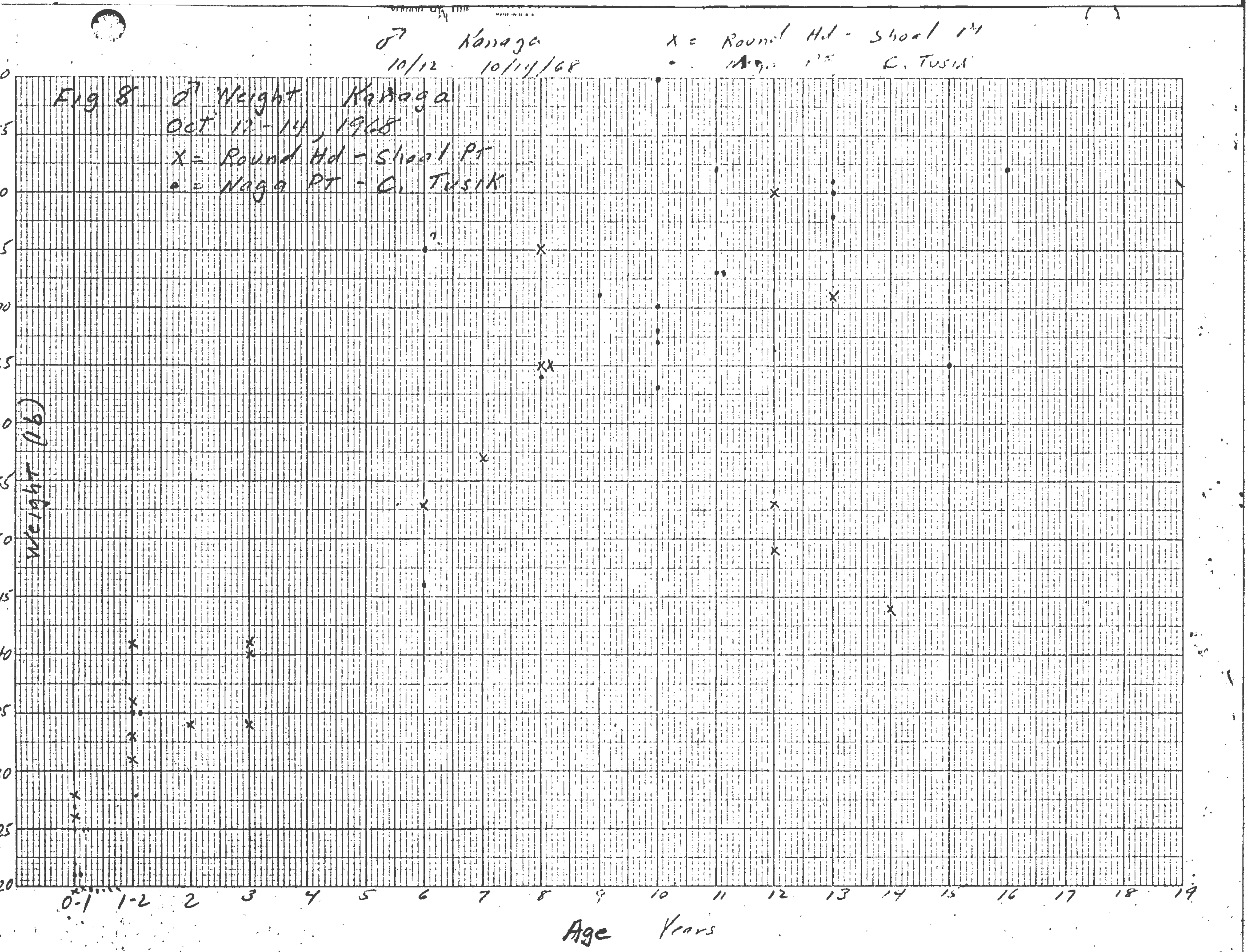
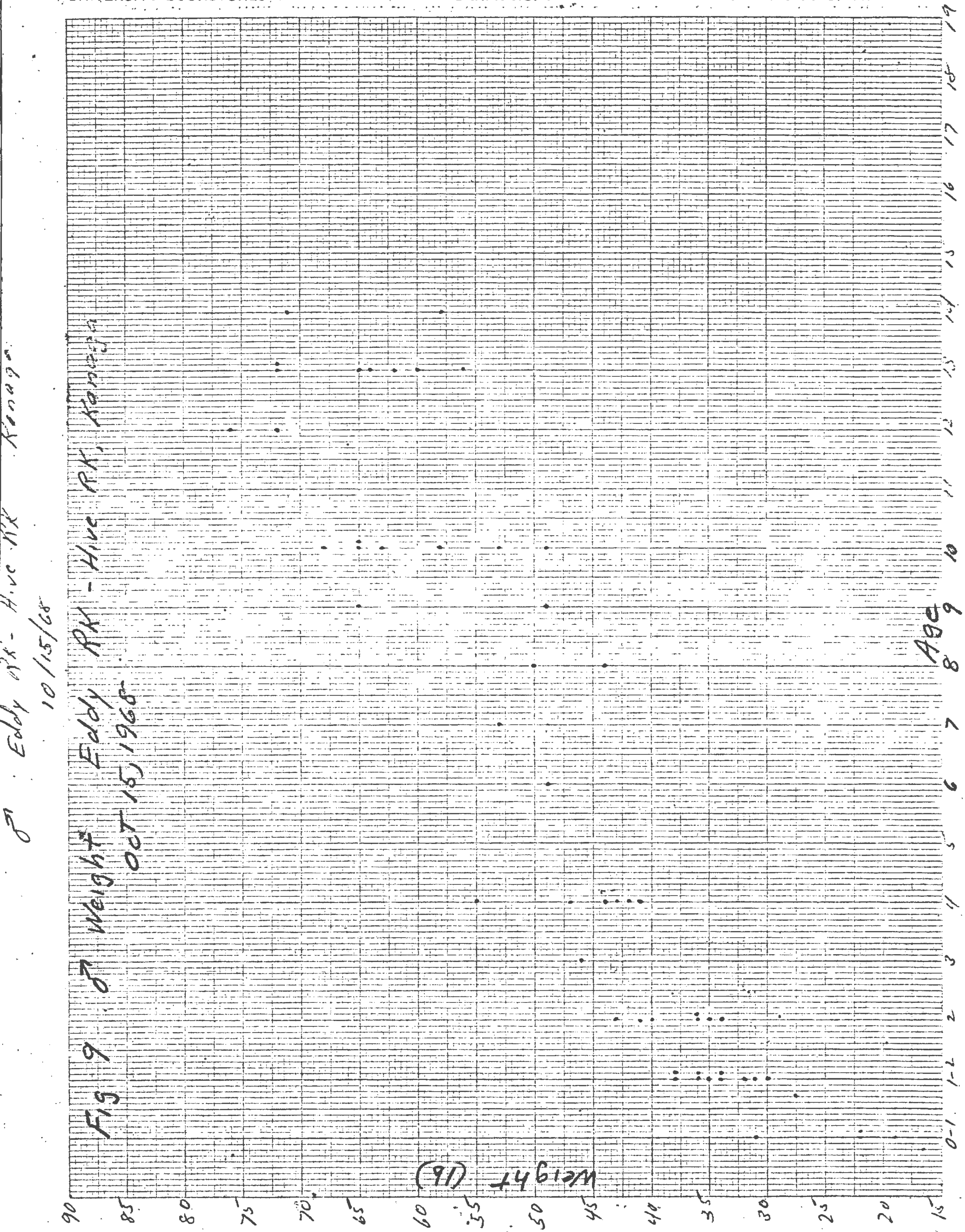


Fig 7 ♂ Weight Mid Pt - Blind Pt.
Adak Oct 20, 1968
♂ Mid Pt - Blind Pt Adak
10/20/68
Age
Weight (lb)
0-1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15



♂ Kanaga
10/12 - 10/14/68
X = Round Hd - Shoal Pt
• = Naga Pt - C. Tusik
Fig 8 ♂ Weight Kanaga
Oct 12 - 14, 1968
X = Round Hd - Shoal Pt
• = Naga Pt - C. Tusik
Weight (lb)
0-1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Age Years


♂ Eddy Rk - Hive Rk Kansas
10/15/68
Fig 9 ♂ Weight Eddy Rk - Hive Rk, Kansas
Oct 15, 1968
Age
0-1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Weight (lb)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15

Amchitka (Ivakin Pt to Cr Reefer)

♂ 6/30/68 - 8/13/68

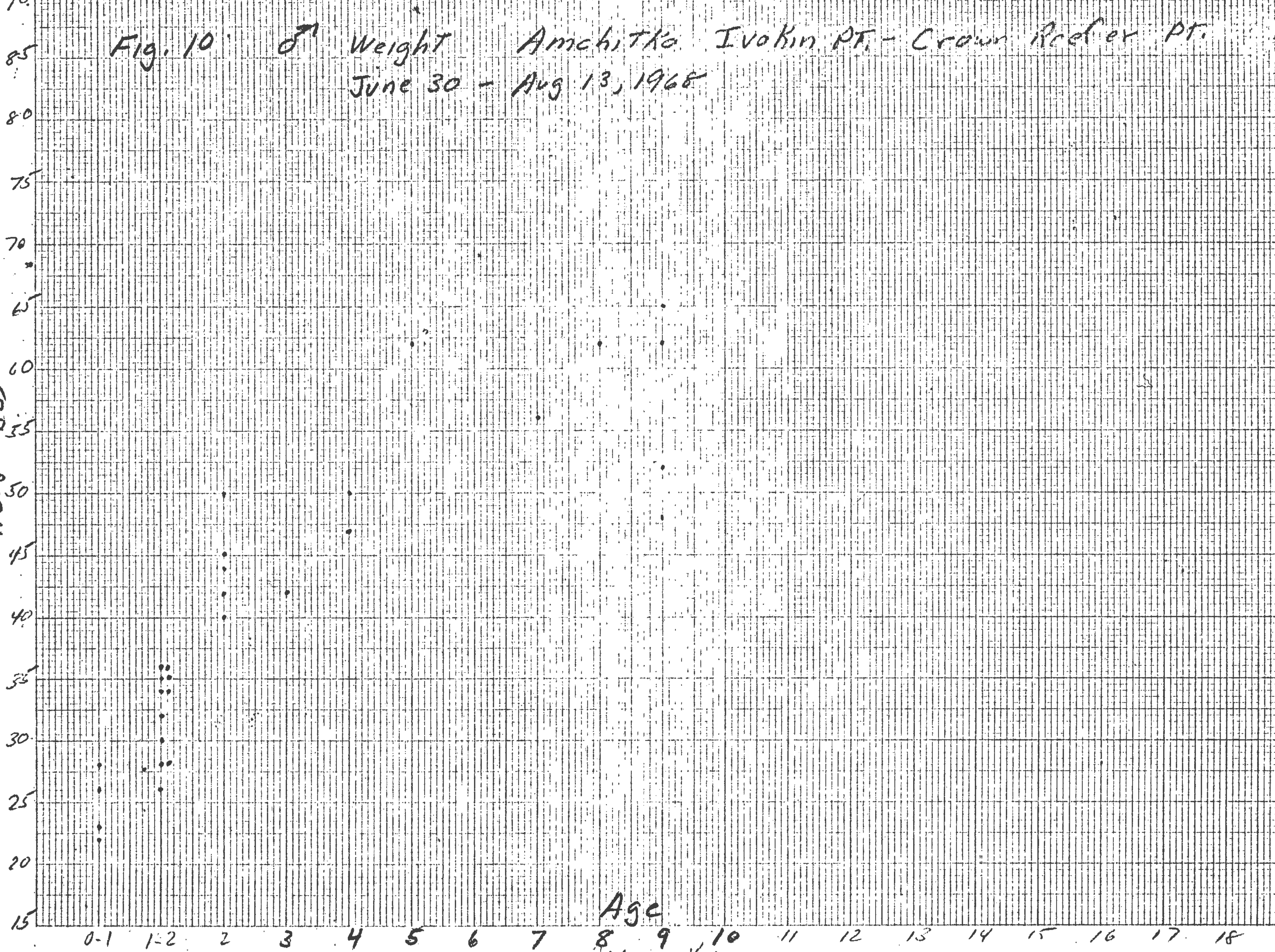


Fig. 10 ♂ Weight Amchitka Ivakin Pt. - Crown Reefer Pt.
June 30 - Aug 13, 1968

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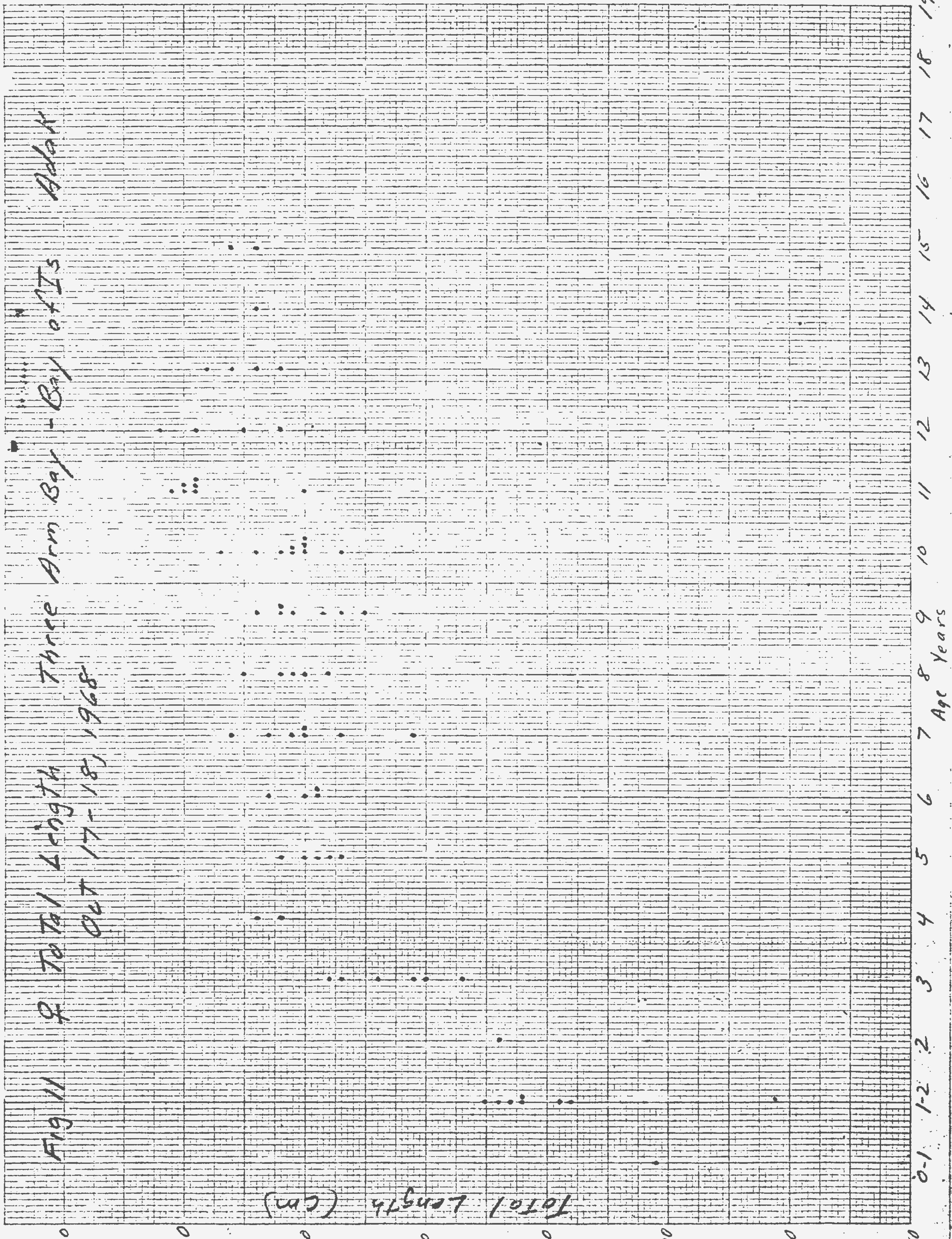


Fig 11 ♀ Total Length Three Arm Bay - Bay of Is Adult
Oct 17-18, 1968

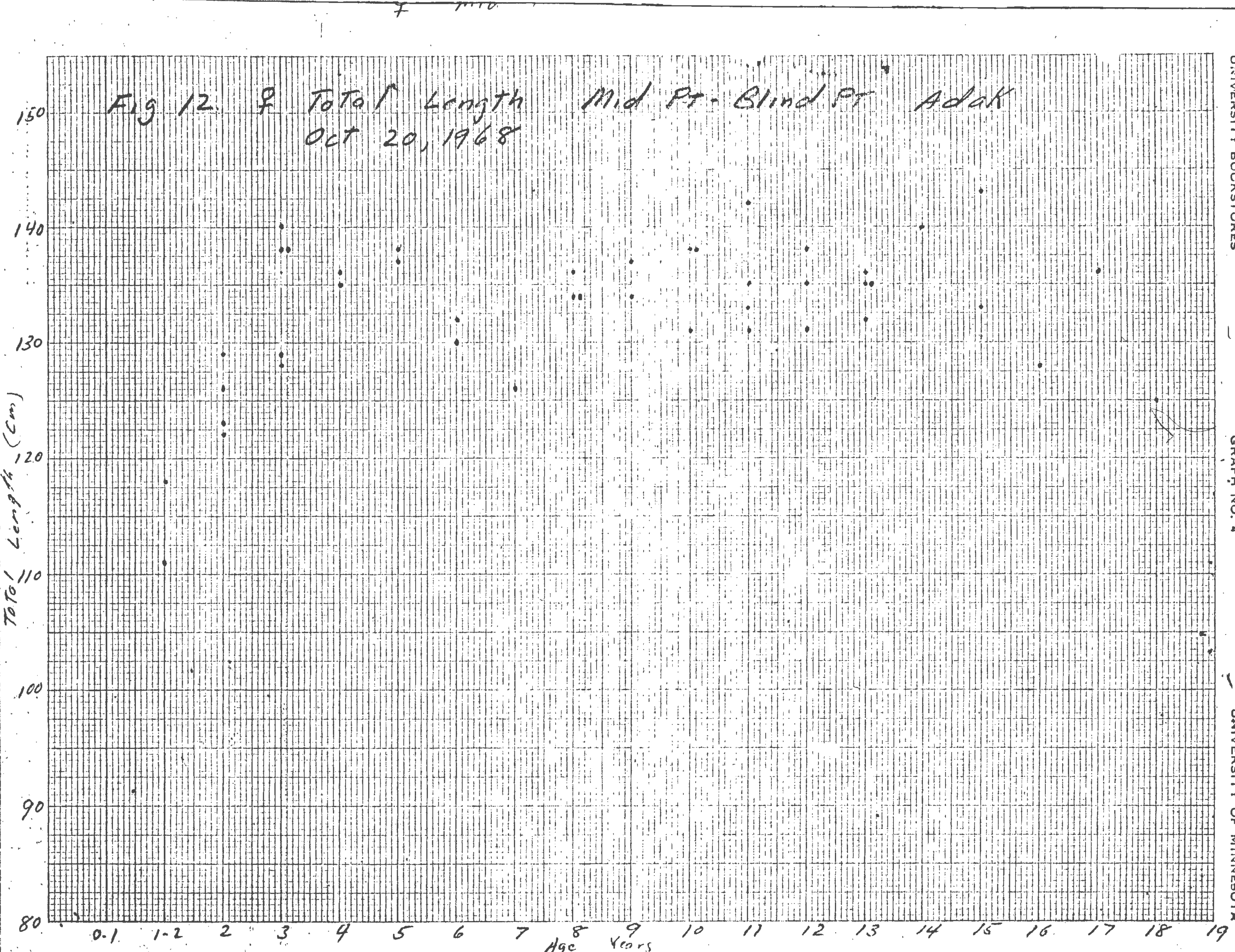
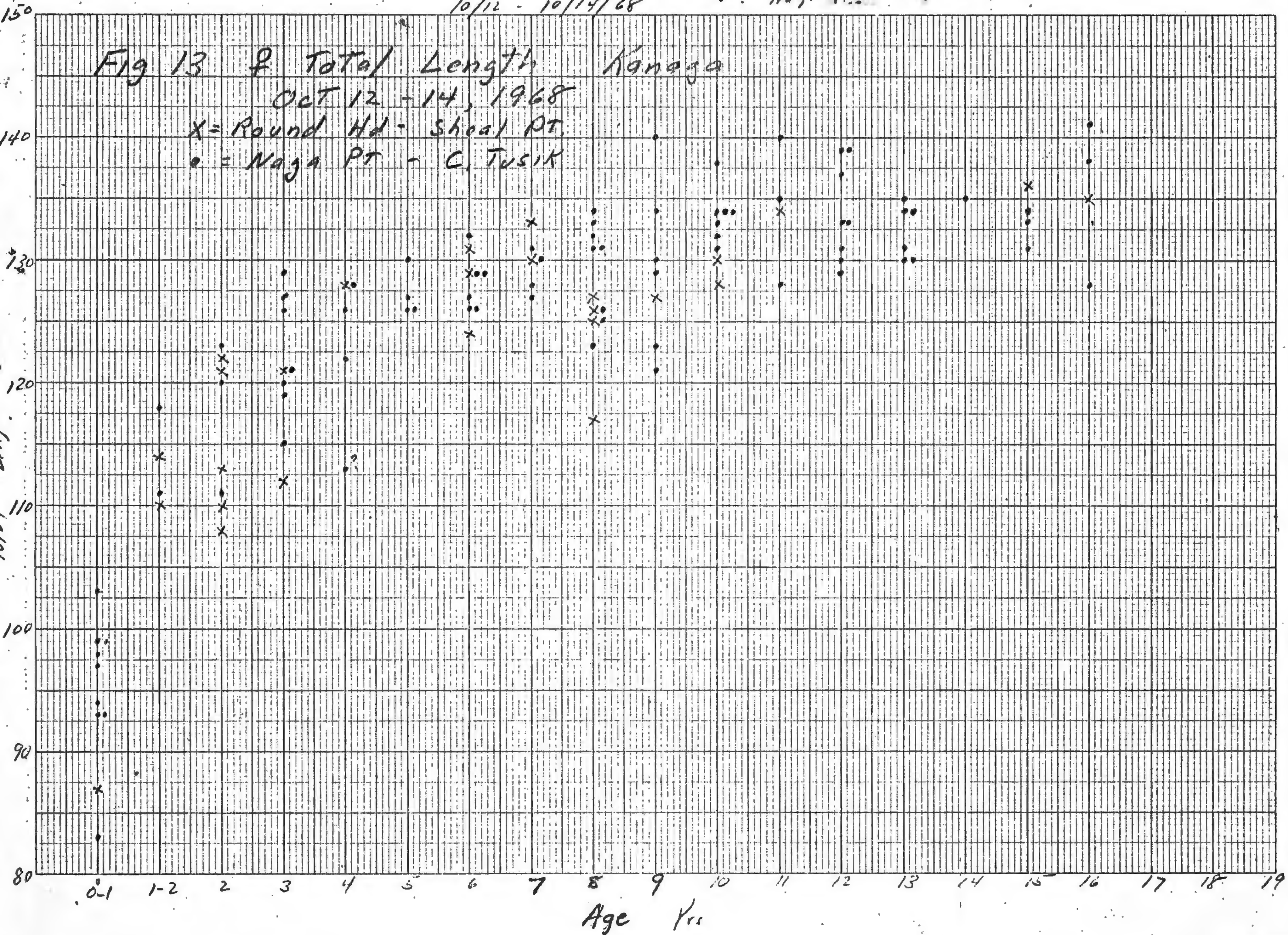


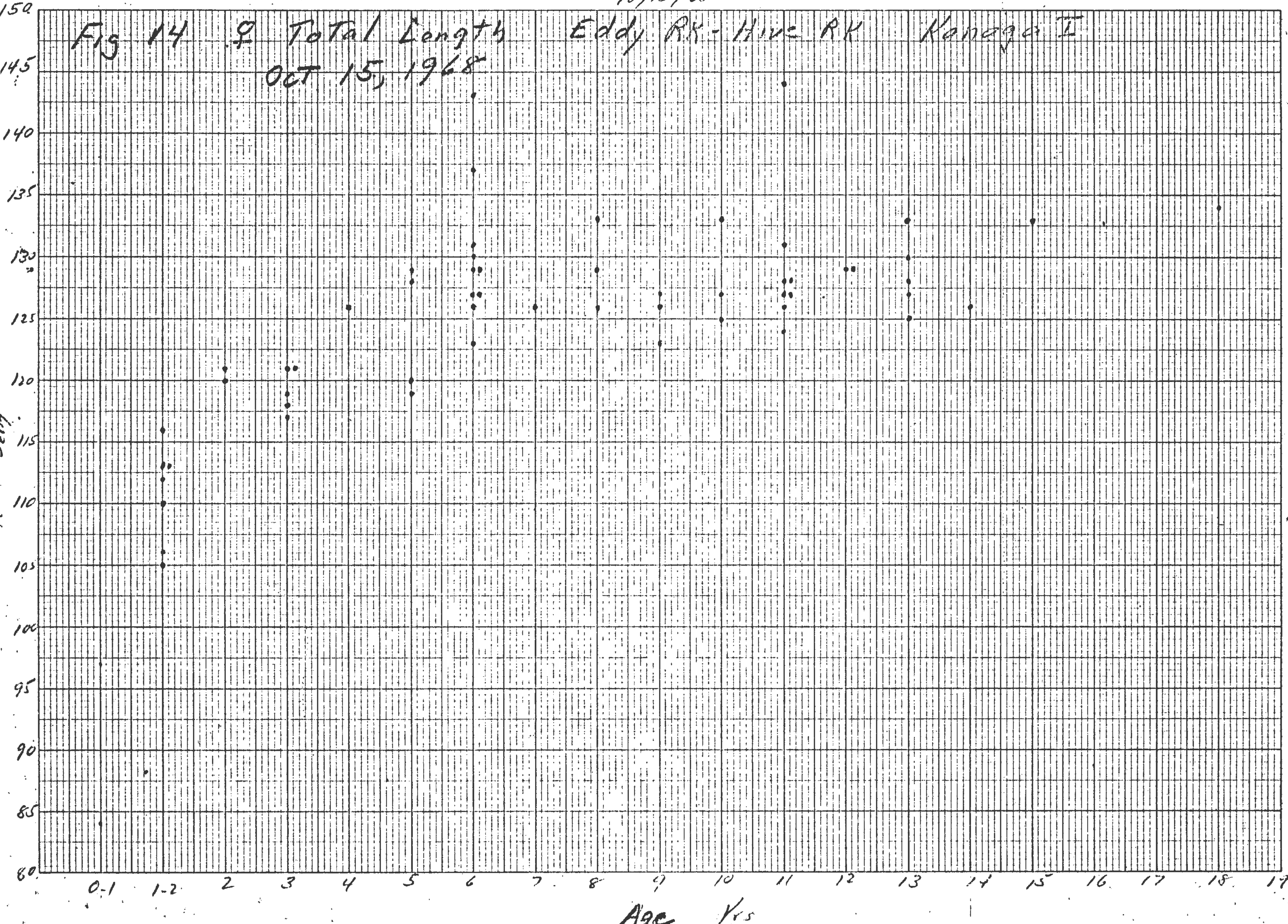
Fig 12 ♀ Total Length Mid Pt - Blind Pt Adak
Oct 20, 1968
Total Length (Cm)
150
140
130
120
110
100
90
80
0-1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Age Years
UNIVERSITY BOOKSTORES
GRAPH NO. 4
UNIVERSITY OF MINNESOTA

♀ Kanaga
10/12 - 10/14/68

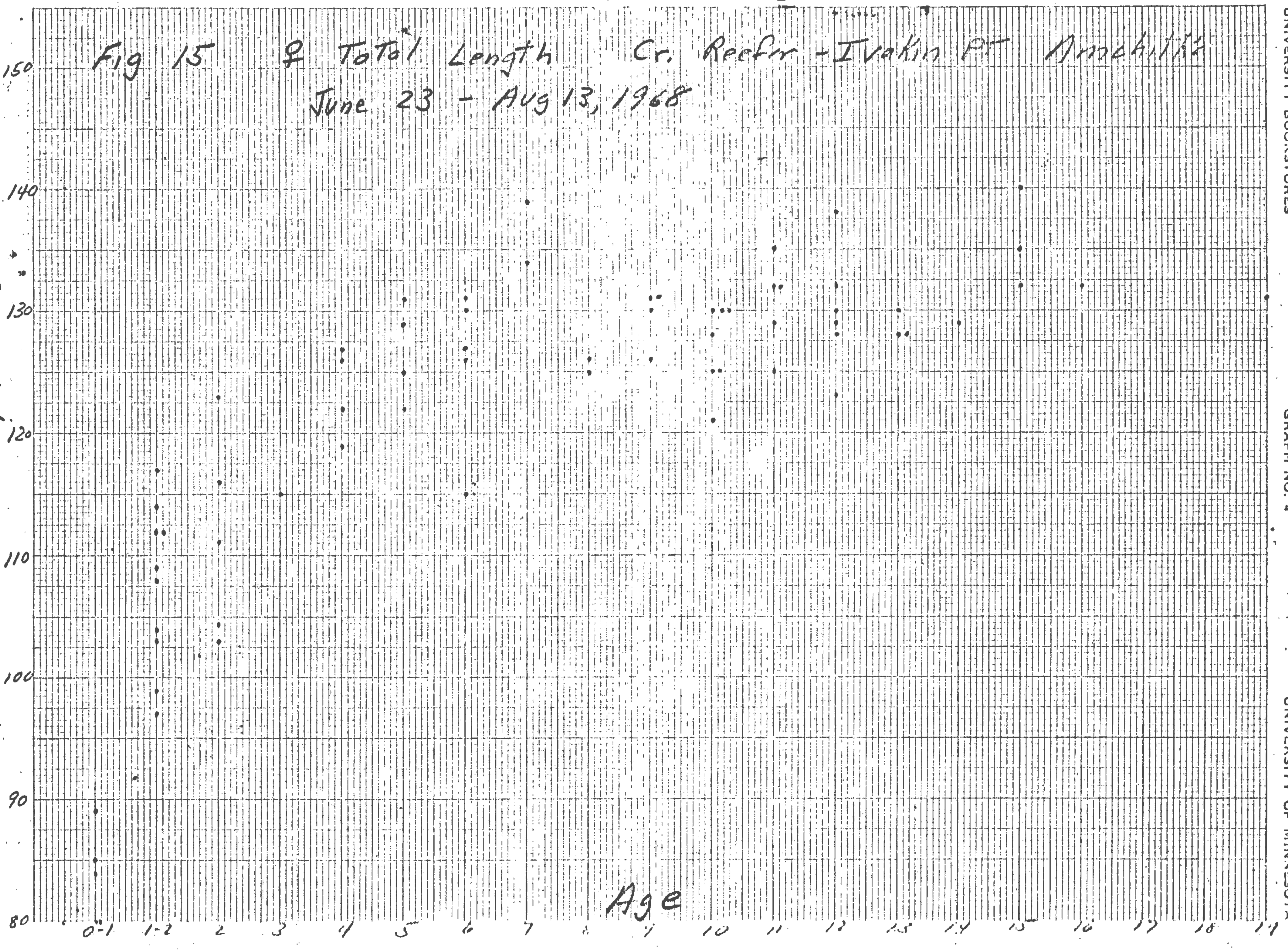
x = Round head - Shoal Pt.
• : Naga Pt. - C. Tusik



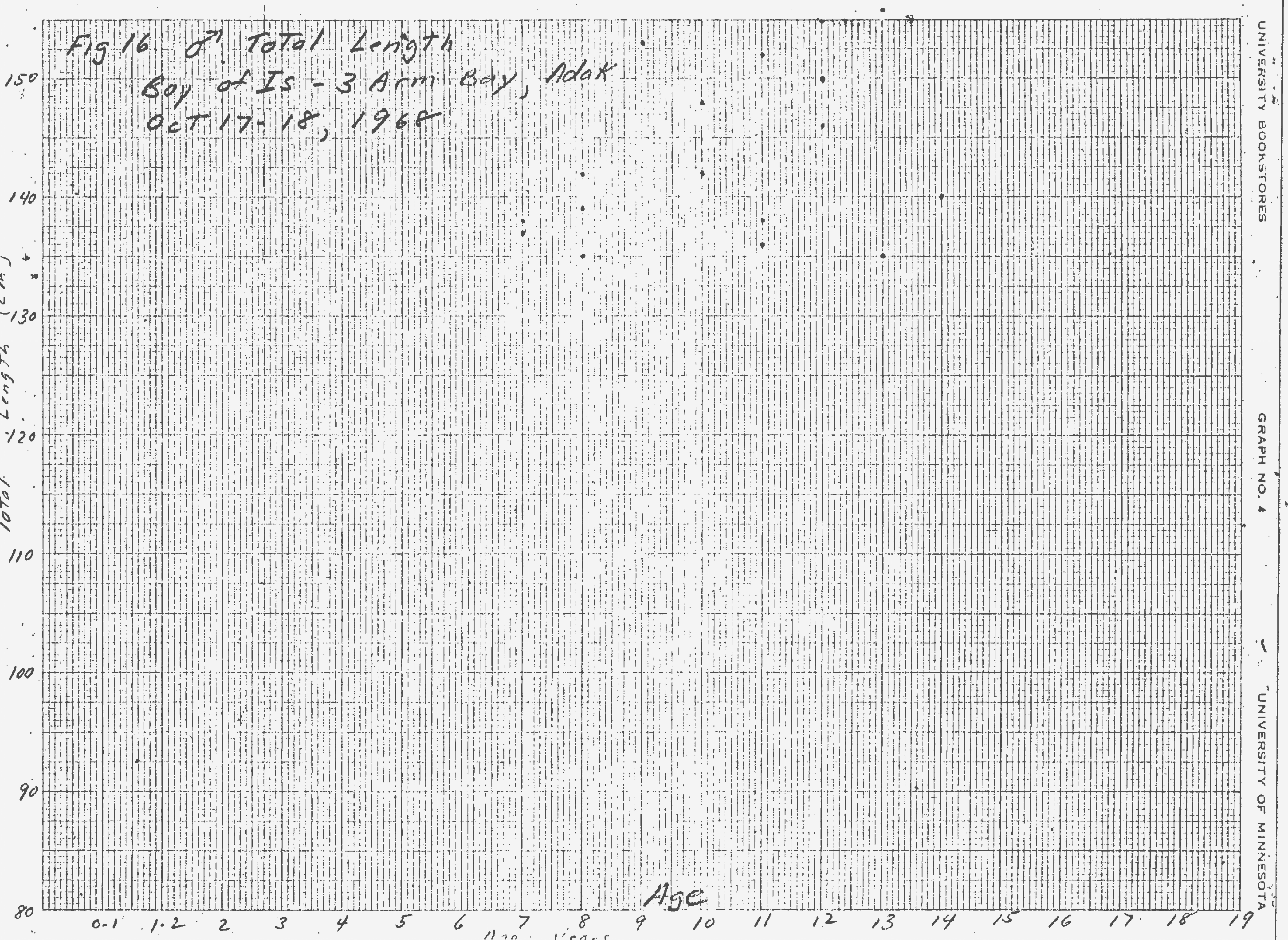
♀ Eddy RK - Hive RK Kanaga
10/15/68



♀ Amchitka Cr Reefer - Ivakin Pt.
6/23 - 8/13/68



♂ Bay of Is. + 3 arm Bay Adak Oct 17-18, 1968



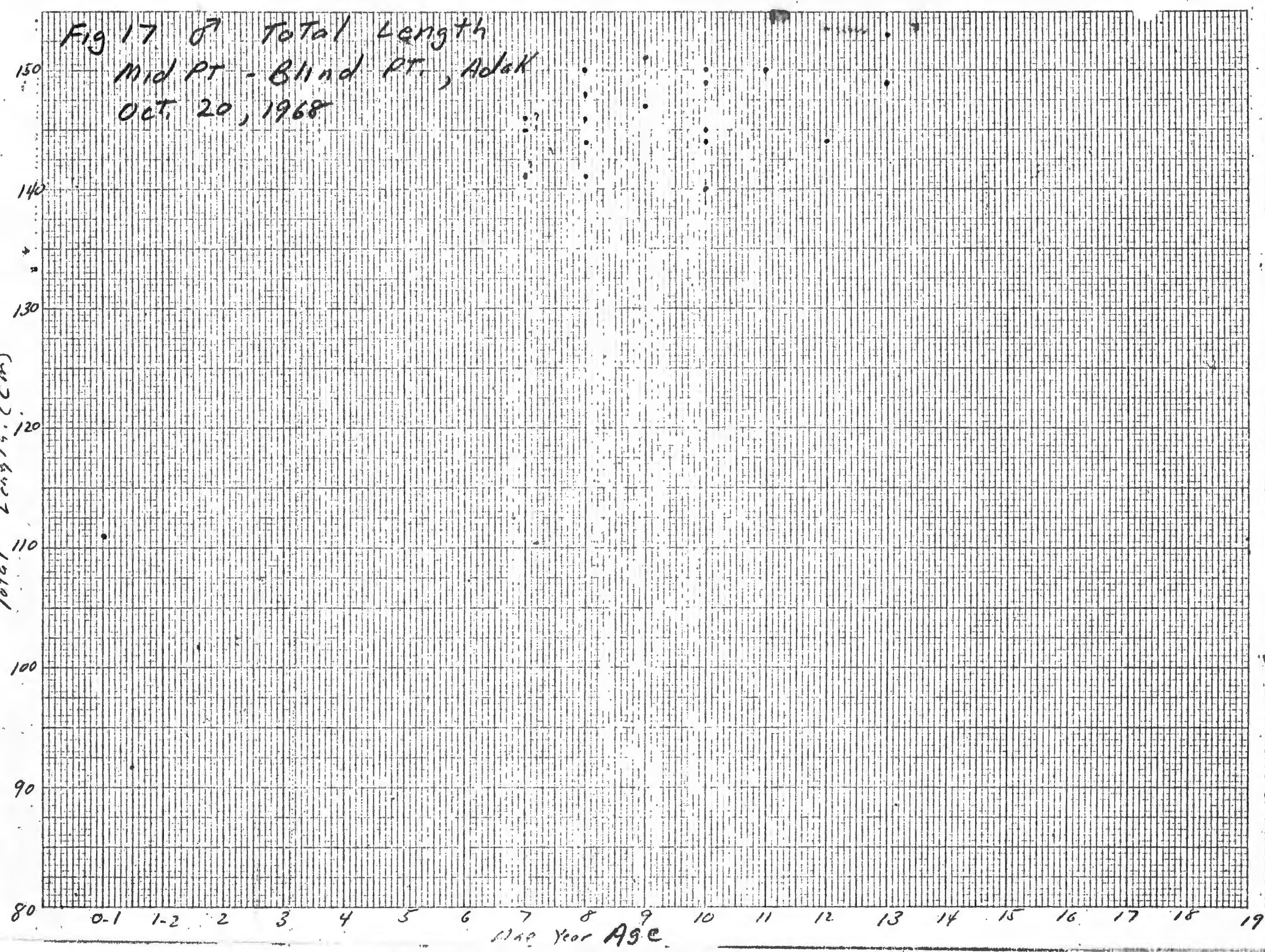
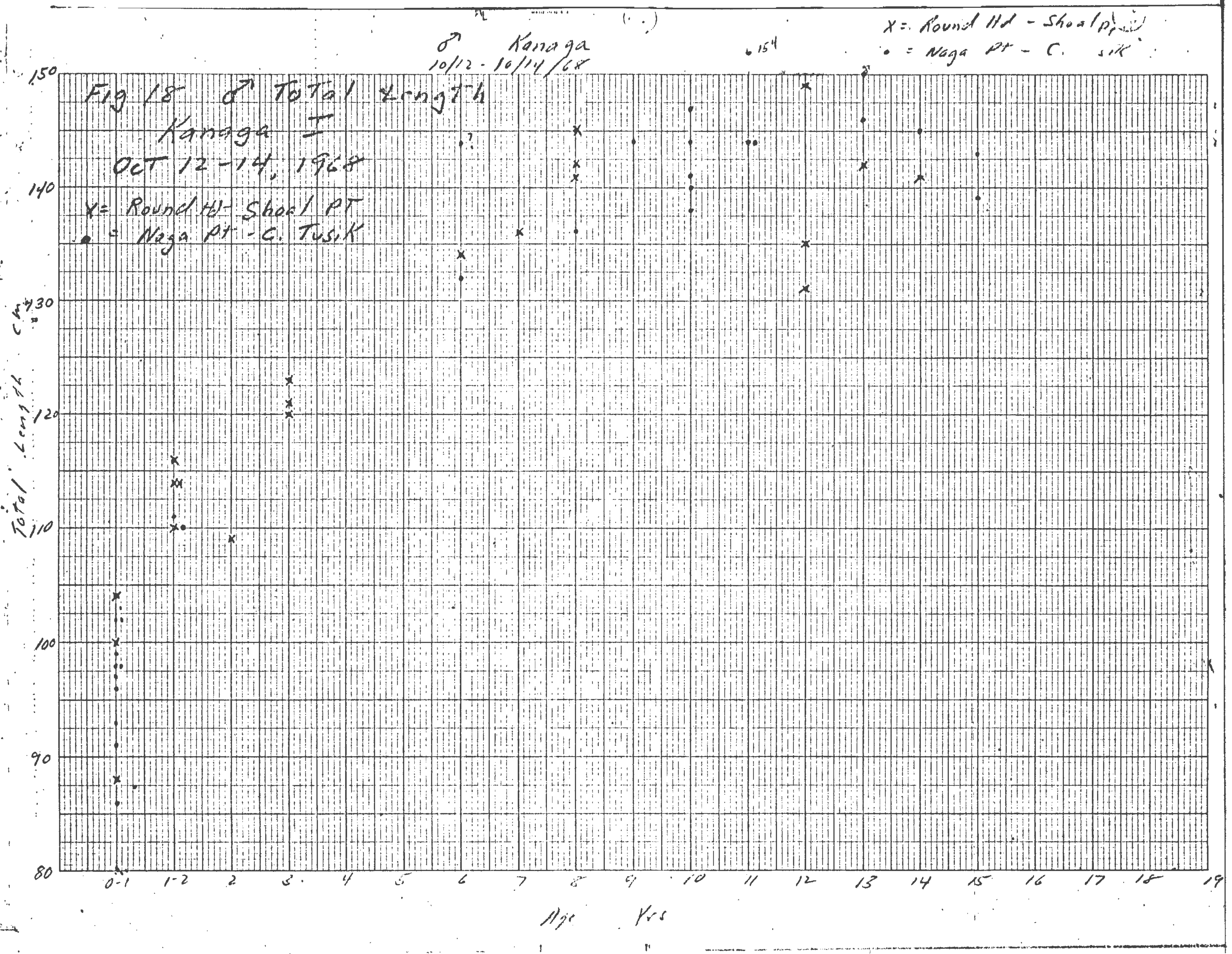
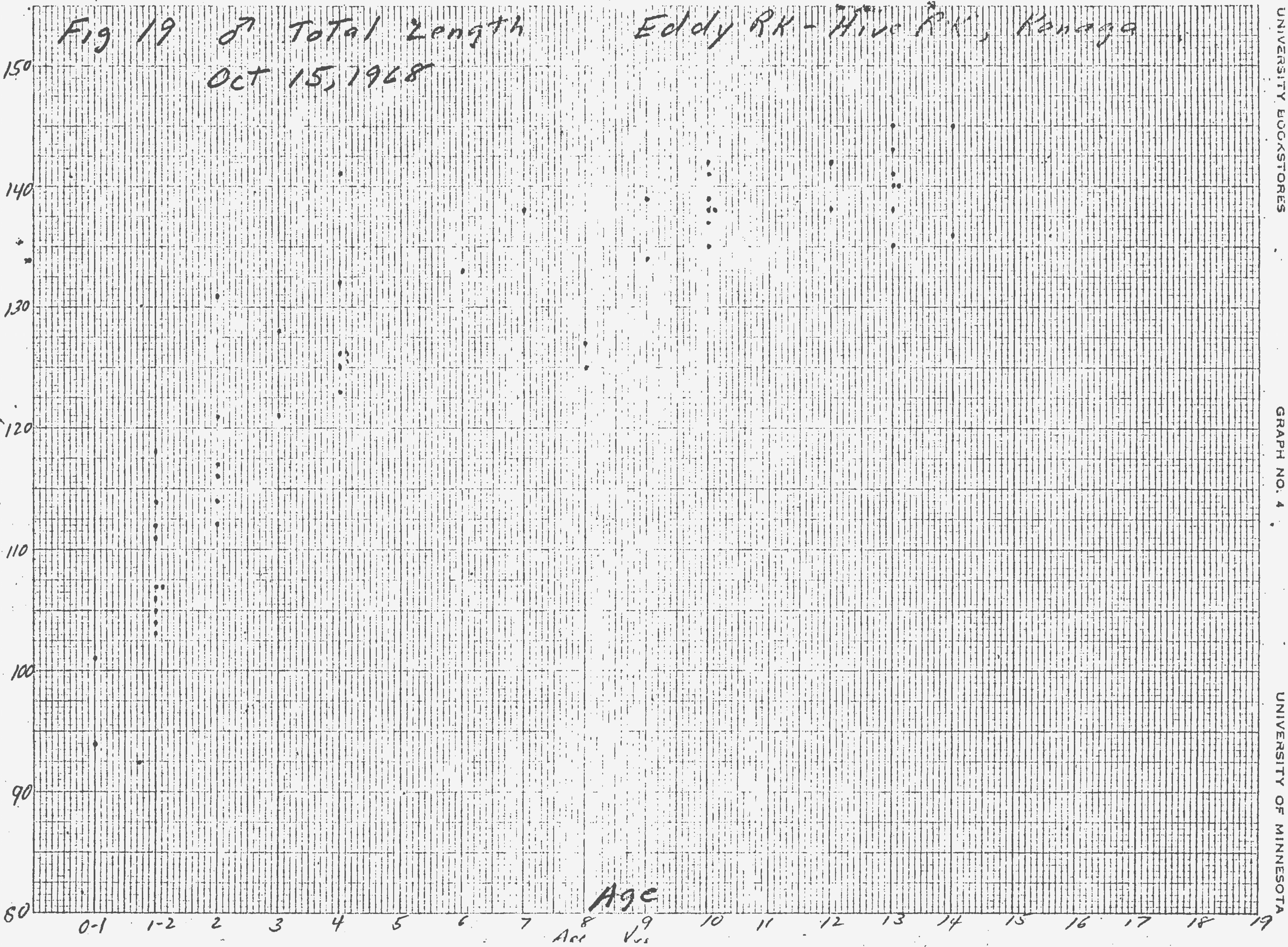


Fig 17 ♂ Total Length
Mid Pt - Blind Pt., Adak
Oct. 20, 1968
Total Length (Cm)
150
140
130
120
110
100
90
80
0-1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Age Year Age

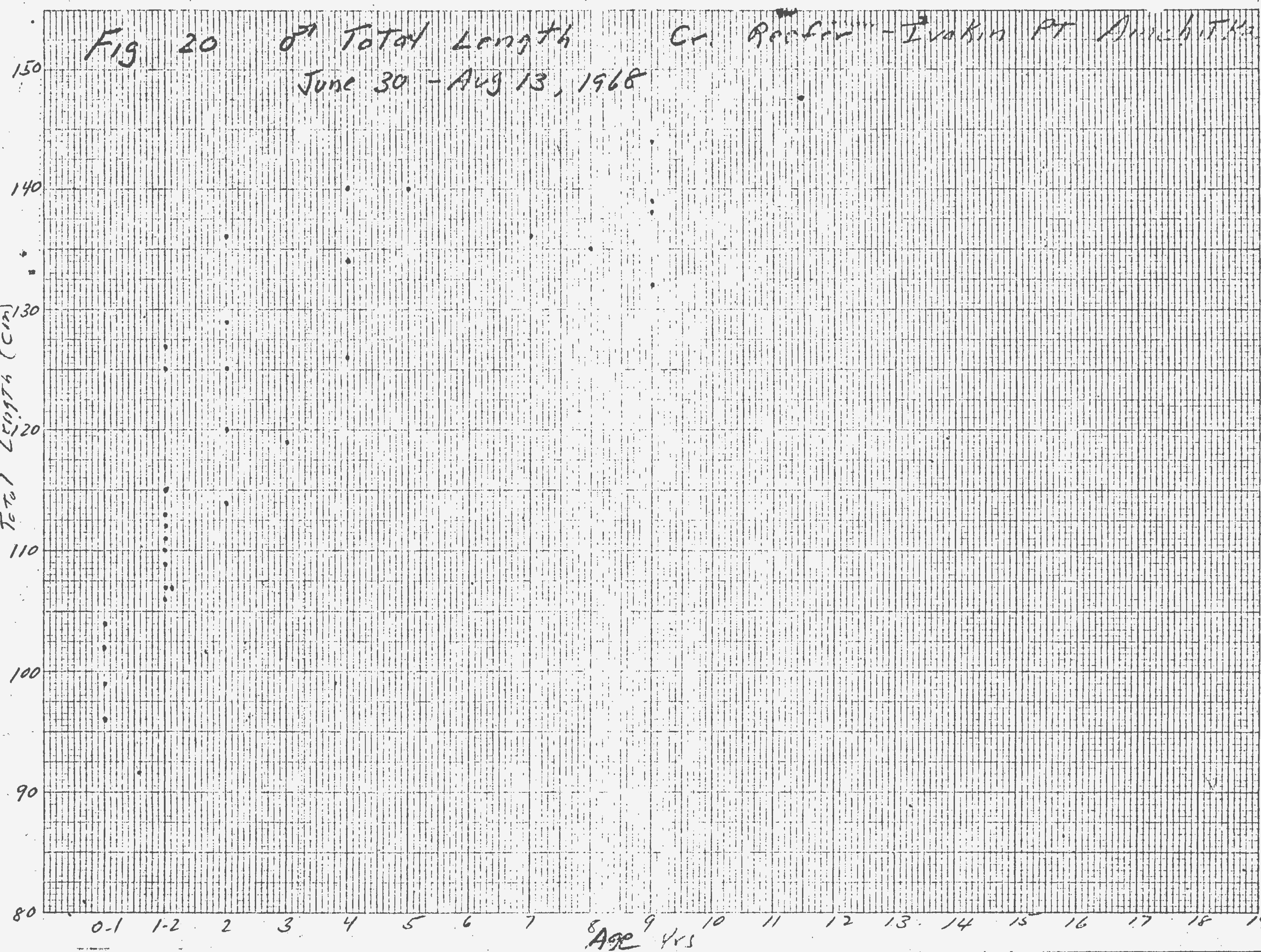


♂ Kanaga
10/12 - 10/14/68
X = Round Hd - Shoal Pt
• = Naga Pt - C. Tusik
Fig 18 ♂ Total Length
Kanaga I
Oct 12-14, 1968
X = Round Hd - Shoal PT
• = Naga Pt - C. Tusik
Total Length cm
150
140
130
120
110
100
90
80
0-1
1-2
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Age Yrs

♂ Eddy RK to Hive RK Kanaga
10/15/68



♂ Amchitka
6/30 - 8/13/68



Reproduction

Table 1 summarizes the information from female reproductive tracts collected from 1967 to 1969. The criteria used for the various categories are:

Nulliparous - Horns of uterus small, thin and smooth. Usually no corpora lutea or corpora albicantia although there is occasionally evidence of a past ovulation, but no evidence of implantation.

Multiparous - Uterus thicker, corpora lutea and/or corpora albicantia present. Includes primiparous animals (these are not readily separated from multiparous animals).

Anestrus - Largest follicle under 3.5 mm, no corpus luteum.

Proestrus - Follicles over 3.5 mm.

Estrus - Follicles approximately 10 mm.

Unimplanted Pregnant - Corpus luteum present (usually under 10 mm and with a central antrum), no gross sign of implantation.

Post Partum - Uterine horn still noticeably enlarged; fresh, rough-looking placental scar, newly formed corpus albicans with some luteal tissue remaining.

The information from sexually mature females including 1962 and 1963 data from Kenyon is presented graphically in Fig. 1. This graph assumes that the samples were collected uniformly, which may not be the case. There is bias in all the samples because of collecting methods.

Females with pups are often avoided in harvests. Most of these animals would be considered anestrous. This would effectively reduce the percentages of females in the other categories. On a skiff survey, 7 percent of the animals counted had pups that were readily identified. Assuming this is the number of animals not shot because of the pups it can be calculated that 15 percent of the sexually mature females are purposely avoided. The actual percentage probably varies with the hunter and conditions. However, this probably indicates the order of magnitude of this bias.

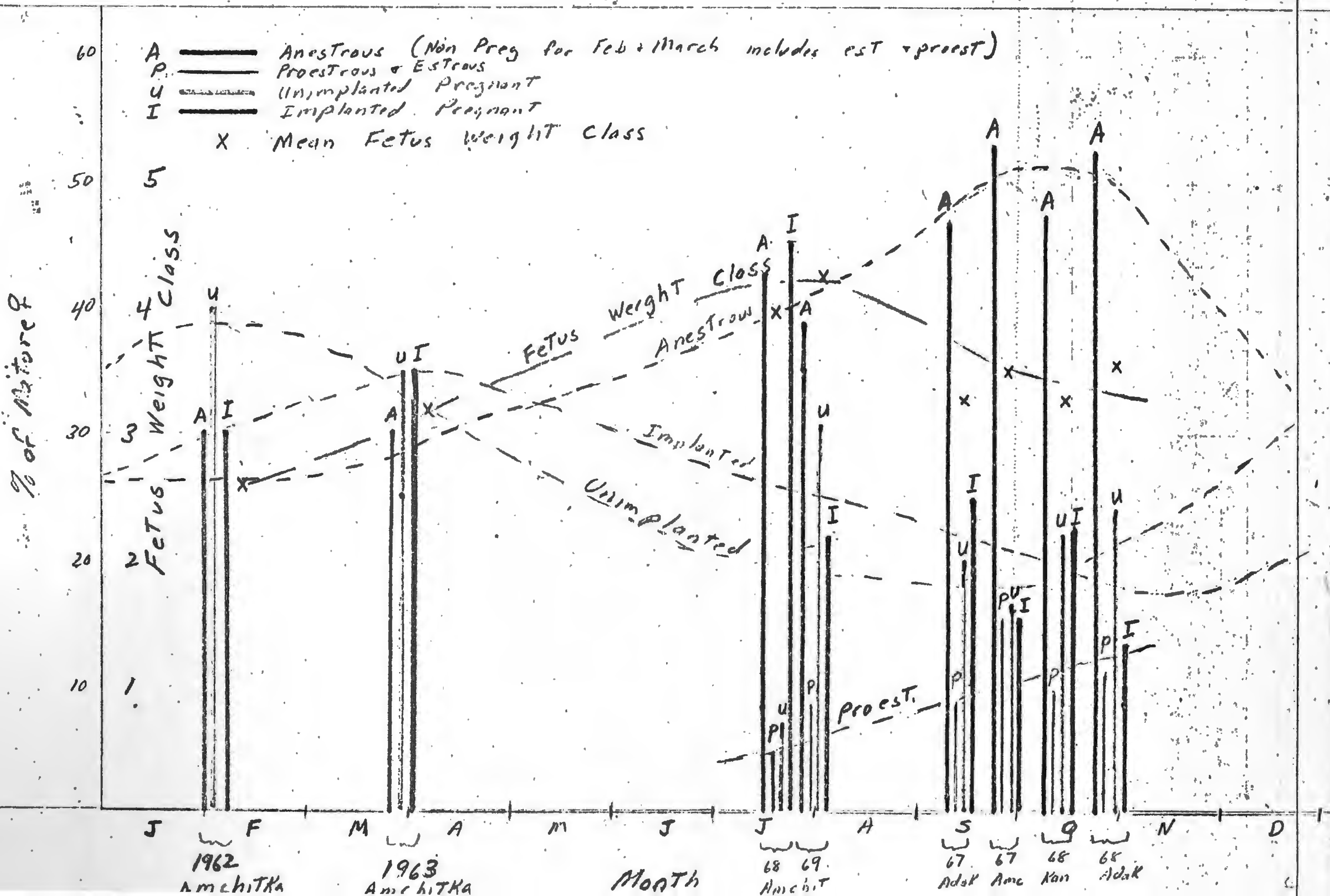
Fig. 1 indicates seasonal fluctuations in sexual activity. In most cases, the samples fit the pattern fairly well. The most glaring exception is in the 1968 and 1969 Amchitka samples. These samples are from the same area at the same time of year and were collected from transplant mortalities. The percentage in each category except unimplanted pregnant and implanted pregnant are very similar. However, in 1968 there was a large percentage of implanted pregnancies with large fetuses and very few unimplanted pregnancies.

Table 1. Summary of Female Reproductive Information

Dates	Island	Nulliparous	MULTIPAROUS										Unk.	Total
			Anestrus	Proestrus Estrus	Unimpl. Preg.	Impl. Preg.	Fetus Weight Class					Post Partum		
							1	2	3	4	5			
6/23/68 - 8/13/68	Amchitka[3]	20	17 (38.6)[2]	2 (4.6)	3 (6.8)	20 (45.4)	1 (2.3)	2 (4.6)	3 (6.8)	5 (11.3)	9 (20.4)	2 (4.6)	3	67
7/6 - 8/12/69	Amchitka[3]	20	17 (36.9)	4 (8.6)	14 (30.4)	10 (21.9)	0 (0)	1 (2.2)	1 (2.2)	2 (4.3)	6 (13.2)	1 (2.2)	0	66
9/25 - 10/6/67	Amchitka	54	55 (47.8)	18 (15.7)	19 (16.5)	23 (14.8)	4 (3.5)	0 (0)	0 (0)	10 (8.7)	3 (2.6)	6 (5.2)	3	172
9/10 - 9/17/67	Adak	53	71 (44.4)	14 (8.8)	30 (18.8)	40 (25.0)	6 (3.8)	6 (3.8)	8 (5.0)	9 (5.6)	11 (6.8)	5 (3.0)	4	217
10/18 - 10/20/68	Adak	20[4]	46 (46)	11 (11)	24 (24)	13 (13)	2 (2)	3 (3)	0 (0)	4 (4)	4 (4)	6 (6)	0	120
10/12 - 10/15/68	Kanaga	39[4]	58 (41.3)	13 (9.3)	31 (22.0)	31 (22.2)	4 (2.9)	4 (2.9)	7 (5.0)	11 (7.8)	5 (3.6)	6 (4.3)	1 Resorp.	179

1. Fetus weight classes: 1 = 0-1g, 2 = 1-10g, 3 = 10-100g, 4 = 100-1000g, 5 = 1000+g
2. Percent of sexually mature females
3. Transplant mortalities
4. Reproductive tracts not collected from many young (nulliparous)

Fig 1 Reproductive cycles of Sea Otter



In 1969, the number of unimplanted pregnancies was much greater. However, the total number of pregnant animals was almost identical for the two years. This might indicate a change in the timing of the peak of breeding without a change in the rate of pregnancy. No explanation can be offered at this time, but it does raise the possibility that when an animal tends to breed once every two years it is possible that two separate two year cycles may be established for a period of time similar to salmon runs. If this situation occurs there would be problems in trying to compare samples from different years and different islands.

Gestation Periods, Peaks of Breeding and Pupping

Fig. 2 presents the total percentages of pregnant females (unimplanted and implanted) throughout the year. These percentages are probably slightly high because of hunting bias.

If the total gestation period was 12 months, one would expect the percent of pregnant animals to remain fairly constant throughout the year. The information in Fig. 2 suggests that the gestation period is considerably greater or less than 12 months.

Kenyon's manuscript presents an estimate of the gestation period calculated by Dr. D. G. Chapman of the University of Washington. Chapman used Hugget and Widdas' (1951, J. Phys., 144:306-317) procedure to estimate the implanted period. Data from Jan. - Feb., 1962, March 1963 and July 1963 were used. October 1962 data did not include any implanted pregnancies.

The specific growth velocity is estimated by plotting a regression of the cube roots of the mean weights in each weight class and the mean time in months (based on percentages to give equal representation to each time of year).

Table 2 presents Chapman's estimates and a new estimate adding data from the 1967 and 1968 harvests. Data from the transplants of 1968 and 1969 were omitted because of the possibility that females with large fetuses were more susceptable to injury from handling. Chapman's estimate (Table 2B) was 154 days while the new estimate (Table 2C) was 109 days. This is the period of linear growth and does not include the initial period while the fetus becomes established. Chapman allowed 2 weeks for this period.

The difference between the estimates is undoubtably due to sampling. The July sample included only nine animals. Chapman's estimate relies very heavily on this small sample.

If sea otters bred uniformly throughout the year it would be impossible to estimate the gestation period from this method. The method assumes a peak of breeding activity. When a species breeds throughout the year and the peak is not pronounced, a large sample from all times of year becomes necessary. The data used by Chapman obviously is not adequate and it is very likely that the new estimate is still not good enough.

Fig. 2 Percent of mature ♀ pregnant

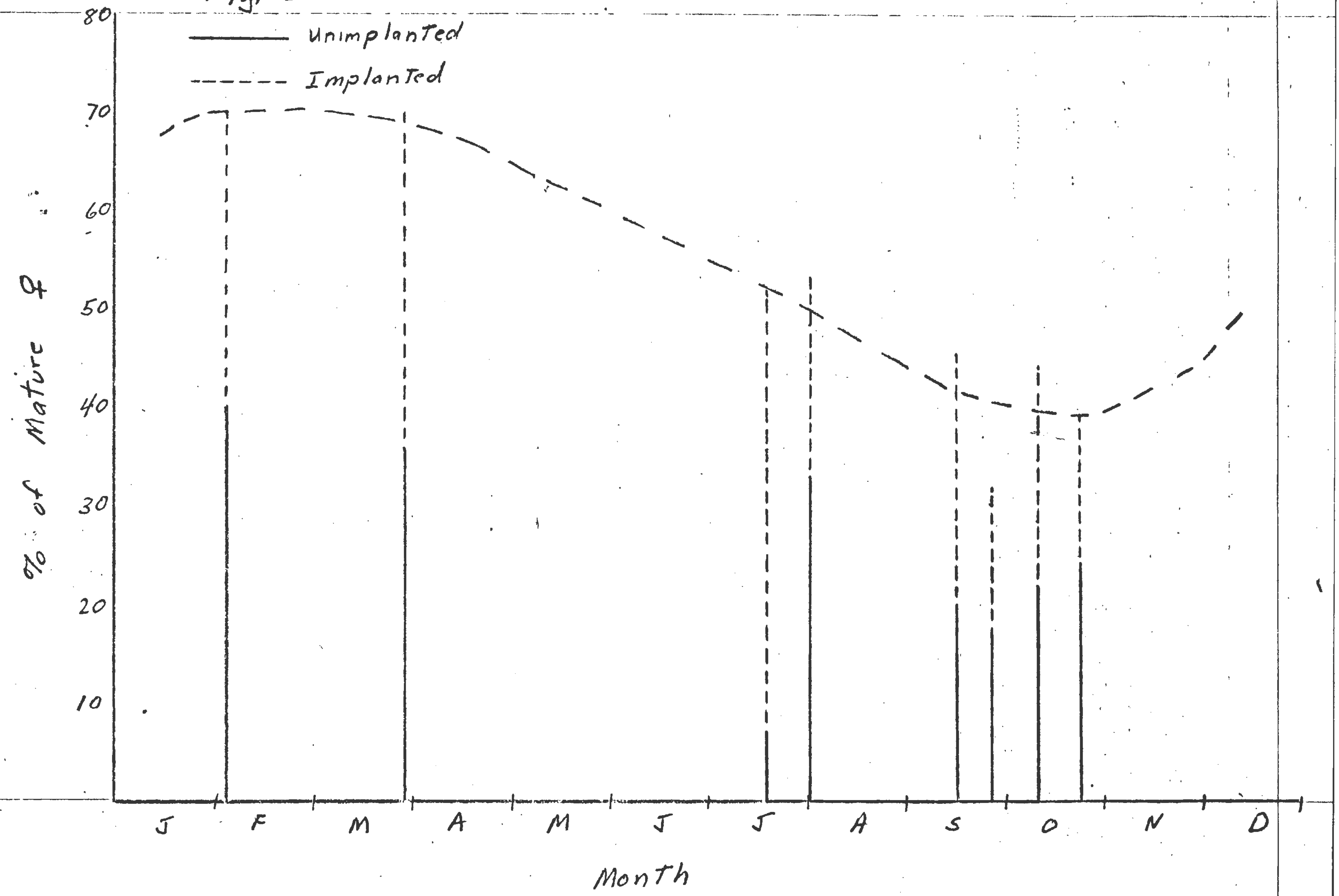


Table 2. Estimated Length of Implanted Period.

A. Percent of Fetuses in each Weight Class.

Time of Collection After January	1	2	3	4	5
1 month	31	15	15	38	0
3 months	18	12	22	35	12
7 months	0	0	22	33	44
9 months	20	7	10	40	23
10 months	14	18	12	33	23

B. Chapman's Estimate Based on 1, 3 and 7 Month Samples.

Mean Time in Months after January	1.7	1.9	4.0	3.5	6.1
Cube root of Unweighted Mean Weight	0.74	2.21	3.27	7.18	11.45

Specific growth velocity = 0.076/day.

Estimated implanted period = 154 days.

C. Estimate Based on all Samples

Mean Time in Months after January	4.8	5.7	5.5	6.0	7.7
Cube root of Unweighted Mean Weight	0.68	1.7	3.5	7.4	11.4

Specific grwoth velocity = 0.113/day.

Estimated implanted period = 109 days.

It should be recognized that using samples from different years and different populations may cause some error.

Chapman carried his estimates on to estimate the unimplanted period by comparing the frequency of unimplanted and implanted pregnancies for each season. He estimated that 60 percent of the pregnancies were unimplanted, therefore the unimplanted period was half again as long as the implanted period. However, he used the very small summer sample and an even smaller fall sample giving them equal weight to the larger samples.

Using the more recent information and throwing out the small samples the estimate is 52 percent of the pregnancies are unimplanted.

Therefore, the two estimates for the total gestation period are:

	Chapman's Estimate	Revised Estimate
Unimplanted Period	154 days	109 days
Establishment of Embryo	15	15
Implanted Period	230	118
Total Gestation Period	~~349~~ 399 days	242 days
or Approximately	13 months	8 months

Neither estimate should be considered precise. In addition to the inherent sampling problems, there is a good possibility that the unimplanted period is variable. The estimates do illustrate the problems involved and the results of the larger sample indicate a gestation period of substantially less than a year. This is more consistent with other information (Fig. 2).

<u>Peaks of Breeding and Pupping</u>
All the curves in Fig 1 and 2 are influenced by more than one variable so it is difficult to draw precise conclusions from them. Generally the curves indicate the greatest number of pups are born in the period from June or July through November and the greatest breeding activity occurs from September through January. The information suggests a gestation period closer to 9 months rather than the 12 months assumed by some studies.

<u>Frequency of Pupping</u>
The mean percentage of pregnant animals throughout the year appears to be about 50 percent of the sexually mature females. This supports the theory that most females pup once every two years.

That females seldom breed while accompanied by a pup is also supported by the fact that only one out of 120 lactating females was definitely pregnant (excluding those with term fetuses). However, Table 3 indicates that an average of 14.2 percent of the lactating females have enlarged follicles or possible corpora lutea. This

Table 3. Reproductive Condition of Lactating Females.

Location	Date	Inactive[1]	Active[2]	% Active
Bay of Is., Adak	Sept. 1967	9	1	10.0
Amchitka	Sept.-Oct., 1967	17	2	10.5
Mid Pt. - Blind Pt., Adak	Oct. 1968	19	3	13.6
Bay of Is., Adak	Oct. 1968	22	4	15.4
Kanaga	Oct. 1968	32	5[3]	13.5
Amchitka	July-Aug, 1969	4	2	33.3
Total		103	17	14.2

1. Anestrous or pregnant with term fetus.

2. Large follicles or corpus luteum present.

3. Includes one implanted pregnancy with small fetus.

indicates that females continue to ovulate or at least go into proestrus while supporting a pup, but only occasionally become pregnant. This is also supported by the fact that one corpus albicans may be formed per year after sexual maturity (Tables 4 - 7). Some lutenization probably occurs and a corpus albicans is formed for each ovulation even though pregnancy does not result. It would appear that a failure to breed every year may be behavioral rather than physiological.

Multiple Ovulation and Twins
The following is a summary of suspected multiple ovulations and twin fetuses. In all cases, the corpora lutea were of similar size and completely separate, often in different ovaries.

Total pregnant females	258
Implanted pregnancies	137
Unimplanted pregnancies with 2 CL(Corpora Lutea)	6
Implanted pregnancies with 2 CL and 1 Fetus	4
Implanted pregnancies with 3 CL and 1 Fetus	1
Implanted pregnancies with 2 CL and 2 Fetuses	4
Total multiple ovulations	15
Number of CL's per pregnancy	1.062
Percent multiple ovulations	5.8%
Percent twin pregnancies	2.9%

In addition to these, one instance of triplets was recorded. All had implanted in the same horn and were being resorbed. Only skeletal fragments remained.

All multiple fetuses appear to be the result of separate ovulations and all had separate placentas, however, all implanted in a single horn.

Age of Sexual Maturity
Tables 4 - 7 list the frequency of numbers corpora albicantia and corpora lutea found in females of different areas. It should be recognized that the ages may not always be exact. Animals from Amchitka appear to become sexually mature when about 4 years old. It appears that more animals may become mature earlier on Adak. The information is too limited to make any definite conclusions from this, however, the food availability is probably better at Adak and an earlier age of sexual maturity may be a response to better nutrition.

Table 4. Frequency of occurance of Numbers of Corpora Albicantia Amchitka - June-August 1968.

AGE (Years)	NUMBER OF CORPORA ALBICANTIA 1	2	3	4	5	6	7	8	9	10	11
0-1											
1-2											
2											
3											
4	1	1									
5	2 (1)										
6	1	1 (1)									
7		2 (1)	1								
8		1		1 (1)							
9				2 (1)	1 (1)	1 (1)					
10	1 (1)	4 (3)	2								1 (1)
11						2 (1)	1				
12	1 (1)		2 (1)	1 (1)							
13									1		
14					1	1 (1)					
15					2		1				
16					1						
17											
18											
19					1						

Numbers inside parentheses = Number of individuals with corpus luteum.

Table 5. Frequency of occurance of Numbers of Corpora Albicantia Kanaga - October 1968.

AGE (Years)	NUMBER OF CORPORA ALBICANTIA 1	2	3	4	5	6	7	8	9	10	11
0-1											
1-2											
2											
3											
4	2 (1)										
5	3	4 (1)	(Plus 2 with corpus luteum but no corpora albicantia)								
6	6 (3)	10(5)	1								
7	4 (4)		1 (1)								
8	4	5 (1)	3								
9	2 (1)	3	2 (1)	3 (3)	1						
10	1	3 (2)	5 (1)		1 (1)		1 (1)				
11	1 (1)	2	3	3 (1)	1 (1)	1					
12		1	4 (1)	1 (1)	2 (1)	1			1		
13		1 (1)	3 (3)	4 (1)	2 (2)		1 (1)				
14			1		1 (1)						
15	1 (1)		2						1	1 (1)	
16		1			1 (1)	1					
17										1 (1)	
18											

Numbers inside parentheses = Number of individuals with corpus luteum.

Table 6. Frequency of occurance of Numbers of Corpora Albicantia Mid Pt.-Blind Pt., Adak - October 1968.

AGE (Years)	NUMBER OF CORPORA ALBICANTIA 1	2	3	4	5	6	7	8	9	10	11
0-1											
1-2											
2	1?	(Plus one with corpus luteum but no corpus albicans)									
3		(One with corpus luteum but no corpus albicans)									
4	2 (1)										
5		1			1(1)?						
6	1 (1)	1									
7		1 (1)									
8			1 (1)	1							
9		2 (1)			1						
10				1	1 (1)		1				
11		1		2	1 (1)						
12			1 (1)	1		1					
13		1	1		1		1				
14				1							
15	1 (1)										
16							1				
17											1
18				1							

Numbers inside parentheses = Number of individuals with corpus luteum.

Table 7. Frequency of occurance of Numbers of Corpora Albicantia
Three Arm Bay - Bay of Islands, Adak - October 1968.

AGE (Years)	NUMBER OF CORPORA ALBICANTIA 1	2	3	4	5	6	7	8	9	10	11
0-1											
1-2											
2	One with corpus luteum but no corpora albicantia										
3	One with corpus luteum but no corpora albicantia										
4	2	1?									
5	1 (1)	3	(Plus one with corpus luteum but no corpora albicantia)								
6	1 (1)	2 (1)									
7	1	2 (2)			1						
8		1 (1)	2 (1)	4 (1)							
9	2 (1)		2 (2)	1 (1)	1						
10	2 (1)		2	2	3	1					
11	1 (1)		2	2	3 (1)						
12			1		1 (1)	2 (1)					
13			2 (1)				1		1 (1)		
14	1										
15		1		1							
16											
17											
18											

Numbers inside parentheses = Number of individuals with corpus luteum.

Frequency of Ovulation

From Tables 4 - 7 it can be seen that the maximum number of corpora albicantia for each age roughly equals the number of years after sexual maturity indicating that some animals ovulated once every year after maturity. It can be assumed that many corpora albicantia are invisible macroscopically after several years, particularly if they are not remnants of a corpus luteum of pregnancy. Therefore, it is possible that most females ovulate every year. This possibility is also supported by the high incidence of large follicles in lactating females. Table 3.

Maximum Breeding Age

Tables 4 - 7 indicate that at least some females continue to breed at a very old age. The samples are to small to determine whether a significant number become unproductive at any point.

Tagged Sea Otters

The following sea otters were released at Amchitka by Battelle Memorial Institute after the nuclear test "Milrow". Each otter wore a single monel metal cattle tag in a hind flipper.

Tag No.	Sex	Weight	Date & Location
1101	♂	26 lb.	
1102	♂	43	
1103	♀	30	
1104	♀	35	
1106	♂	47	
1107	♀	44 w/pup	Released at Constantine Harbor 10/6/69 or 10/12/69.
1108	♂	47	
1109	♀	50	
1120	♀	34	
1122	♂	32	
1124	♀	38	
1125	♂	36	
1110	♂	57	
1111	♀	48	2 released west of Rifle Range Pt. 10/2/69.
1112	♀	44	2 released Constantine Hbr. 10/6/69.
1113	♂	39	
1116	♂	54	
1117	♀	29	2 escaped west of Rifle Range Pt. 10/2/69.
1119	♀	40	1 released Constantine Hbr. 10/6/69.