BERING SEA HERRING

AERIAL SURVEY MANUAL

(BRISTOL BAY DATA REPORT, NO. 85-2)

BY

ROBERT C. LEBIDA

AND

D. CRAIG WHITMORE

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES

ANCHORAGE, ALASKA

MARCH 1985

TABLE OF CONTENTS

Page

LIST OF APPENDICES.....iii

INTRODUCTION..... 1

OBJECTIVES..... 3

STUDY AREA..... 4

Bristol Bay..... 4

Togiak District..... 4

Kulukak Section..... 4

Nunavachak Section..... 4

Togiak Section..... 4

Hagemeister Section..... 4

Kuskokwim..... 5

Security Cove District..... 5

Goodnews Bay District..... 5

Jacksmith Bay Area..... 5

Anogok Area..... 6

Nelson Island District..... 6

Nunivak Island District..... 6

Yukon

Cape Romanzof District..... 6

Arctic

Norton Sound District..... 7

Port Clarence District..... 7

Kotzebue District..... 7

METHODS

Equipment..... 8

Assessment of Herring School Size..... 8

Assessment of Herring Spawn..... 14

Assessment of Commercial Fishing Effort..... 15

Climatological Data Collection..... 15

Survey Data Collection..... 16

In-season Data Analysis..... 17

Computation of relative abundance indices (RAI)..... 17

Computation of biomass..... 19

Related Studies and Considerations..... 20

Helicopter surveys..... 20

Biomass conversion estimates..... 21

Capelin investigations..... 22

APPENDIX..... 24

LIST OF APPENDICES

Appendix		Page
I.	Bering Sea herring aerial survey index area maps	24
II.	Herring aerial survey data forms	25
III.	Instructions for use of a sighting tube	26
IV.	Instructions for use of an optical reading clinometer	27
V.	Altitude conversion tables for aerial survey calculations	29
VI.	Sample aerial survey data recording	30
VII.	Biomass conversion estimate procedures	31

INTRODUCTION

The purpose of this manual is to outline specific procedures to be used when conducting herring aerial surveys and to identify problems involved in interpreting results. Management of the eastern Bering Sea Pacific herring resource is largely based upon information obtained through aerial surveys. It is important, therefore, that methods used in conducting and assessing results of such surveys be standardized for individual commercial fishing districts within this large geographic area, especially since surveys in the same district may often be flown by different observers.

Aerial surveys must be integrated with test fishing, catch sampling and spawning substrate studies to provide a basis for management decisions. Aerial surveys are also to be used to provide information on capelin which may become the focus of future commercial fishing ventures. Most capelin information will be obtained during routine herring surveys. However, it will be necessary to obtain biomass conversion factors, if actual abundance of capelin is to be estimated.

Various problems exist in using aerial surveys to assess herring abundance:

1. species composition of schools observed during surveys is sometimes questioned and often not confirmed through test fishing;

2. survey coverage is often limited by adverse weather, poor water clarity and lack of funding;

3. movement patterns of herring schools prior to, during and after spawning are not known; therefore, since schools could be enumerated more than once, only the peak daily survey can usually be used as the season's biomass estimate;

4. spawning herring (observed as cloudy areas of milt) are recorded as "miles of spawn," but this information cannot be used in calculating relative abundance or biomass (i.e. only schooled herring can be counted);

5. few determinations have been made relating school surface area to biomass (i.e. 19 estimates have been made in Bristol Bay; only six of these were based on actual landing of captured herring);

6. behavior of herring in relation to various physical (e.g. water depth, time of day, etc.) and physiological (e.g. sexual maturity, spawning condition, etc.) factors are not known and could affect survey and biomass conversion results.

Analysis of aerial survey results should be done with these shortcomings in mind. Special effort should be made to solve some of these problems. It will be particularly important to schedule as many surveys as possible during the season, to sample several schools of questionable species composition through coordination with ADF&G test fishing crews, and to obtain more estimates of biomass per surface area of fish school (in Security Cove and Norton Sound as well as Bristol Bay).

This manual is subject to revision pending refinement or development of techniques and procedures.

OBJECTIVES

Specific objectives of herring aerial surveys are to:

1. determine seasonal distribution and relative abundance of herring schools and spawn within each fishing district;

2. estimate the biomass of schooled herring by converting surface area estimates to short ton equivalents;

3. determine species composition of fish schools sighted by working with test fishing crews;

4. compare the accuracy and repeatability of aerial surveys;

5. document movement of herring schools in relation to time of day and stage of tides;

6. estimate commercial fishing effort (and effort distribution) for the sac roe, food/bait and roe on kelp fisheries; and

7. develop new techniques for accurate biomass assessment.

Approximate dates for survey coverage are indicated with index area maps (Appendix I).

STUDY AREA

I. Bristol Bay - Togiak District (15 April - 15 June)

A. Kulukak Section

1. Nushagak

a. Cape Constantine to Kikertalik Lake (NUS-1).

b. Kikertalik Lake to western spit of Tvativak Bay (NUS-2).

2. Kulukak - western spit of Tvativak Bay to Metervik Bay Point (KUK-1).

3. Metervik - Metervik Bay Point to Right Hand Point (MET-1).

B. Nunavachak Section

1. Nunavachak - Right Hand Point to Ungalikthluk Point (NVK-1)

2. Ungaliktnluk - Ungalikthluk Point to Anchor Point including Summit Island (UGL-1).

C. Togiak Section

1. Togiak - Anchor Point to Togiak Reef (TOG-1).

2. Tongue Point - Togiak Reef to Tongue Point (TNG-1).

D. Hagemeister Section

1. Motogak - Tongue Point to Estus Point (MTG-1).

2. Osviak - Estus Point to Norseman Lake (OSK-1).

3. Pyrite Point - Norseman Lake to Tokomarik Point (PYR-1).

4. Cape Newenham - Tokomarik Point to Cape Newenham (CN-1).

5. Hagemeister Island (HAG-1).

II. Kuskokwim (1 May - 20 June)

A. Security Cove District.

1. Security Cove - Cape Newenham to Pinnacle Rock (SC).

2. Chagvan - Pinnacle Rock to Salmon River (CGV).

3. South Red Mountain - Salmon River to valley between Thorenson Mt. and Red Mt. (SRM).

B. Goodnews Bay District

1. North Red Mountain - valley betwen Thorenson Mt. and Red Mt. to Seattle Creek (NRM).

2. Goodnews Bay Entrance - Seattle Creek to south edge of Nanvakfak Lake (GBE).

3. Goodnews Bay - all water of Goodnews Bay (GB).

4. Carter Bay - south edge of Nanvakfak Lake to north point of Carter Spit (CB).

C. Jacksmith Bay Area

1. Cripple Creek South - north point of Carter Spit to Cripple Creek (CCS).

2. Cripple Creek North - Cripple Creek to Jacksmith Point (CCN).

3. Jacksmith Bay - Jacksmith Point to Quinhagak (JSB).

D. Anogok Area

1. Ishkowik - Ishkowick R. to Kwigillinok (ISH)

2. Kwig - Kwigillingok to Cape Avinof (KW).

3. Kinak Bay - Cape Avinof to Kinia River (KB).

4. Koavinarak River - Kinia River to Kolavinarak River (KR).

5. Chinigyak Cape - Kolavinarak River to Chinigyak Cape (CC).

E. Nelson Island District

1. Kangirlvar Bay - Chinigyak Cape to Umkumiut (KGB).

2. Cape Vancouver - Umkumiut to Taluvarevuk Pt. (CPV).

3. Tanunak Bay - Taluvarevuk Pt. to Nilikluguk (TAB).

4. Nilikluguk - Nilikluguk to the tundra flats (NLK).

5. Kigigak - tundra flats to Kigigak Island (KIG).

F. Nunivak Island District

1. Ingrumiut - Dunulimjingia Pt. to Twin Mt. (ING).

2. Cape Corwin - Twin Mt. to Cape Mendenhal (CCW).

3. Binajoak - Cape Mendenhall to Jayalick River (BIN).

4. Bluff - Jayalik R. to Cape Monican (BLF).

5. Mikisag - Cape Monican to Cape Algonquin (MIK)

6. Abaramiut - Cape Algonquin to Kikartik Rock (ABA).

7. Mekoryuk - Kikartik Rock to Dunulimjingia Pt. (MEK).

III. Yukon

A. Cape Romanzof District (20 May - 1 July)

1. Kokecnik Bay - all waters of Kokecnik Bay (KB).

2. Scammon Bay - Cape Romanzof to Kun River (SB).

IV. Arctic

A. Norton Sound District (15 May - 15 July)

1. Klikitarik - Cape Stebbins to Spruce Creek (including Stuart Island) (KIK 1 & 2).

2. Unalakleet - Spruce Creek to Junction Creek (UNK).

3. Cape Denbigh - Junction Creek to Island Point (CD).

4. Norton Bay - Island Point to Kwiniuk River (NIB).

5. Elim - Kwiniuk River to Cape Darby (ELM).

6. Golovin - Cape Darby to Rocky Point (GOL).

7. Nome - Rocky Point to Cape Douglas (BLF 1 & 2, NOM, SIN and WOL).

B. Port Clarence District (1 June - 15 July)

1. Port - Cape Douglas to N.W. shore of Brevig Lagoon (PTC).

2. York - N.W. shore of Brevig Lagoon to Cape Prince of Wales (YOR).

C. Kotzebue District (1 June - 15 July)

1. Shishmaref - Inlet and coastal waters from Cape Prince of Wales to Cape Espenberg (SHI).

2. Circle - Cape Espenberg to Goodhope River (CIR)

3. Deering - Goodhope River to Garnet Point (DER).

4. Kotzebue - Garnet Point to Pipe Spit (KOZ).

5. Hotham Inlet - all waters of Hotham Inlet from Pipe Spit to Nimiuk Point (HOT).

6. Shesnalik - Pipe Spit to Cape Krusenstern (SHE).

METHODS

I. Equipment

A. Polaroid sunglasses

B. Sighting tube with calibrated grid

C. Survey index maps

D. Dictaphone and cassettes (optional)

E. Clinometer

F. Survey data forms: Herring Aerial Survey Summary, Herring Aerial Survey District Summary, Herring Biomass Conversion Estimate Worksheet, and Herring Biomass Conversion Estimate Summary (Appendix II).

G. Pencils

H. Watch

I. Stop watch

J. Photographic equipment (as required or optional)

II. Assessment of Herring School Size

A. Record the size, location and observation angle of all fish schools sighted on survey maps classifying each school or groups of schools to appropriate water depths.

1. Water depths of 16 ft (5 m) or less.
2. Water depths between 16 ft (5 m) and 26 ft (8 m).
3. Water depths greater than 26 ft (8 m).

B. All fish schools sighted during surveys will be enumerated according to size category or actual surface area.

1. Small - surface area less than or equal to 538 ft^2 (50 m^2).

2. Medium - surface area greater than 538 ft^2 (50 m^2) but less than or equal to 4,841 ft^2 (450m^2).

3. Large - surface area greater than 4,841 ft^2 (450 m^2) - every effort should be made to estimate actual surface area or every large school sighted rather than simply recording them as "large".

C. Several techniques can be used to help estimate school surface areas.

1. A sighting tube with a grid of known focal length should be used to provide a reference scale to estimate fish school surface area (Appendix III).

a. The grid can be calibrated for any survey altitude, when length of the grid reference line (L), focal length of tube (F), and survey altitude (A) are known, by using the equation:

x = ground distance covered by reference line = $A\ (L/F)$.

b. Results of calculations for six different survey altitudes are presented in Appendix III. <u>An altitude of 1500 feet is recommended.</u>

c. Use of the grid is important, particularly for large schools.

d. For elliptical shaped schools, maximum length and maximum width will provide a rough estimate (over-estimate) of surface area; for irregularly shaped schools (U-shaped, long wavy bands, etc.) measure length and width of separate sections and combine for a total estimate.

1. Fly directly over each school to achieve best length and width measurements.

2. When schools are off the flight path utilize a clinometer (Appendix IV) and altitude conversion tables (Appendix V) for calculating school size adjustment factors.

3. Record the clinometer reading angle on the survey maps for all fish schools sighted off the flight path.

4. Calibrate eye to known ground references and use vessels, nets, islands, coast, etc., as size scales when schools are nearby.

5. Aircraft airspeed can be used to get a rough measure of extremely long schools that either extend offshore where size reference points may not be available or along the shore where no landmarks to guage distance are available.

   a. Use a stopwatch to determine the time needed to traverse the length of the entire school (the sighting tube may be sufficient to estimate width) at a constant, pre-determined, airspeed and calculate the school length and area by using the equations:

$$L = SCT \quad \text{where:}$$

L = school length,

S = airspeed (kts, mph, km/h),

C = constant - ft/sec (1 kt = 1.69 ft/sec; 1 mph = 1.47 ft/sec; 1 km = 0.91 ft/sec),

T = time to fly length of school (seconds)

then:

$A = LW$ where:

A = area,

L = length of school,

W = width of school.

Example: If it takes 75 seconds to traverse a school at 130 kts (150 mph, 240 km/h), with an average width of 100 ft, the school length is 16,478 ft and the area is 1,647,800 ft^2.

L = 130 kts x 1.69 ft/sec x 75 sec = 16,478 ft

A = 16,478 ft x 100 ft = 1,647,800 ft^2

<u>Conversion Table</u>

1 kt = 1.15 mph; 1.85 km/h

1 mph = 0.87 kt; 1.60 km/hr

1 km/h = 0.54 kt; 0.62 mph

b. To obtain an accurate measure of school length, actual aircraft speed in relation to the ground must be known. This requires the use of vector arithmetic, i.e. you must know wind speed and

direction. Since this is usually not possible, make two transects along the school from opposite directions and average the results. Remember, if the plane travels downwind the school length will be underestimated; if the plane travels upwind, the school length will be overestimated.

6. Aerial photographs or video tapes can be used as a post-season check on the accuracy of surface area estimates made during the season. Calculation of distance is done using the same equation given for the sighting tube grid (where F = camera focal length).

   a. Pictures should be taken when the aircraft is directly over a fish school to minimize distortion of distance and shape.

   b. Try to take pictures at altitudes high enough to include ground size reference points.

   c. Be sure to indicate on survey maps and data forms the film roll and frame numbers which correspond to each school.

7. Locations of large schools of questionable species composition should be reported to test fishing crews so that actual fish samples can be obtained.

III. Assessment of Herring Spawn

A. Areas in which herring are spawning appear cloudy (milky) when seen from aircraft due to presence of milt in water.

B. All areas of herring spawn should be noted and recorded on maps and appropriate data forms.

1. Estimate length and width (extent) of spawn patch as you would size of fish schools (see previous section, II. Assessment of Herring School Size, B. Techniques) and record on survey map. Note whether the patch has been dispersed along shore or offshore by wind and water currents.

2. Record combined lengths of all spawn patches seen during a survey in miles on survey summary forms.

3. Report location of spawn patch to ground crews so that surveys can be made to assess intensity and density of spawn.

IV. Assessment of Commercial Fishing Effort

A. Record numbers and locations of fishing vessels and tenders/processors sighted during surveys on maps. Include all vessels present.

B. Record pertinent information on survey maps such as number of vessels actually fishing (i.e. setting gear or pulling gear), waiting to deliver, pumping fish, etc.

C. Record occurrence of kelp harvesting and try to estimate effort level (number of people, skiffs, etc.) if possible. Record this information on survey maps.

D. Make a special effort to locate evidence of wastage (i.e. fishermen dumping herring from vessels, piles of dead herring on beach or in shallow water, etc.) - follow such observations with investigations on the ground through coordination with field crews.

V. Climatological Data Collection

A. Be sure to record for every index area: wind speed and direction, percent cloud cover, water clarity, and general survey conditions rated from 1 (Excellent) to 5 (Unacceptable).

B. Other comments concerning weather should be placed under Comments section of the data form, if these are thought to be important.

C. Secchi discs (photometers if available) should be used by ground crews to provide an objective measure of actual water clarity in some index areas.

VI. Survey Data Collection (Also see Appendix VI)

A. Record time survey began and ended and draw flight path on survey map. The flight path will, in general, follow the coast line of index areas.

B. Surveys from fixed wing aircraft have been flown at altitudes ranging from 300 to 1,500 ft and airspeeds ranging from 80 to 140 knots (92 to 161 mph). Use your judgement and the pilot's in determing safe operating altitudes and speeds (record altitude and airspeed used in surveying each index area under comments section of data form or on survey maps).

C. Conduct surveys during times of low water (i.e. towards end of ebb or beginning water or flood tide) whenever possible to ensure comparability with results of past surveys. Additional surveys can be made during other tide stages to determine whether this affects survey results.

D. Record fish school sightings, area of spawn and commercial fishing effort on survey maps.

E. Observations concerning weather, survey conditions, etc. should either be recorded on maps or read onto dictaphone tape.

F. Please use standard symbols on maps to help eliminate post-season confusion during data analysis.

G. Make sure that any pictures taken (fish schools, spawn, fishing violations, etc.) are recorded on maps with film roll and frame numbers including date and exact time.

H. The dictaphone can be used to make any detailed observations you feel are pertinent - however, be sure that all standard observations are recorded on maps during flights to ensure that this information is not lost.

I. After surveys are completed, tally numbers of small, medium, and large schools and record in appropriate space on survey maps.

J. Complete survey summary data forms upon returning using information from maps and dictaphone.

VII. In-season Data Analysis (Also see Appendix VI)

A. Computation of relative abundance indices (RAI's; Herring Aerial Survey Summary)

1. Total fish school counts are to be converted to total fish school surface area for each water depth classification or each index area during each survey date.

2. Surface area for each school is expressed as a multiple of 538 ft^2 (50 m^2 the maximum area of a "small" school i.e. 1 R.A.I. = 538 ft^2 [50 m^2]), therefore, total counts of each size category are expressed in R.A.I.'s as follows:

   a. Each small school = 1 R.A.I.

   b. Each medium school = 5 R.A.I.'s (approximate midpoint of size range 549 - 4,841 ft^2 [51-450 m^2] is 2,690 ft^2 [250 m^2], which is 5 x 538 ft^2 [50 m^2]).

   c. Each large school = actual surface area/538 ft^2 (50 m^2) = number of R.A.I.'s.

3. The following equation is used to calculate total R.A.I.'s for each area after each survey:

   Total R.A.I.'s = (total number of small schools x 1) + (total number of medium schools x 5) + (total surface area [ft^2] of large schools/538 ft^2).

B. Computation of biomass (short tons of herring present)

1. Total R.A.I.'s for each index area during each survey will be converted to equivalent <u>short tons</u> of herring using the equation:

Biomass = Total R.A.I.'s x Z*

a. All districts

1) Z = 1.52 st/R.A.I. for water depths of 16 ft(5 m) or less.

2) Z = 2.58 st/R.A.I. for water depths between 16 ft(5 m) and 26 ft(8 m).

3) Z = 2.83 st/R.A.I., the mean of all biomass conversion estimates previously attempted, for water depths greater than 26 ft (8 m) or if no depth information is available.

*based upon 1983 analysis of all data.

2. Conversion factors can be modified later in the season, if additional estimates are obtained.

3. Refer to district coastal charts to obtain water depth information (AYK Region).

<u>Conversion Table</u>

1 short ton = 2,000 lb = 0.91 mt

1 metric ton = 2,205 lb = 1.1 st

VIII. Related Studies and Considerations

A. Helicopter surveys (Bristol Bay only)

1. Three important survey functions will be provided by a helicopter.

a. Increased assessment capabilities by providing an aircraft on the fishing grounds.

1) Surveys can be flown with less advance notice and increased frequency without relying entirely upon flights from Dillingham.

2) By conducting multiple surveys of selected areas throughout the day and at various tide stages, information can be obtained on herring abundance and distribution in relation to these factors.

b. Examination of repeatability and accuracy of surveys by determining daily changes in herring abundance and distribution.

1) Results of multiple helicopter surveys during the same day [see a. (2) above] may indicate whether there are "best" time periods to conduct surveys (e.g. whether herring move inshore during certain times of the day or otherwise

become more accessible to being enumerated through surveys).

2) Estimates of school surface area may be easier and more accurate using a helicopter, since this aircraft can hover above a school. (This will also simplify photographing schools.)

c. Greater ability to sample fish schools of questionable species composition, since test fish crews and gear can be transported by helicopter to desired locations.

B. Biomass conversion estimates (Also see Appendix VII)

1. Commercial purse seiners should be chartered (using short term vessel contracts or on volunteer basis) to capture herring schools whose surface area has first been estimated by ADF&G aerial surveyors.

2. Close cooperation and coordination must be maintained between the chartered seiner, his spotter pilot and the ADF&G observers.

3. Surface area and tonnage estimates should be obtained from the commercial spotter pilot prior to attempts to capture schools for comparison with independent ADF&G observer estimates.

4. Whenever possible, water depth at capture site should be determined from chartered vessel (i.e. from fathometer or sounding line with lead).

5. Upon delivery to buyer, a sample of the catch from the school should be taken to determine maturity stage, age and size.

6. It may be desirable to place an ADF&G employee aboard the seiner to determine water depth and temperature and to obtain a sample of the catch.

C. Capelin Investigations

1. Surveyors should record number and size of capelin schools and occurrence of spawning during routine herring assessment surveys.

2. If time allows, biomass conversion estimates may be made on selected capelin schools (see B. Biomass conversion estimates). When chartering a vessel for this, be sure the purse seine gear is suitable for capturing capelin.

3. Close cooperation and coordination should be maintained between surveyors and the capelin project biologist so that samples of capelin schools can be obtained.

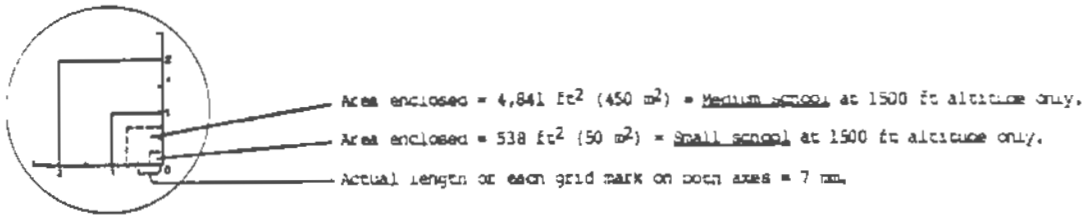
4. Additional aerial surveys for capelin may be required during or after the herring spawning season as time, personnel and funding allow.

APPENDIX I

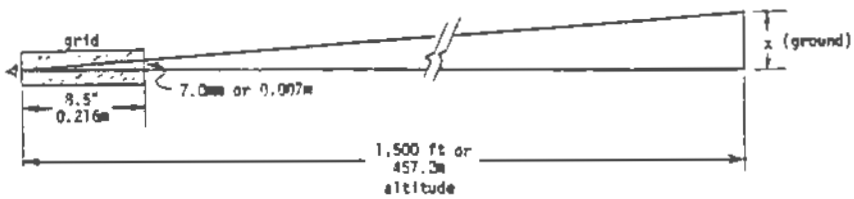
Bering Sea herring aerial survey index area maps.

Sighting Tube

This device was prepared to help aerial surveyors estimate surface areas of fish schools. The distance between the grid and your eye (focal point) is 8.5 inches (216 mm). Actual tube length is 7.75 in (197 mm). This length adjustment of 0.75 in (19 mm) compensates for the distance between the eye and polaroid glassses the observer wears which maintains an overall 8.5 in (216 mm) focal length. Lengths of grid reference marks are given below:



The following is an example illustrating how ground distances can be estimated using the sighting tube:



At 1,500 ft (457 m), the ground distance represented by the 0 – 1 mark on the grid (14 mm long) = survey altitude X $\left(\frac{\text{grid line length}}{\text{sighting tube focal length}}\right)$

$$= 457 \text{ m} \times \frac{14 \text{ mm}}{216 \text{ mm}} = 30 \text{ m or approximately 100 ft}$$

For quick reference, the following table can be used:

Approximate Ground Distance (ft) from 0

Survey Altitude (ft)	⊥	1	⊥	2	⊥	Tube Diameter	Sides of □	Sides of ⊓
500	16	32	48	65	81	115	8	23
600	19	39	58	78	97	139	10	28
700	23	45	68	91	113	162	11	32
800	26	52	78	104	130	185	13	37
900	29	58	87	117	146	208	15	42
1000	32	65	97	130	162	232	16	46
1100	36	71	107	142	178	254	18	51
1200	39	78	117	156	195	278	19	56
1300	42	84	126	168	211	301	21	60
1400	45	91	136	182	227	324	23	65
1500	49	97	146	194	243	347	24	69
1600	52	104	156	208	259	371	26	74
1700	55	110	165	220	275	393	28	79
1800	58	117	175	233	292	417	29	83
1900	62	123	185	246	308	440	31	88
2000	65	130	195	259	324	463	32	93
2100	68	136	204	272	340	486	34	97
2200	71	143	214	285	357	510	36	102
2300	75	149	224	298	373	532	37	106
2400	78	156	233	311	389	556	39	111
2500	81	162	243	324	405	579	41	116
2600	84	169	253	337	422	602	42	120
2700	88	175	263	350	438	625	44	125
2800	91	182	272	363	454	649	45	130
2900	94	188	282	376	470	671	47	134
3000	97	195	292	389	486	695	49	139

Appendix IV

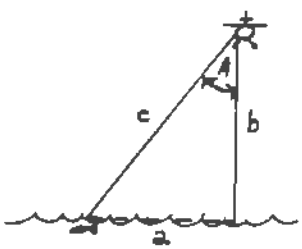
Clinometer

This instrument is used to determine the angle (A) at a known altitude (b) from which fish schools (shore, etc.) are observed and measured. Actual observation distance (c) and horizontal (ground) distance (a) of the fish school (shore, etc.) from the flight path can also be determined by applying trigonometric formulae for the solution of a right triangle. All calculations have been completed for various altitudes and are listed on separate tables (Appendix V).

Clinometer readings are usually taken with the right eye. It is of prime importance, regardless of which eye is used, that both eyes are kept open. The supporting hand must not obstruct the vision of the other eye.

The instrument is held before the reading eye so that the scale can be read through the prism optics which should face to the left. The instrument is aimed at the object by raising or lowering it until the hair line is sighted against the point to be measured. At the same time the position of the hair line against the scale gives the reading. Owing to an optical illusion the hair line (crosshair) seems to continue outside the frame and is thus easily observed against the terrain of the object.

The left-hand scale gives the slope (observation) angle in degrees from the horizontal plane at eye level. The right hand scale gives the height of the point of sight from the same horizontal eye level and is expressed in percent of the horizontal distance.



Given: A = 90°-clinometer reading (90°-70°=20°)
b = altitude (1500 ft)

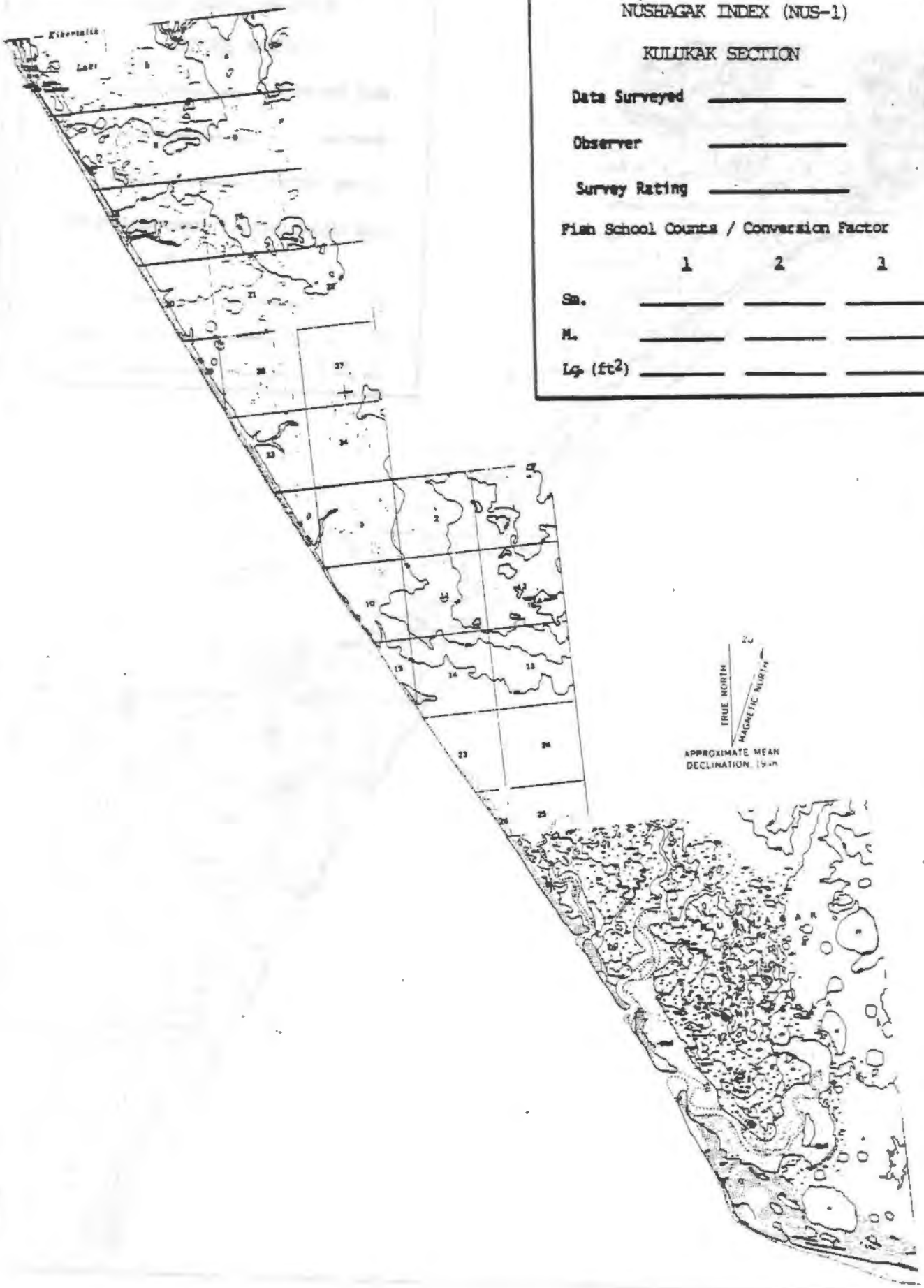
a = b tan A	c = b/cos A
= 1500 x tan 20°	= 1500/cos 20°
= 1500 x .3640	= 1500/.9397
= 546 ft (.1 mi)	= 1,596 ft (.3 mi)

The size adjustment factor compensates for the difference in size of a fish school measured at a greater distance than the actual altitude due to the observation angle being other than vertical. The factor is calculated as the percent increase in size between a vertical observation and an observation of X°.

e.g. Observ. angle = 20°; Altitude = 1500 ft; Observ. distance = 1596 ft

Using:

Ground Distance (GD)
GD = altitude x .032407 $\left(\text{constant} = \frac{\text{7 mm grid line length}}{\text{216 mm (8.5 in focal length)}}\right)$



NUSHAGAK INDEX (NUS-1)

KULUKAK SECTION

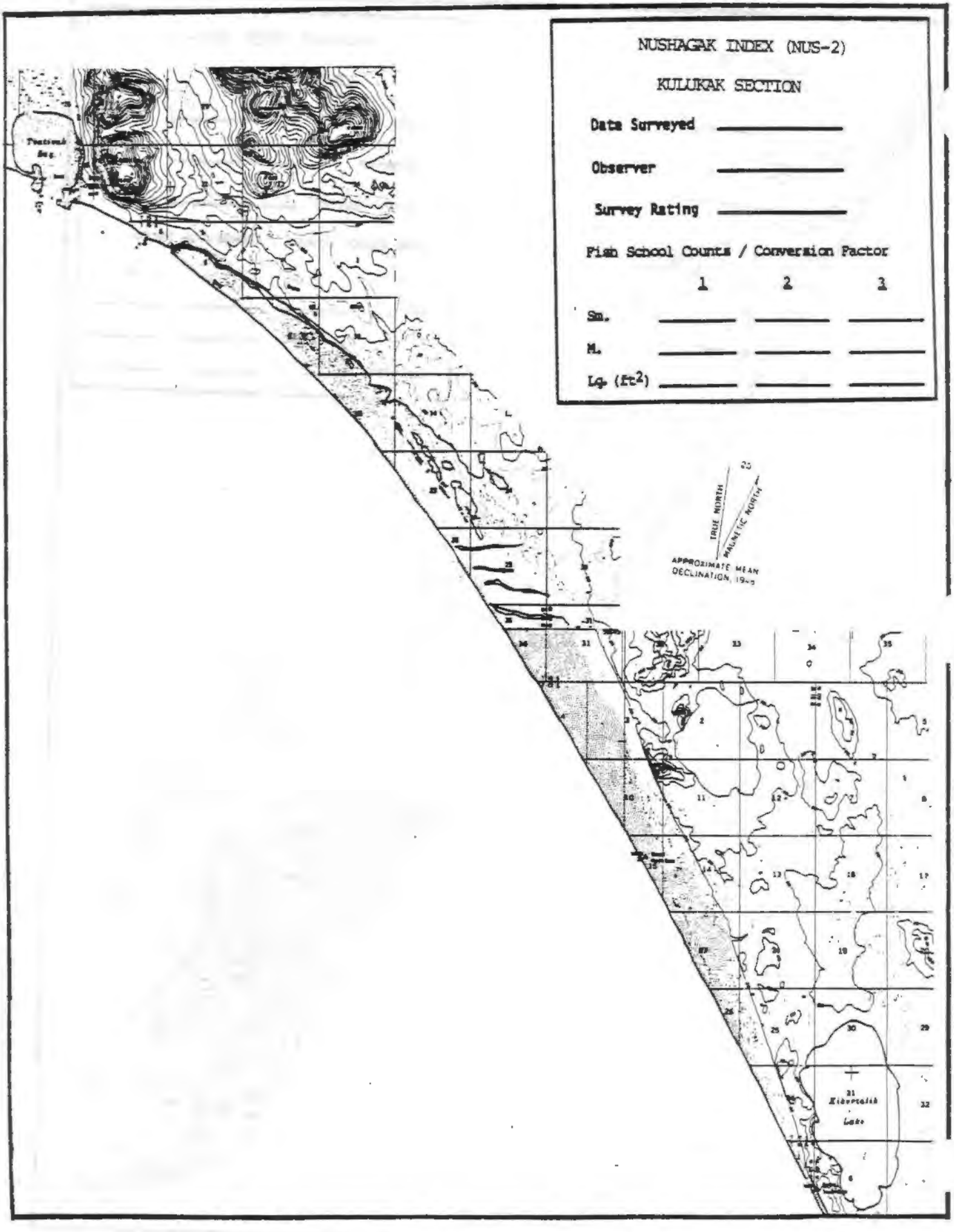
Data Surveyed _____

Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft^2)			


NUSHAGAK INDEX (NUS-2)
KULUKAK SECTION
Date Surveyed
Observer
Survey Rating
Fish School Counts / Conversion Factor
1
2
3
Sm.
M.
Lg. (Ft2)
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1949

BSH-MAP/103

KULUKAK INDEX (KUK-1)

KULUKAK SECTION

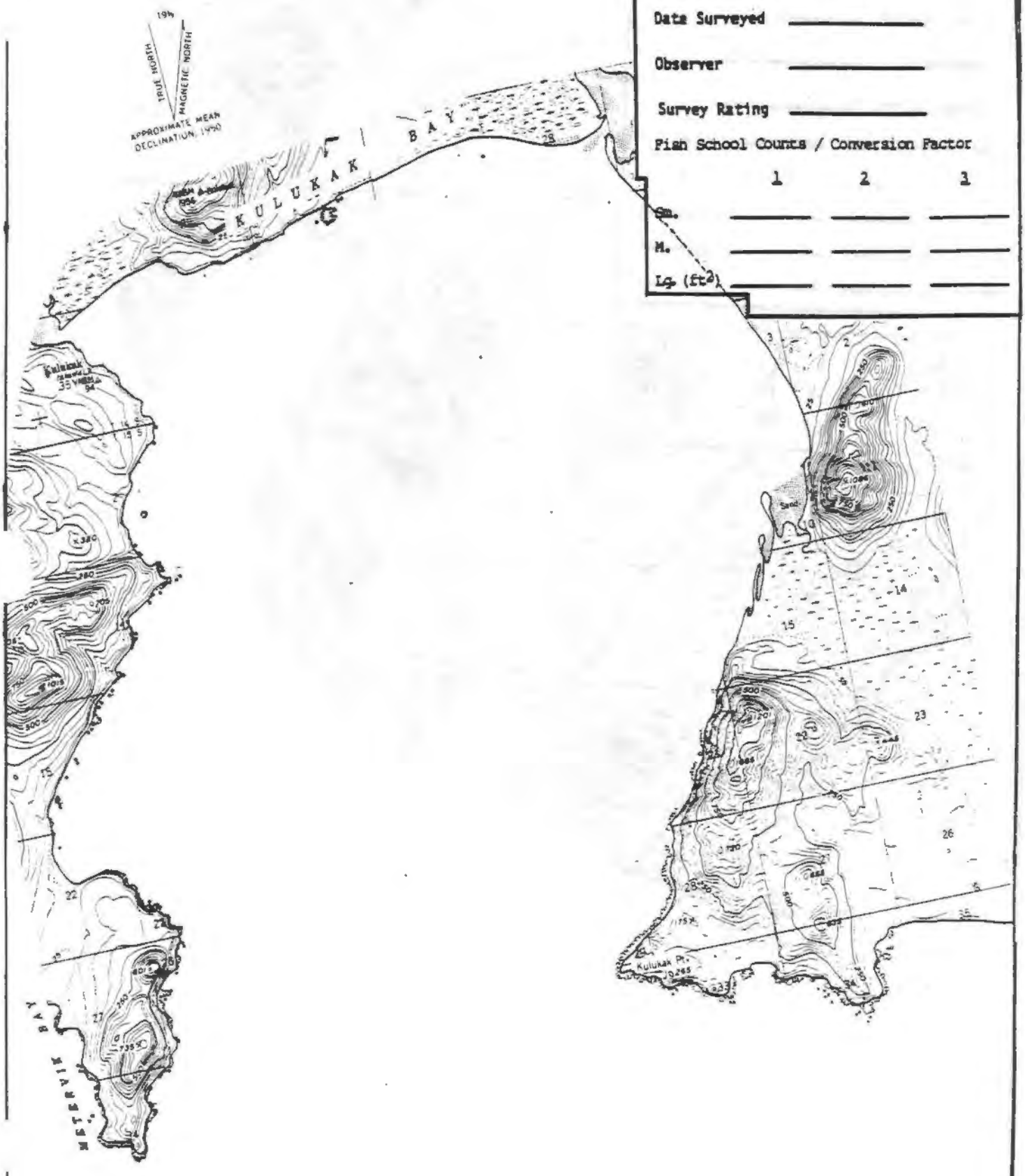
Date Surveyed _____

Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg (ft^2)			



BSH-MAP/104

METERVIK INDEX (MET-1)

KULUKAK SECTION

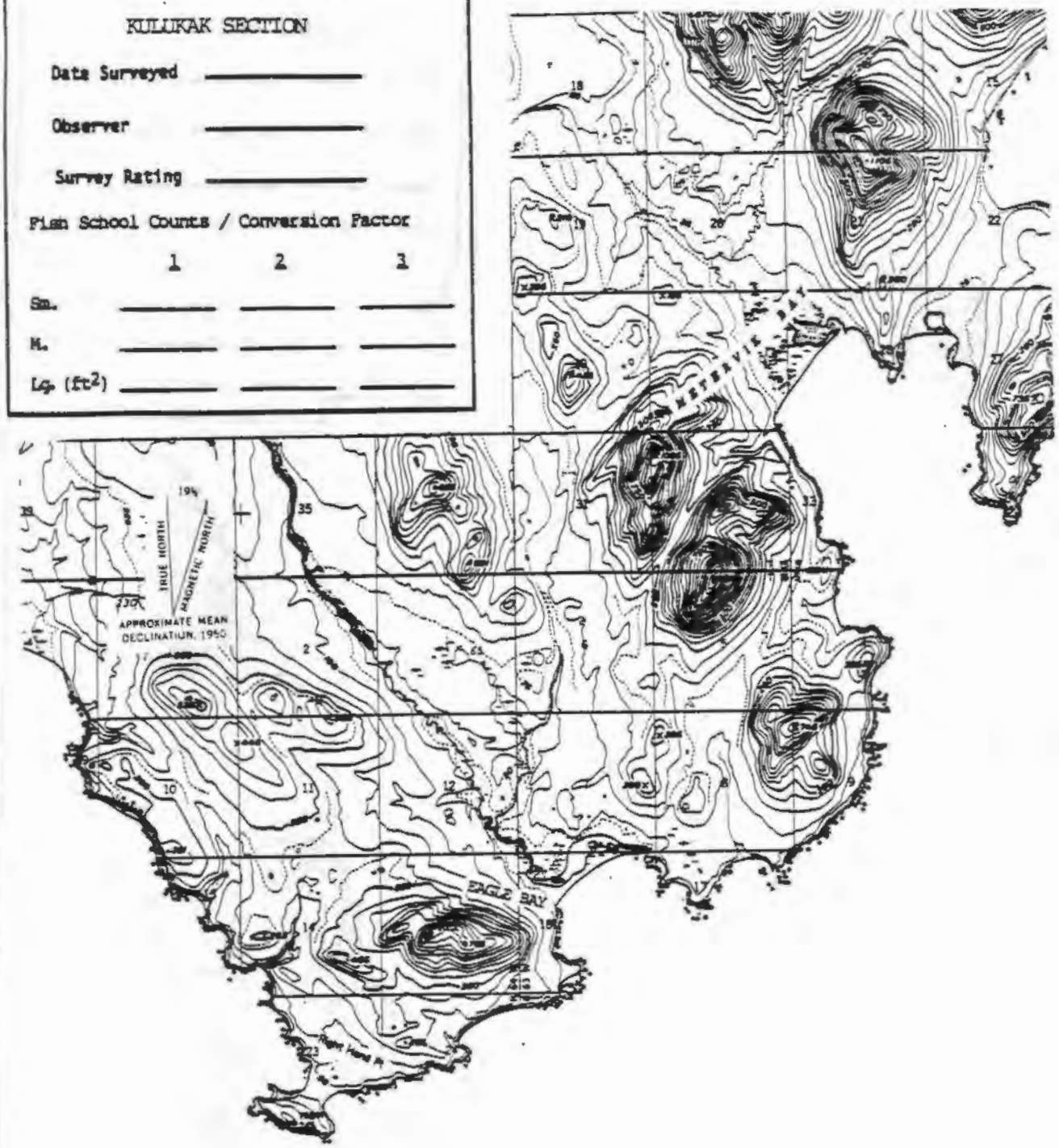
Date Surveyed _____

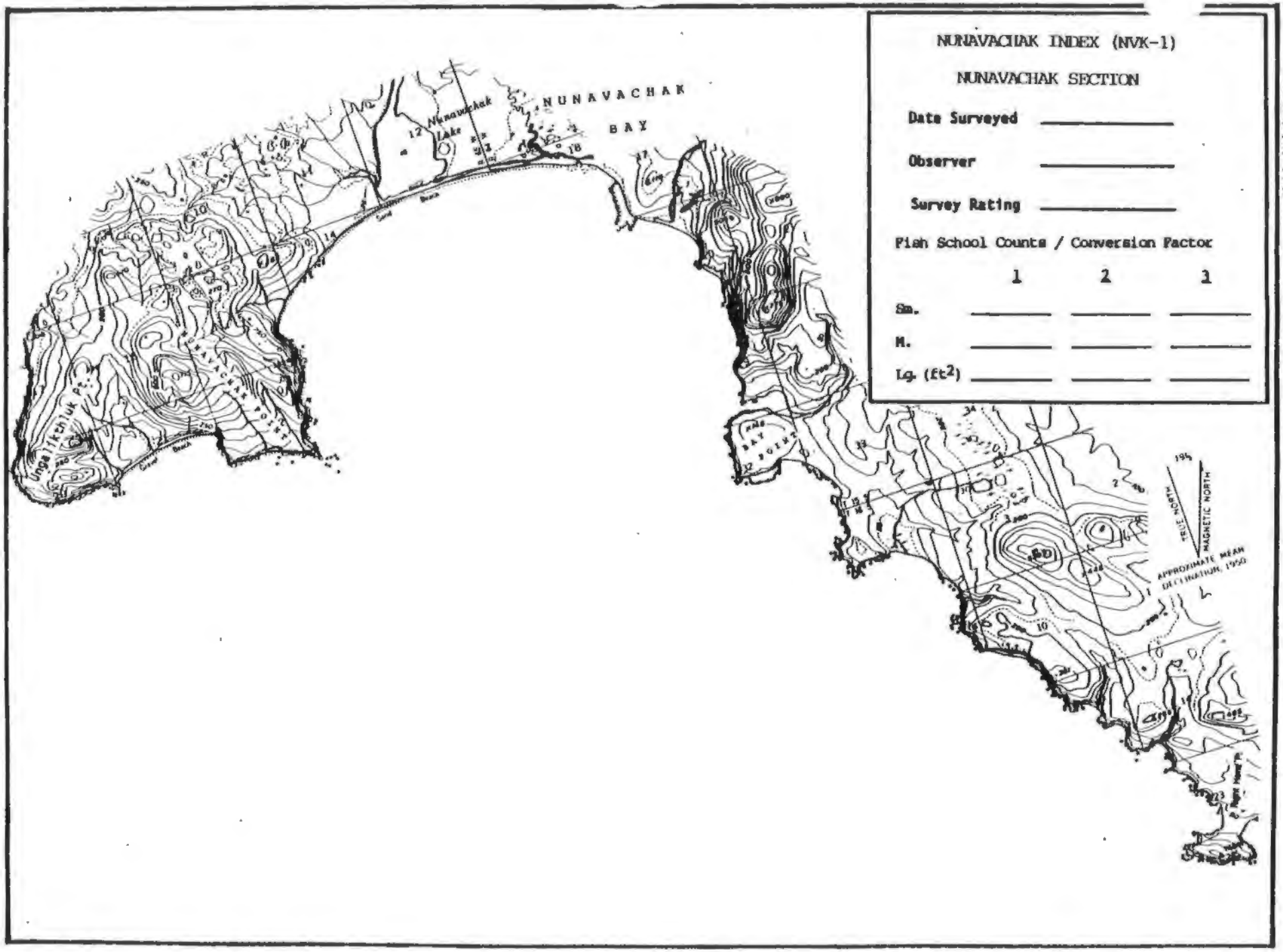
Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.	_____	_____	_____
M.	_____	_____	_____
Lg. (ft^2)	_____	_____	_____




NUNAVACHAK INDEX (NVK-1)
NUNAVACHAK SECTION
Date Surveyed
Observer
Survey Rating
Fish School Counts / Conversion Factor
1
2
3
Sm.
M.
Lg. (ft2)
NUNAVACHAK BAY
Nunavachak Lake
Ungalikchuk P.
NUNAVACHAK POINT
BAY POINT
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1950

BSH-MAP/105

BSH-MAP/106

UNGALIKTHLUK INDEX (UGL-1)

NUNAVACHAK & TOGIAK SECTIONS

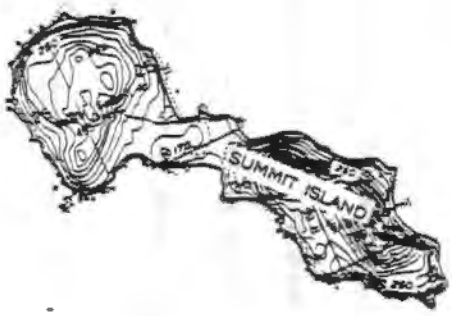
Data Surveyed _____

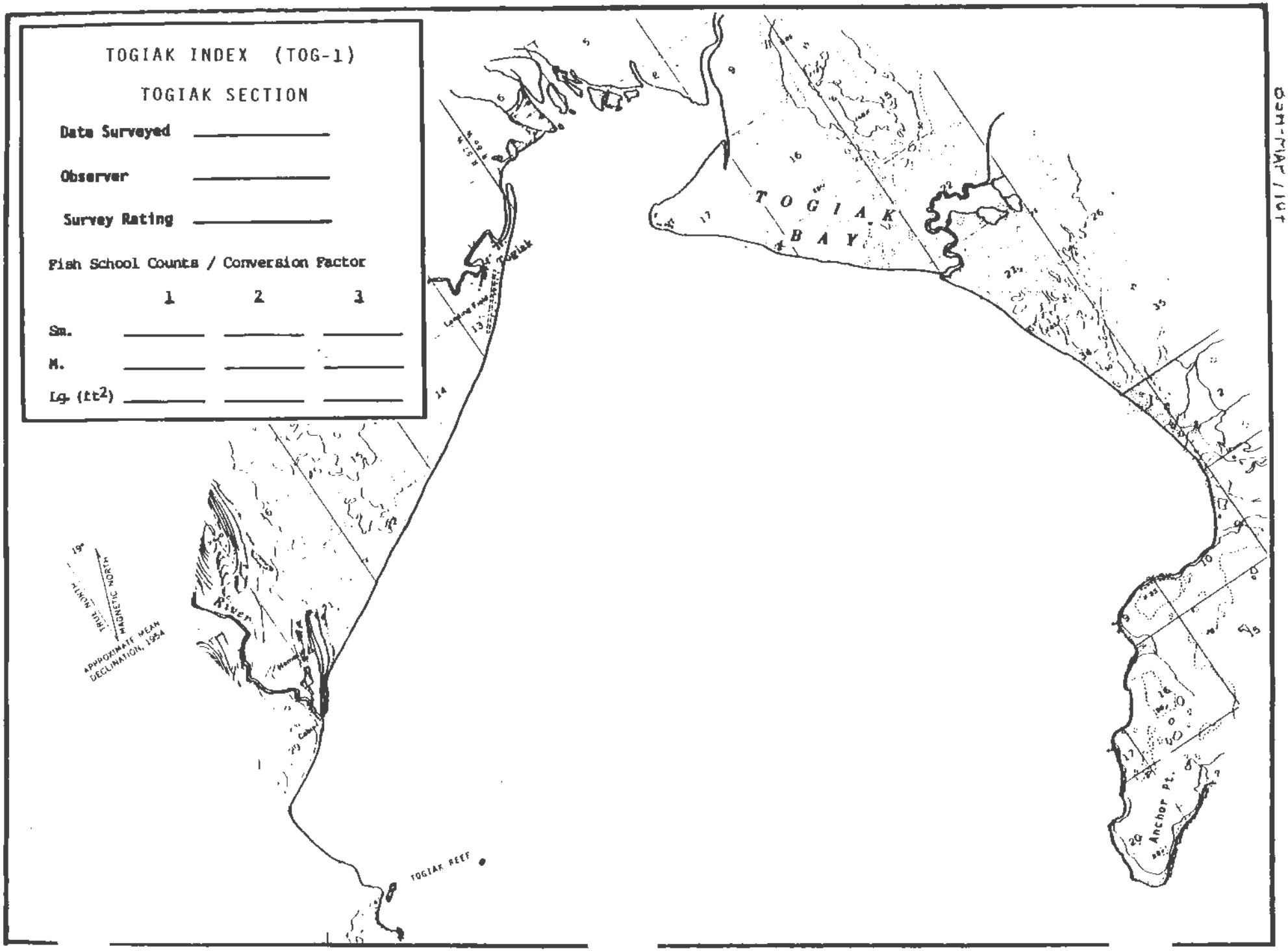
Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft^2)			




TOGIAK INDEX (TOG-1)
TOGIAK SECTION
Date Surveyed
Observer
Survey Rating
Fish School Counts / Conversion Factor
1
2
3
Sm.
M.
Lg. (ft2)
TOGIAK BAY
Togiak
River
TOGIAK REEF
Anchor Pt.
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1954

TONGUE POINT INDEX (TNG-1)

TOGIAK SECTION

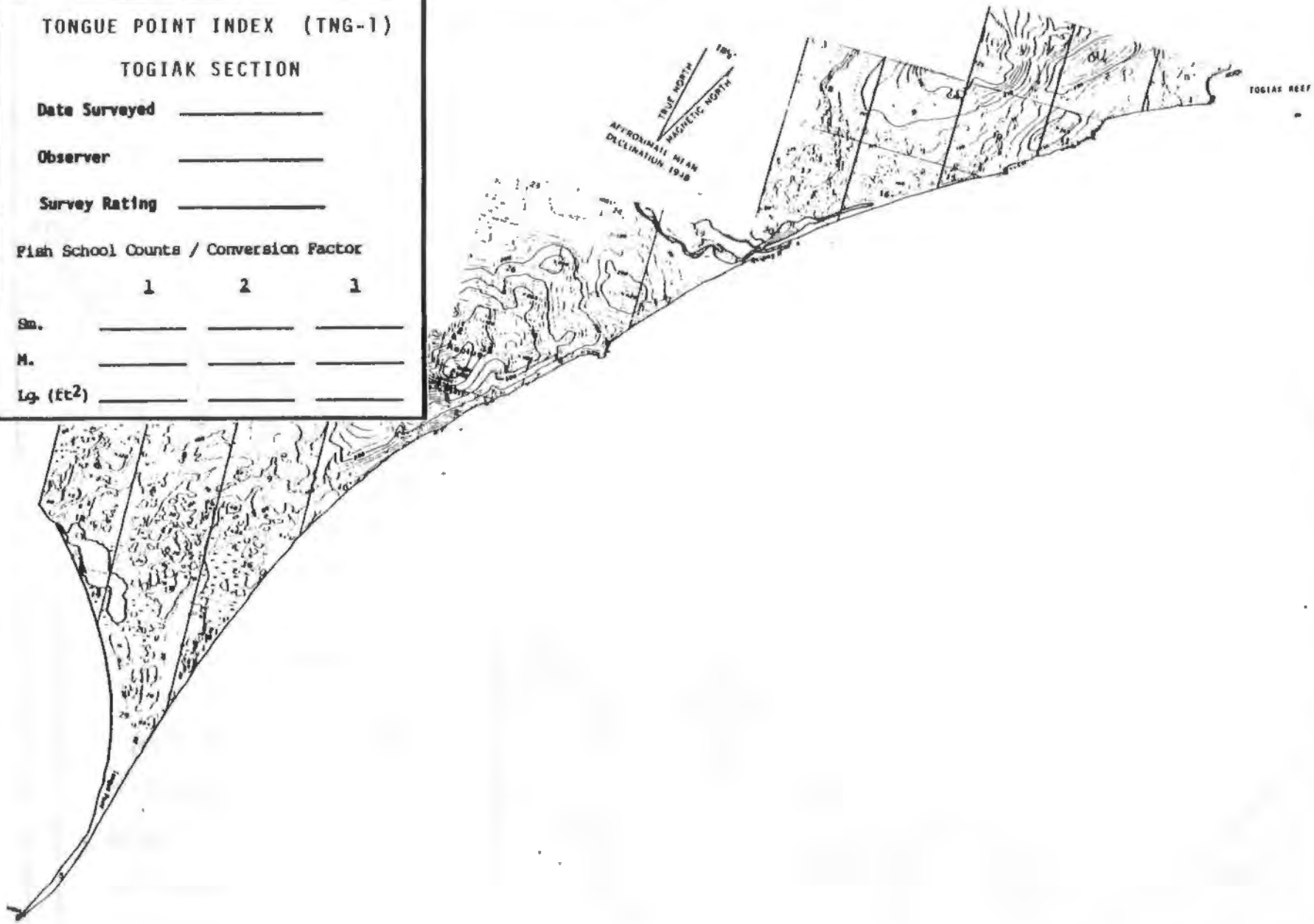
Date Surveyed _____

Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	1
Sm.	_____	_____	_____
M.	_____	_____	_____
Lg. (ft^2)	_____	_____	_____



BSH-MAP/108

MATOGAK INDEX (MTG-1)

HAGEMEISTER SECTION

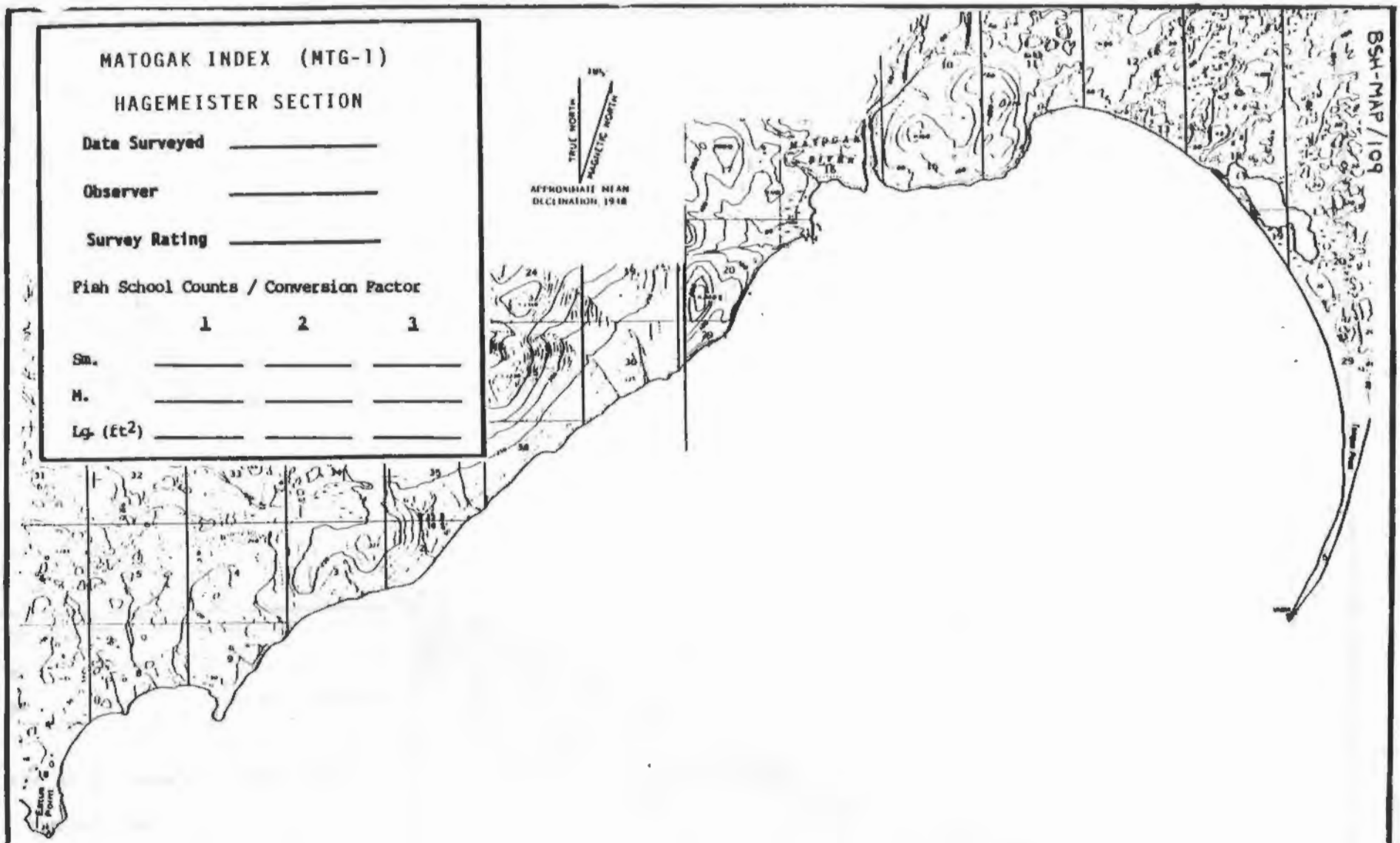
Date Surveyed _____

Observer _____

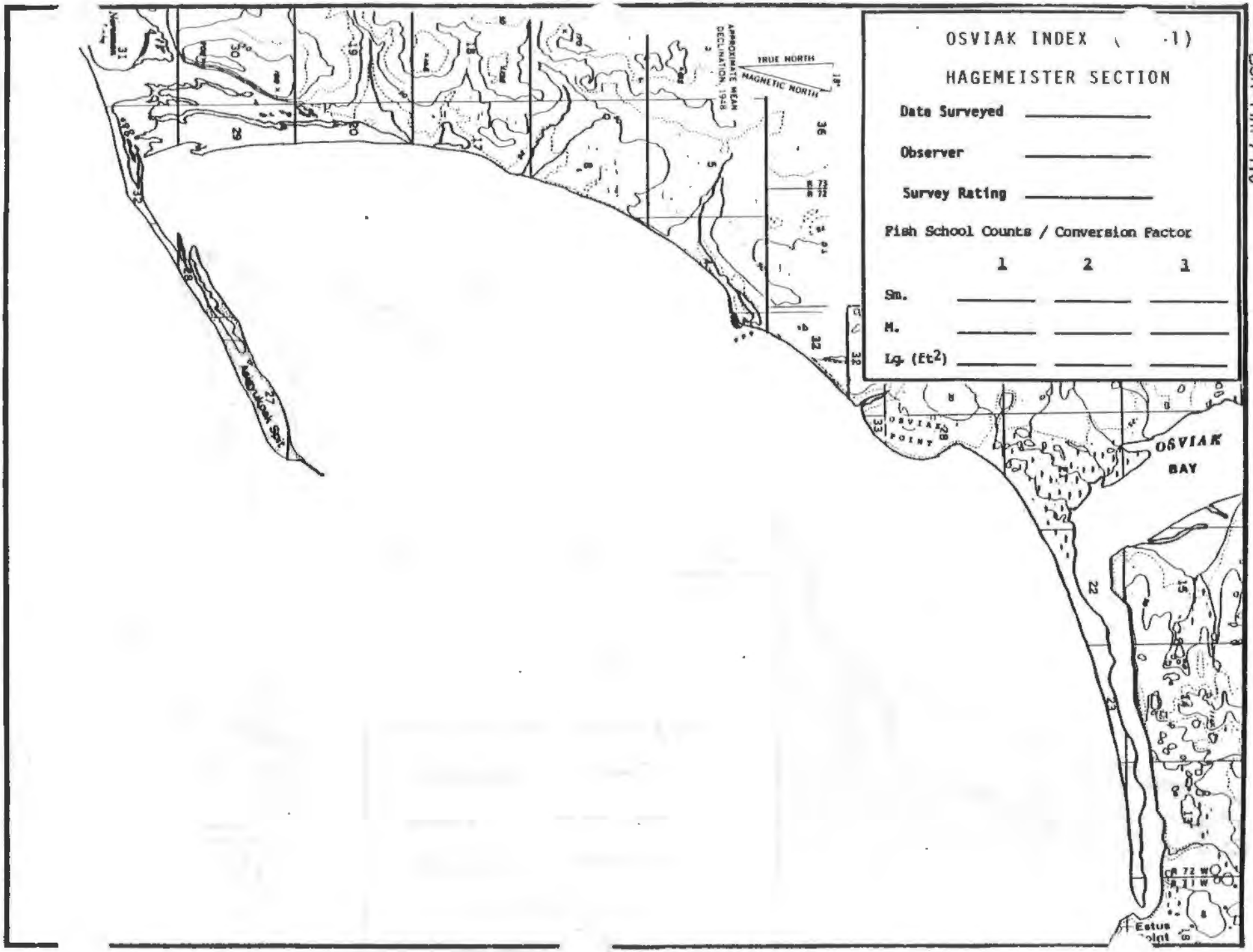
Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft^2)			



BSH-MAP/109


OSVIAK INDEX (-1)
HAGEMEISTER SECTION
Date Surveyed
Observer
Survey Rating
Fish School Counts / Conversion Factor
1 2 1
Sm.
M.
Lg. (Et2)
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1948
OSVIAK POINT
OSVIAK BAY
Estus Point

BSH-MAP/110

BSH-MAP/ III

PYRITE POINT . (PYR-1)

HAGEMEISTER SECTION

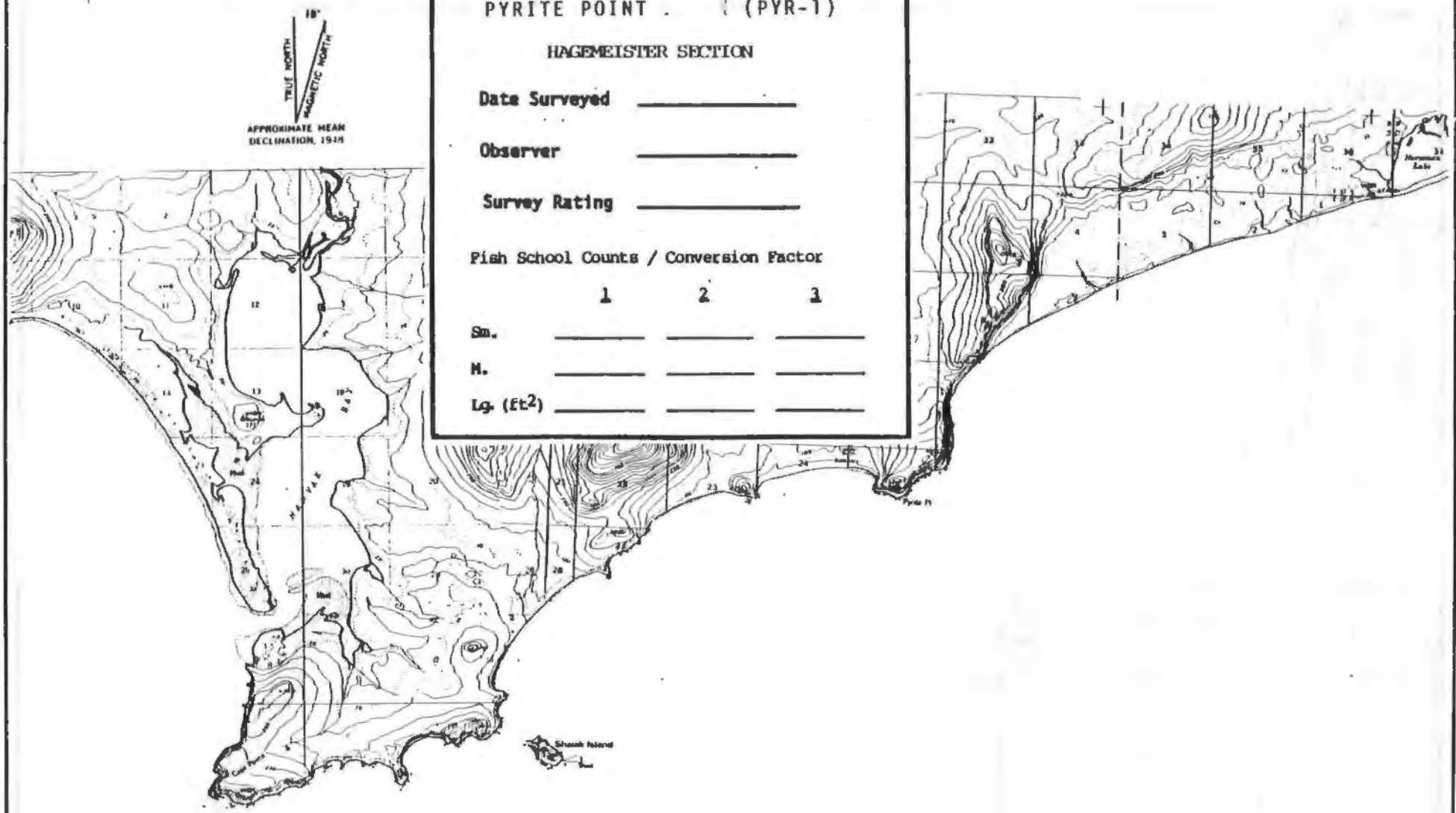
Date Surveyed _____

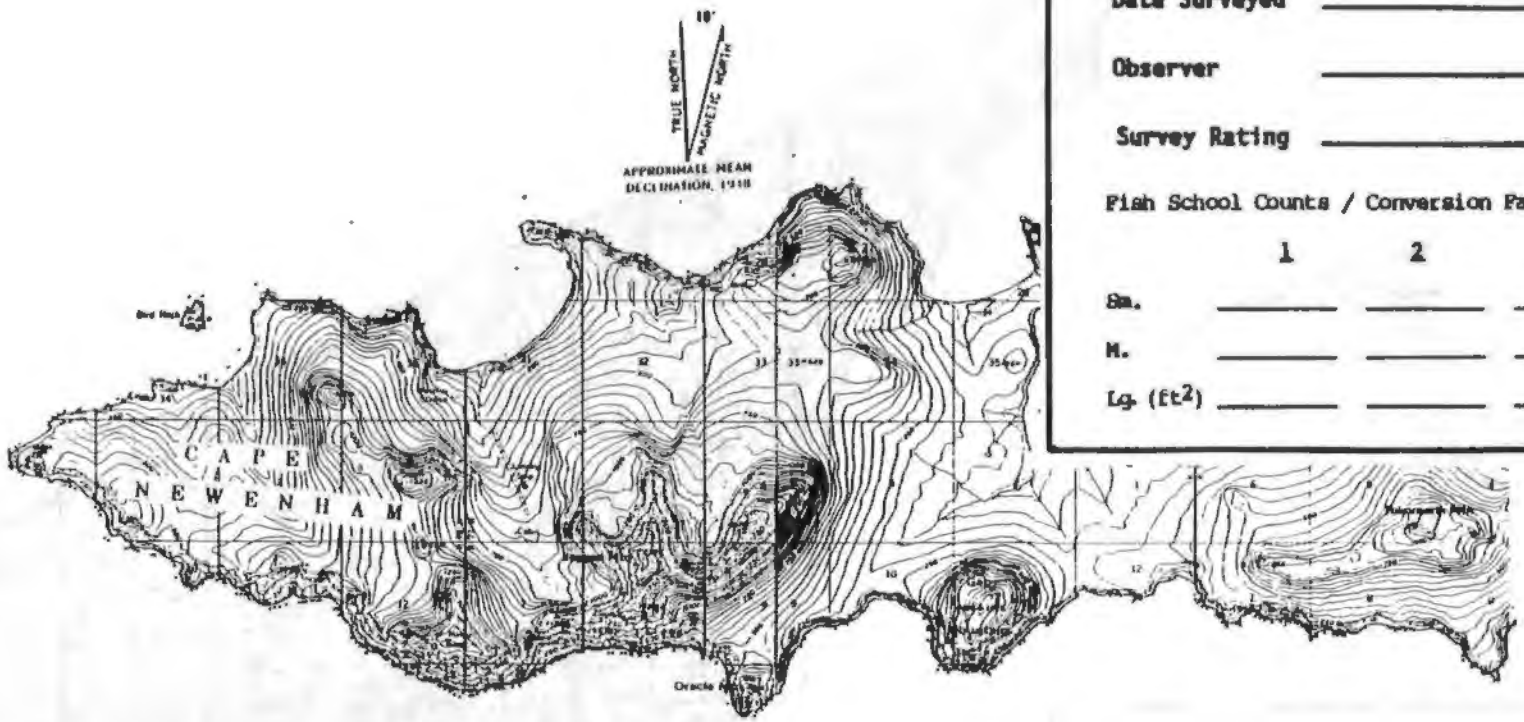
Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft^2)			





CAPE NEWENHAM INDEX (CN-1)

HAGEMEISTER SECTION

Date Surveyed _____

Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft^2)			

HAGEMEISTER INDEX (HAG-1)

HAGEMEISTER SECTION

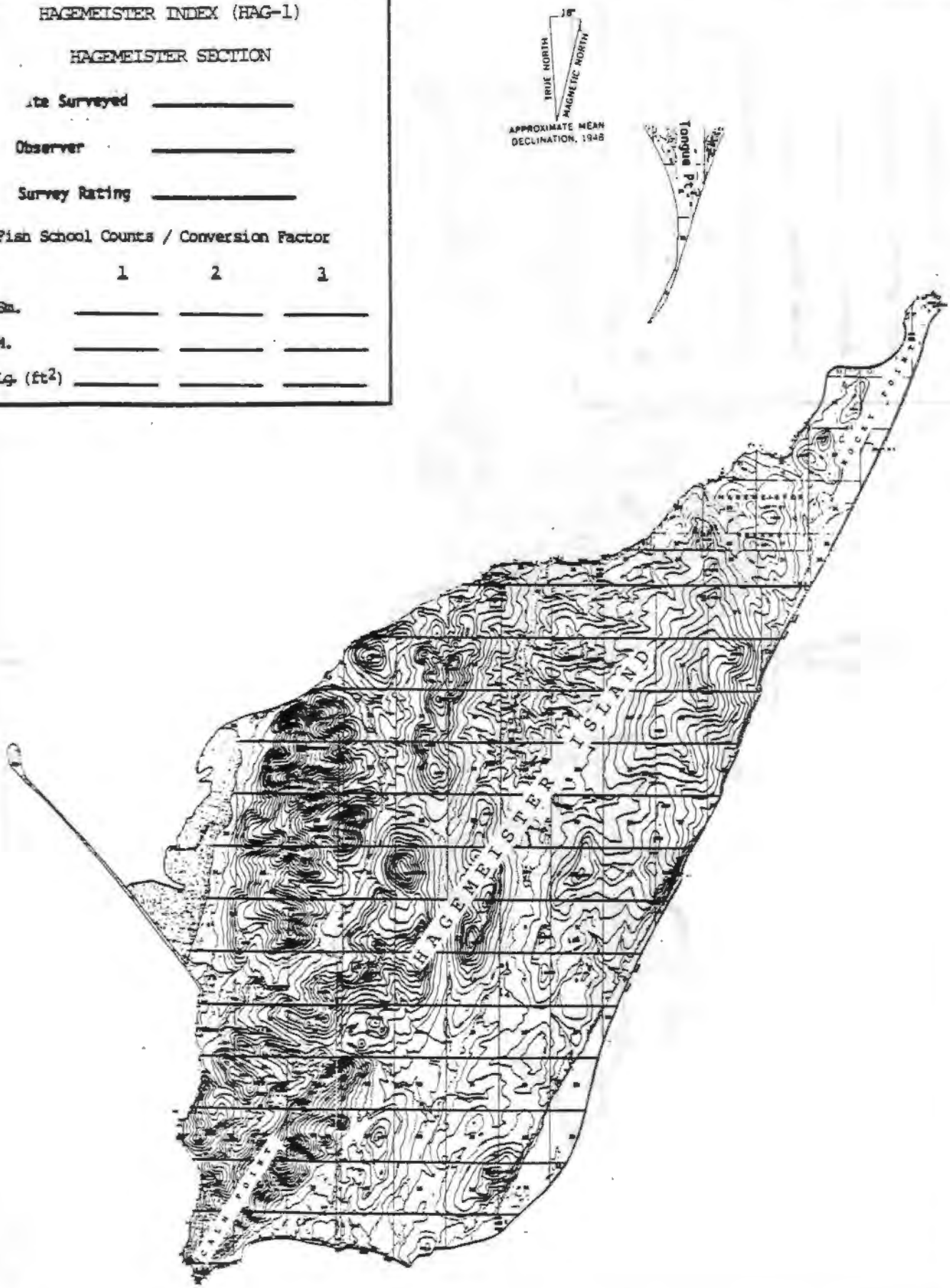
Date Surveyed _____

Observer _____

Survey Rating _____

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft^2)			



APPENDIX II

Herring aerial survey data forms.

2/ Index Areas:

Kulukak Section

NUS = Nushagak - Cape Constantine to western spit of Tvativak Bay.
KUK = Kulukak - western spit of Tvativak Bay to eastern point of Metervik Bay.
MET = Metervik - eastern point of Metervik Bay to Right Hand Point.

Nunavachak Section

NVK = Nunavachak - Right Hand Point to Ungalikthluk Point.
UGL = Ungalikthluk - Ungalikthluk Point to Anchor Point including Summit Island.

Togiak Section

TOG = Togiak - Anchor Point to Togiak Reef.
TNG = Tongue Point - Togiak Reef to Tongue Point.

Hagemeister Section

HTG = Hotogak - Tongue Point to Entus Point.
OSK = Osviak - Entus Point to Nottaman Lake.
PYR = Pyrite Point - Nottaman Lake to Tokomarik Point.
CN = Cape Newenham - Tokomarik Point to Cape Newenham.
HAG = Hagemeister - Hagemeister Island.

3/ Survey Rating:

1 = Excellent (calm, no glare)
2 = Good (light ripple, uneven lighting, easy to spot schools)
3 = Fair (light chop, some glare or shadows, relatively easy to spot schools)
4 = Poor (rough seas, strong glare, difficult to spot schools)
5 = Unsatisfactory

4/ Number of Schools:

Small = less than or equal to 538 ft^2 (50 m^2).
Medium = greater than 538 ft^2 (50 m^2) but less than or equal to 4,841 ft^2 (450 m^2).
Large = greater than 4,841 ft^2 (450 m^2).

5/ Conversion Factors: (subject to change pending new data)

1 - 1.52 mt/RAI (1.18mt/RAI) for water depths of 16 ft (5m) or less.
2 - 2.58 mt/RAI (2.34mt/RAI) for water depths between 16 ft (5m) and 26 ft (8m).
3 - 2.83 mt/RAI (2.57mt/RAI) for water depths greater than 26 ft (8m).

BSH-CF/202 (Rev. 2/85)

HERRING AERIAL SURVEY DISTRICT SUMMARY

District_____ Year_____

Date (Time)	Flight Number	Survey Rating	Index Areas	Number of Schools				Biomass Estimates (st)		Spawn		
				Sm	Med	Lg	Total	Formula	_____	No.	Mi.	Cum. Mi.

BSH-CF/203

SHORT TERM CHARTER LIST

Year_____

Code Letter	Seine Vessel			Company & Tender	Aircraft			
	Name	L.O.A.	Captain		Type	Call Sign	Freq.	Pilot

L /204

HERRING BIOMASS CONVERSI STIMATE WORSHEET

Date_____ Time_____ Location_____ Survey Rating_____ Observer(s)_____ Aircraft_____

Airspeed_____ Altitude_____ % Cloud Cover_____ Wind_____ Water Clarity_____ Tide Stage_____

Vessel_____ Operator/Crew_____ Spotter Plane_____ Pilot_____

Tender_____ Processing Vessel_____ Company_____ Fish Ticket Number_____

	Water Depth	Distance from shore (Mi)	School Surface Area (ft2)	Percent Captured	Maturity Stage	Weight of Catch (st)	Conversion Factor (st/538 ft2)
ADF&G							
Aerial			A=				C/A X 538 =
Ground							
Charter							
Spotter							
Vessel							
Processor						C=	

Remarks:

DSH-C)

HERRING BIOMASS CONVER ESTIMATE SUMMARY

Y

Date	Survey Rating 1/	Charter Code	Location	Water Depth	School Surface Area Est. (ft2)		Tonnage Est. (st)		% School Captured	Maturity Stage	Landed Weight (st)	st/538 ft2
					ADF&G	Spotter	ADF&G	Spotter				

1/ 1=Excellent (calm, no glare)
2=Good (light ripple, uneven lighting, easy to see schools)
3=Fair (light chop, some glare or shadows relatively easy to spot schools)
4=Poor (rough seas, strong glare, difficult to spot schools)
5=U factory

BS 206

HERRING INDEX A. ,IOMASS SUMMARY

District_____ Year_____

Date (Time)	Survey Conditions	Milt Sightings		Estimated Biomass (st) By Index Area												
		No.	Length (mi)	NUS	KUK	MET	NUK	UGL	TCG	TNG	MIG	HAG	CSK	PYR	CN	Daily Total

At 0°, GD = 1500 x .032407
= 48.61 ft

At 20°, GD = 1596 x .032407
= 51.72 ft

$$\text{Size adjustment factor} = 1 + \frac{X^\circ\ GD - 0^\circ\ GD}{X^\circ\ GD}$$

$$= 1 + \frac{51.72 - 48.61}{51.72}$$

$$= 1 + .0601$$

$$= 1.060$$

This size adjustment factor must be applied to each measurement (length and width) used in determing fish school surface area.

e.g. 100 ft x 200 ft = 20,000 ft^2 (unadjusted for 0° observation angle)
106 ft x 212 ft = 22,472 ft^2 (adjusted for 20° observation angle)

APPENDIX V

Altitude conversion tables for aerial survey calculations.

HEARING AERIAL SURVEY TABLES

for ALTITUDE of 500 feet.

CLINOMETER READING deg.	OBSERV. ANGLE deg.	OBSERV. DISTANCE feet	OBSERV. DISTANCE miles	HORIZ. DISTANCE feet	HORIZ. DISTANCE miles	SIZE ADJUSTMENT FACTOR
90	0	500	0.09	0	0.00	1.000
89	1	500	0.09	9	0.00	1.000
88	2	500	0.09	17	0.00	1.001
87	3	501	0.09	26	0.00	1.001
86	4	501	0.09	35	0.01	1.002
85	5	502	0.10	44	0.01	1.004
84	6	503	0.10	53	0.01	1.005
83	7	504	0.10	61	0.01	1.007
82	8	505	0.10	70	0.01	1.010
81	9	506	0.10	79	0.01	1.012
80	10	508	0.10	88	0.02	1.015
79	11	509	0.10	97	0.02	1.018
78	12	511	0.10	106	0.02	1.022
77	13	513	0.10	115	0.02	1.026
76	14	515	0.10	125	0.02	1.030
75	15	518	0.10	134	0.03	1.034
74	16	520	0.10	143	0.03	1.039
73	17	523	0.10	153	0.03	1.044
72	18	526	0.10	162	0.03	1.049
71	19	529	0.10	172	0.03	1.054
70	20	532	0.10	182	0.03	1.060
69	21	536	0.10	192	0.04	1.066
68	22	539	0.10	202	0.04	1.073
67	23	543	0.10	212	0.04	1.079
66	24	547	0.10	223	0.04	1.086
65	25	552	0.10	233	0.04	1.094
64	26	556	0.11	244	0.05	1.101
63	27	561	0.11	255	0.05	1.109
62	28	566	0.11	266	0.05	1.117
61	29	572	0.11	277	0.05	1.125
60	30	577	0.11	289	0.05	1.134
59	31	583	0.11	300	0.06	1.143
58	32	590	0.11	312	0.06	1.152
57	33	596	0.11	325	0.06	1.161
56	34	603	0.11	337	0.06	1.171
55	35	610	0.12	350	0.07	1.181
54	36	618	0.12	363	0.07	1.191
53	37	626	0.12	377	0.07	1.201
52	38	635	0.12	391	0.07	1.212
51	39	643	0.12	405	0.08	1.223
50	40	653	0.12	420	0.08	1.234
49	41	663	0.13	435	0.08	1.245
48	42	673	0.13	450	0.09	1.257
47	43	684	0.13	466	0.09	1.269
46	44	695	0.13	483	0.09	1.281
45	45	707	0.13	500	0.09	1.293
44	46	720	0.14	518	0.10	1.305
43	47	733	0.14	536	0.10	1.318
42	48	747	0.14	555	0.11	1.331
41	49	762	0.14	575	0.11	1.344
40	50	778	0.15	596	0.11	1.357
39	51	795	0.15	617	0.12	1.371
38	52	812	0.15	640	0.12	1.384
37	53	831	0.16	664	0.13	1.398
36	54	851	0.16	688	0.13	1.412
35	55	872	0.17	714	0.14	1.425
34	56	894	0.17	741	0.14	1.441
33	57	918	0.17	770	0.15	1.455
32	58	944	0.18	800	0.15	1.472
31	59	971	0.18	832	0.16	1.488
30	60	1,000	0.19	866	0.16	1.500
29	61	1,031	0.20	902	0.17	1.515
28	62	1,065	0.20	940	0.18	1.531
27	63	1,101	0.21	981	0.19	1.546
26	64	1,141	0.22	1,025	0.19	1.562
25	65	1,183	0.22	1,072	0.20	1.577
24	66	1,229	0.23	1,123	0.21	1.593
23	67	1,280	0.24	1,178	0.22	1.609
22	68	1,335	0.25	1,238	0.23	1.625
21	69	1,395	0.26	1,303	0.25	1.642
20	70	1,462	0.28	1,374	0.26	1.658
19	71	1,536	0.29	1,452	0.28	1.674
18	72	1,618	0.31	1,539	0.29	1.691
17	73	1,710	0.32	1,635	0.31	1.708
16	74	1,814	0.34	1,744	0.33	1.724
15	75	1,932	0.37	1,866	0.35	1.741
14	76	2,067	0.39	2,005	0.38	1.758
13	77	2,223	0.42	2,166	0.41	1.775
12	78	2,405	0.46	2,352	0.45	1.792
11	79	2,620	0.50	2,572	0.49	1.809
10	80	2,879	0.55	2,836	0.54	1.826
9	81	3,196	0.61	3,157	0.60	1.844
8	82	3,593	0.68	3,558	0.67	1.861
7	83	4,103	0.78	4,072	0.77	1.878
6	84	4,793	0.91	4,767	0.90	1.895
5	85	5,737	1.09	5,715	1.08	1.913
4	86	7,168	1.36	7,150	1.35	1.930
3	87	9,554	1.81	9,541	1.81	1.948
2	88	14,327	2.71	14,318	2.71	1.965
1	89	28,649	5.43	28,645	5.43	1.983

HERRING AERIAL SURVEY TABLES

For ALTITUDE of 1000 feet.

CLINOMETER READING deg.	OBSERV. ANGLE deg.	OBSERV. DISTANCE feet	OBSERV. DISTANCE miles	HORIZ. DISTANCE feet	HORIZ. DISTANCE miles	SIZE ADJUSTMENT FACTOR
90	0	1,000	0.19	0	0.00	1.000
89	1	1,000	0.19	17	0.00	1.000
88	2	1,001	0.19	35	0.01	1.001
87	3	1,001	0.19	52	0.01	1.001
86	4	1,002	0.19	70	0.01	1.002
85	5	1,004	0.19	87	0.02	1.004
84	6	1,006	0.19	105	0.02	1.005
83	7	1,008	0.19	123	0.02	1.007
82	8	1,010	0.19	141	0.03	1.010
81	9	1,012	0.19	158	0.03	1.012
80	10	1,015	0.19	176	0.03	1.015
79	11	1,019	0.19	194	0.04	1.018
78	12	1,022	0.19	213	0.04	1.022
77	13	1,026	0.19	231	0.04	1.026
76	14	1,031	0.20	249	0.05	1.030
75	15	1,035	0.20	268	0.05	1.034
74	16	1,040	0.20	287	0.05	1.039
73	17	1,046	0.20	306	0.06	1.044
72	18	1,051	0.20	325	0.06	1.049
71	19	1,058	0.20	344	0.07	1.054
70	20	1,064	0.20	364	0.07	1.060
69	21	1,071	0.20	384	0.07	1.066
68	22	1,079	0.20	404	0.08	1.073
67	23	1,086	0.21	424	0.08	1.079
66	24	1,095	0.21	445	0.08	1.086
65	25	1,103	0.21	466	0.09	1.094
64	26	1,113	0.21	488	0.09	1.101
63	27	1,122	0.21	510	0.10	1.109
62	28	1,133	0.21	532	0.10	1.117
61	29	1,143	0.22	554	0.10	1.125
60	30	1,155	0.22	577	0.11	1.134
59	31	1,167	0.22	601	0.11	1.143
58	32	1,179	0.22	625	0.12	1.152
57	33	1,192	0.23	649	0.12	1.161
56	34	1,206	0.23	675	0.13	1.171
55	35	1,221	0.23	700	0.13	1.181
54	36	1,236	0.23	727	0.14	1.191
53	37	1,252	0.24	754	0.14	1.201
52	38	1,269	0.24	781	0.15	1.212
51	39	1,287	0.24	810	0.15	1.223
50	40	1,305	0.25	839	0.16	1.234
49	41	1,325	0.25	869	0.16	1.245
48	42	1,346	0.25	900	0.17	1.257
47	43	1,367	0.26	933	0.18	1.269
46	44	1,390	0.26	966	0.18	1.281
45	45	1,414	0.27	1,000	0.19	1.293
44	46	1,440	0.27	1,036	0.20	1.305
43	47	1,466	0.28	1,072	0.20	1.318
42	48	1,494	0.28	1,111	0.21	1.331
41	49	1,524	0.29	1,150	0.22	1.344
40	50	1,556	0.29	1,192	0.23	1.357
39	51	1,589	0.30	1,235	0.23	1.371
38	52	1,624	0.31	1,280	0.24	1.384
37	53	1,662	0.31	1,327	0.25	1.398
36	54	1,701	0.32	1,375	0.26	1.412
35	55	1,743	0.33	1,428	0.27	1.426
34	56	1,788	0.34	1,483	0.28	1.441
33	57	1,836	0.35	1,540	0.29	1.455
32	58	1,887	0.36	1,600	0.30	1.470
31	59	1,942	0.37	1,664	0.32	1.485
30	60	2,000	0.38	1,732	0.33	1.500
29	61	2,063	0.39	1,804	0.34	1.515
28	62	2,130	0.40	1,881	0.36	1.531
27	63	2,203	0.42	1,963	0.37	1.546
26	64	2,281	0.43	2,050	0.39	1.562
25	65	2,366	0.45	2,145	0.41	1.577
24	66	2,459	0.47	2,246	0.43	1.593
23	67	2,559	0.48	2,356	0.45	1.609
22	68	2,669	0.51	2,475	0.47	1.625
21	69	2,790	0.53	2,605	0.49	1.642
20	70	2,924	0.55	2,747	0.52	1.658
19	71	3,072	0.58	2,904	0.55	1.674
18	72	3,236	0.61	3,078	0.58	1.691
17	73	3,420	0.65	3,271	0.62	1.708
16	74	3,628	0.69	3,487	0.66	1.724
15	75	3,864	0.73	3,732	0.71	1.741
14	76	4,134	0.78	4,011	0.76	1.758
13	77	4,445	0.84	4,331	0.82	1.775
12	78	4,810	0.91	4,705	0.89	1.792
11	79	5,241	0.99	5,145	0.97	1.809
10	80	5,759	1.09	5,671	1.07	1.826
9	81	6,392	1.21	6,314	1.20	1.844
8	82	7,185	1.36	7,115	1.35	1.861
7	83	8,205	1.55	8,144	1.54	1.878
6	84	9,567	1.81	9,514	1.80	1.895
5	85	11,474	2.17	11,430	2.16	1.913
4	86	14,336	2.72	14,301	2.71	1.930
3	87	19,107	3.62	19,081	3.61	1.948
2	88	28,624	5.43	28,636	5.42	1.965
1	89	57,298	10.85	57,289	10.85	1.983

HERRING AERIAL SURVEY TABLES

for ALTITUDE of 1500 feet.

CLINOMETER READING deg.	OBSERV. ANGLE deg.	OBSERV. DISTANCE feet	OBSERV. DISTANCE miles	HORIZ. DISTANCE feet	HORIZ. DISTANCE miles	SIZE ADJUSTMENT FACTOR
90	0	1,500	0.28	0	0.00	1.000
89	1	1,500	0.28	26	0.00	1.000
88	2	1,501	0.28	52	0.01	1.001
87	3	1,502	0.28	79	0.01	1.001
86	4	1,504	0.28	105	0.02	1.002
85	5	1,506	0.29	131	0.02	1.004
84	6	1,508	0.29	158	0.03	1.005
83	7	1,511	0.29	184	0.03	1.007
82	8	1,515	0.29	211	0.04	1.010
81	9	1,519	0.29	238	0.04	1.012
80	10	1,523	0.29	264	0.05	1.015
79	11	1,528	0.29	292	0.06	1.018
78	12	1,534	0.29	319	0.06	1.022
77	13	1,539	0.29	346	0.07	1.026
76	14	1,546	0.29	374	0.07	1.030
75	15	1,553	0.29	402	0.08	1.034
74	16	1,560	0.30	430	0.08	1.039
73	17	1,569	0.30	459	0.09	1.044
72	18	1,577	0.30	487	0.09	1.049
71	19	1,586	0.30	516	0.10	1.054
70	20	1,596	0.30	546	0.10	1.060
69	21	1,607	0.30	576	0.11	1.066
68	22	1,618	0.31	606	0.11	1.073
67	23	1,630	0.31	637	0.12	1.079
66	24	1,642	0.31	668	0.13	1.086
65	25	1,655	0.31	699	0.13	1.094
64	26	1,669	0.32	732	0.14	1.101
63	27	1,683	0.32	764	0.14	1.109
62	28	1,699	0.32	798	0.15	1.117
61	29	1,715	0.32	831	0.16	1.125
60	30	1,732	0.33	866	0.16	1.134
59	31	1,750	0.33	901	0.17	1.143
58	32	1,769	0.33	937	0.18	1.152
57	33	1,789	0.34	974	0.18	1.161
56	34	1,809	0.34	1,012	0.19	1.171
55	35	1,831	0.35	1,050	0.20	1.181
54	36	1,854	0.35	1,090	0.21	1.191
53	37	1,878	0.36	1,130	0.21	1.201
52	38	1,904	0.36	1,172	0.22	1.212
51	39	1,930	0.37	1,215	0.23	1.223
50	40	1,958	0.37	1,259	0.24	1.234
49	41	1,988	0.38	1,304	0.25	1.245
48	42	2,018	0.38	1,351	0.26	1.257
47	43	2,051	0.39	1,399	0.26	1.269
46	44	2,085	0.39	1,449	0.27	1.281
45	45	2,121	0.40	1,500	0.28	1.293
44	46	2,159	0.41	1,553	0.29	1.305
43	47	2,199	0.42	1,609	0.30	1.318
42	48	2,242	0.42	1,666	0.32	1.331
41	49	2,286	0.43	1,725	0.33	1.344
40	50	2,334	0.44	1,788	0.34	1.357
39	51	2,384	0.45	1,852	0.35	1.371
38	52	2,436	0.46	1,920	0.36	1.384
37	53	2,492	0.47	1,991	0.38	1.398
36	54	2,552	0.48	2,065	0.39	1.412
35	55	2,615	0.50	2,142	0.41	1.426
34	56	2,682	0.51	2,224	0.42	1.441
33	57	2,754	0.52	2,310	0.44	1.455
32	58	2,831	0.54	2,401	0.45	1.470
31	59	2,912	0.55	2,496	0.47	1.485
30	60	3,000	0.57	2,598	0.49	1.500
29	61	3,094	0.59	2,706	0.51	1.515
28	62	3,195	0.61	2,821	0.53	1.531
27	63	3,304	0.63	2,944	0.56	1.546
26	64	3,422	0.65	3,075	0.58	1.562
25	65	3,549	0.67	3,217	0.61	1.577
24	66	3,688	0.70	3,369	0.64	1.593
23	67	3,839	0.73	3,534	0.67	1.609
22	68	4,004	0.76	3,713	0.70	1.625
21	69	4,186	0.79	3,908	0.74	1.642
20	70	4,386	0.83	4,121	0.78	1.658
19	71	4,607	0.87	4,356	0.83	1.674
18	72	4,854	0.92	4,617	0.87	1.691
17	73	5,130	0.97	4,906	0.93	1.708
16	74	5,442	1.03	5,231	0.99	1.724
15	75	5,796	1.10	5,598	1.06	1.741
14	76	6,200	1.17	6,016	1.14	1.758
13	77	6,658	1.26	6,497	1.23	1.775
12	78	7,215	1.37	7,057	1.34	1.792
11	79	7,861	1.49	7,717	1.46	1.809
10	80	8,608	1.64	8,537	1.62	1.826
9	81	9,539	1.82	9,671	1.83	1.844
8	82	10,778	2.04	10,973	2.08	1.861
7	83	12,328	2.33	12,216	2.31	1.878
6	84	14,320	2.72	14,272	2.70	1.895
5	85	17,211	3.26	17,148	3.25	1.913
4	86	21,503	4.07	21,451	4.06	1.930
3	87	28,661	5.43	28,622	5.42	1.948
2	88	42,980	8.14	42,954	8.14	1.965
1	89	85,947	16.28	85,934	16.28	1.983

HERRING AERIAL SURVEY TABLES

For ALTITUDE of 2000 feet.

CLINOMETER READING deg.	OBSERV. ANGLE deg.	OBSERV. DISTANCE feet	OBSERV. DISTANCE miles	HORIZ. DISTANCE feet	HORIZ. DISTANCE miles	SIZE ADJUSTMENT FACTOR
90	0	2,000	0.38	0	0.20	1.000
89	1	2,000	0.38	35	0.21	1.000
88	2	2,001	0.38	70	0.21	1.001
87	3	2,003	0.38	105	0.22	1.001
86	4	2,005	0.38	140	0.23	1.002
85	5	2,008	0.38	175	0.23	1.004
84	6	2,011	0.38	210	0.24	1.005
83	7	2,015	0.38	246	0.25	1.007
82	8	2,020	0.38	281	0.25	1.010
81	9	2,025	0.38	317	0.26	1.012
80	10	2,031	0.38	353	0.27	1.015
79	11	2,037	0.39	389	0.27	1.018
78	12	2,045	0.39	425	0.28	1.022
77	13	2,053	0.39	462	0.29	1.026
76	14	2,061	0.39	499	0.29	1.030
75	15	2,071	0.39	536	0.30	1.034
74	16	2,081	0.39	573	0.31	1.039
73	17	2,091	0.40	611	0.32	1.044
72	18	2,103	0.40	650	0.32	1.049
71	19	2,115	0.40	689	0.33	1.054
70	20	2,128	0.40	729	0.34	1.060
69	21	2,142	0.41	768	0.35	1.066
68	22	2,157	0.41	808	0.35	1.073
67	23	2,173	0.41	849	0.36	1.079
66	24	2,189	0.41	890	0.37	1.086
65	25	2,207	0.42	933	0.38	1.094
64	26	2,225	0.42	975	0.38	1.101
63	27	2,245	0.43	1,019	0.39	1.109
62	28	2,265	0.43	1,063	0.40	1.117
61	29	2,287	0.43	1,109	0.21	1.125
60	30	2,309	0.44	1,155	0.22	1.134
59	31	2,333	0.44	1,202	0.23	1.143
58	32	2,358	0.45	1,250	0.24	1.152
57	33	2,385	0.45	1,299	0.25	1.161
56	34	2,412	0.46	1,349	0.26	1.171
55	35	2,442	0.46	1,400	0.27	1.181
54	36	2,472	0.47	1,453	0.28	1.191
53	37	2,504	0.47	1,507	0.29	1.201
52	38	2,538	0.48	1,563	0.30	1.212
51	39	2,574	0.49	1,620	0.31	1.223
50	40	2,611	0.49	1,678	0.32	1.234
49	41	2,650	0.50	1,739	0.33	1.245
48	42	2,691	0.51	1,801	0.34	1.257
47	43	2,735	0.52	1,865	0.35	1.269
46	44	2,780	0.53	1,931	0.37	1.281
45	45	2,828	0.54	2,000	0.38	1.293
44	46	2,879	0.55	2,071	0.39	1.305
43	47	2,933	0.56	2,145	0.41	1.318
42	48	2,989	0.57	2,221	0.42	1.331
41	49	3,049	0.58	2,301	0.44	1.344
40	50	3,111	0.59	2,384	0.45	1.357
39	51	3,178	0.60	2,470	0.47	1.371
38	52	3,249	0.62	2,560	0.48	1.384
37	53	3,323	0.63	2,654	0.50	1.398
36	54	3,403	0.64	2,753	0.52	1.412
35	55	3,487	0.66	2,856	0.54	1.426
34	56	3,577	0.68	2,965	0.56	1.441
33	57	3,672	0.70	3,080	0.58	1.455
32	58	3,774	0.71	3,201	0.61	1.470
31	59	3,883	0.74	3,329	0.63	1.485
30	60	4,000	0.76	3,464	0.66	1.500
29	61	4,125	0.78	3,608	0.68	1.515
28	62	4,260	0.81	3,761	0.71	1.531
27	63	4,405	0.83	3,925	0.74	1.546
26	64	4,562	0.86	4,101	0.78	1.563
25	65	4,732	0.90	4,289	0.81	1.577
24	66	4,917	0.93	4,492	0.85	1.593
23	67	5,119	0.97	4,712	0.89	1.609
22	68	5,339	1.01	4,950	0.94	1.625
21	69	5,581	1.06	5,210	0.99	1.642
20	70	5,848	1.11	5,495	1.04	1.659
19	71	6,143	1.16	5,808	1.10	1.674
18	72	6,472	1.23	6,155	1.17	1.691
17	73	6,841	1.30	6,542	1.24	1.708
16	74	7,256	1.37	6,975	1.32	1.724
15	75	7,727	1.46	7,464	1.41	1.741
14	76	8,257	1.57	8,022	1.53	1.758
13	77	8,891	1.68	8,663	1.64	1.775
12	78	9,619	1.82	9,409	1.79	1.791
11	79	10,482	1.99	10,289	1.95	1.809
10	80	11,519	2.18	11,343	2.15	1.825
9	81	12,785	2.42	12,637	2.39	1.844
8	82	14,371	2.72	14,231	2.70	1.861
7	83	16,411	3.11	16,299	3.08	1.878
6	84	19,134	3.62	19,029	3.60	1.895
5	85	22,947	4.35	22,868	4.33	1.913
4	86	28,671	5.43	28,601	5.42	1.930
3	87	38,215	7.24	38,162	7.23	1.948
2	88	57,307	10.85	57,272	10.85	1.965
1	89	114,596	21.70	114,575	21.70	1.983

HERRING AERIAL SURVEY TABLES

for ALTITUDE of 2500 feet.

QUINCMETER READING deg.	OBSERV. ANGLE deg.	OBSERV. DISTANCE feet	OBSERV. DISTANCE miles	HORIZ. DISTANCE feet	HORIZ. DISTANCE miles	SIZE ADJUSTMENT FACTOR
90	0	2,500	0.47	0	0.00	1.000
89	1	2,500	0.47	44	0.01	1.000
88	2	2,502	0.47	87	0.02	1.001
87	3	2,503	0.47	131	0.02	1.001
86	4	2,506	0.47	175	0.03	1.002
85	5	2,510	0.48	219	0.04	1.004
84	6	2,514	0.48	263	0.05	1.005
83	7	2,519	0.48	307	0.06	1.007
82	8	2,525	0.48	351	0.07	1.010
81	9	2,531	0.48	396	0.07	1.012
80	10	2,539	0.48	441	0.08	1.015
79	11	2,547	0.48	486	0.09	1.019
78	12	2,556	0.48	531	0.10	1.022
77	13	2,566	0.49	577	0.11	1.026
76	14	2,577	0.49	623	0.12	1.030
75	15	2,588	0.49	670	0.13	1.034
74	16	2,601	0.49	717	0.14	1.039
73	17	2,614	0.50	764	0.14	1.044
72	18	2,629	0.50	812	0.15	1.049
71	19	2,644	0.50	861	0.16	1.054
70	20	2,660	0.50	910	0.17	1.060
69	21	2,678	0.51	960	0.18	1.066
68	22	2,696	0.51	1,010	0.19	1.073
67	23	2,716	0.51	1,061	0.20	1.079
66	24	2,737	0.52	1,113	0.21	1.086
65	25	2,758	0.52	1,166	0.22	1.094
64	26	2,782	0.53	1,219	0.23	1.101
63	27	2,806	0.53	1,274	0.24	1.109
62	28	2,831	0.54	1,329	0.25	1.117
61	29	2,858	0.54	1,386	0.26	1.125
60	30	2,887	0.55	1,443	0.27	1.134
59	31	2,917	0.55	1,502	0.28	1.143
58	32	2,948	0.56	1,562	0.30	1.152
57	33	2,981	0.56	1,624	0.31	1.161
56	34	3,016	0.57	1,686	0.32	1.171
55	35	3,052	0.58	1,751	0.33	1.181
54	36	3,090	0.59	1,816	0.34	1.191
53	37	3,130	0.59	1,884	0.36	1.201
52	38	3,173	0.60	1,953	0.37	1.212
51	39	3,217	0.61	2,024	0.38	1.223
50	40	3,264	0.62	2,098	0.40	1.234
49	41	3,313	0.63	2,173	0.41	1.245
48	42	3,364	0.64	2,251	0.43	1.257
47	43	3,418	0.65	2,331	0.44	1.269
46	44	3,475	0.66	2,414	0.46	1.281
45	45	3,536	0.67	2,500	0.47	1.293
44	46	3,599	0.68	2,589	0.49	1.305
43	47	3,666	0.69	2,681	0.51	1.318
42	48	3,736	0.71	2,777	0.53	1.331
41	49	3,811	0.72	2,876	0.54	1.344
40	50	3,889	0.74	2,979	0.56	1.357
39	51	3,973	0.75	3,087	0.58	1.371
38	52	4,061	0.77	3,200	0.61	1.384
37	53	4,154	0.79	3,318	0.63	1.398
36	54	4,253	0.81	3,441	0.65	1.412
35	55	4,359	0.83	3,570	0.68	1.426
34	56	4,471	0.85	3,706	0.70	1.441
33	57	4,590	0.87	3,850	0.73	1.455
32	58	4,718	0.89	4,001	0.76	1.470
31	59	4,854	0.92	4,161	0.79	1.485
30	60	5,000	0.95	4,330	0.82	1.500
29	61	5,157	0.98	4,510	0.85	1.515
28	62	5,325	1.01	4,702	0.89	1.531
27	63	5,507	1.04	4,907	0.93	1.546
26	64	5,703	1.08	5,126	0.97	1.562
25	65	5,916	1.12	5,361	1.02	1.577
24	66	6,146	1.16	5,615	1.06	1.593
23	67	6,398	1.21	5,890	1.12	1.609
22	68	6,674	1.26	6,188	1.17	1.625
21	69	6,976	1.32	6,513	1.23	1.642
20	70	7,310	1.38	6,869	1.30	1.658
19	71	7,679	1.45	7,261	1.38	1.674
18	72	8,090	1.53	7,694	1.46	1.691
17	73	8,551	1.62	8,177	1.55	1.708
16	74	9,070	1.72	8,719	1.65	1.724
15	75	9,659	1.83	9,330	1.77	1.741
14	76	10,334	1.96	10,027	1.90	1.759
13	77	11,114	2.10	10,829	2.05	1.775
12	78	12,024	2.28	11,762	2.23	1.792
11	79	13,102	2.48	12,861	2.44	1.809
10	80	14,397	2.73	14,178	2.69	1.825
9	81	15,981	3.03	15,784	2.99	1.844
8	82	17,963	3.40	17,798	3.37	1.861
7	83	20,514	3.89	20,361	3.86	1.879
6	84	23,917	4.53	23,786	4.50	1.895
5	85	28,684	5.43	28,575	5.41	1.913
4	86	35,833	6.79	35,752	6.77	1.930
3	87	47,768	9.05	47,703	9.03	1.948
2	88	71,634	13.57	71,590	13.56	1.965
1	89	143,245	27.13	143,223	27.13	1.983

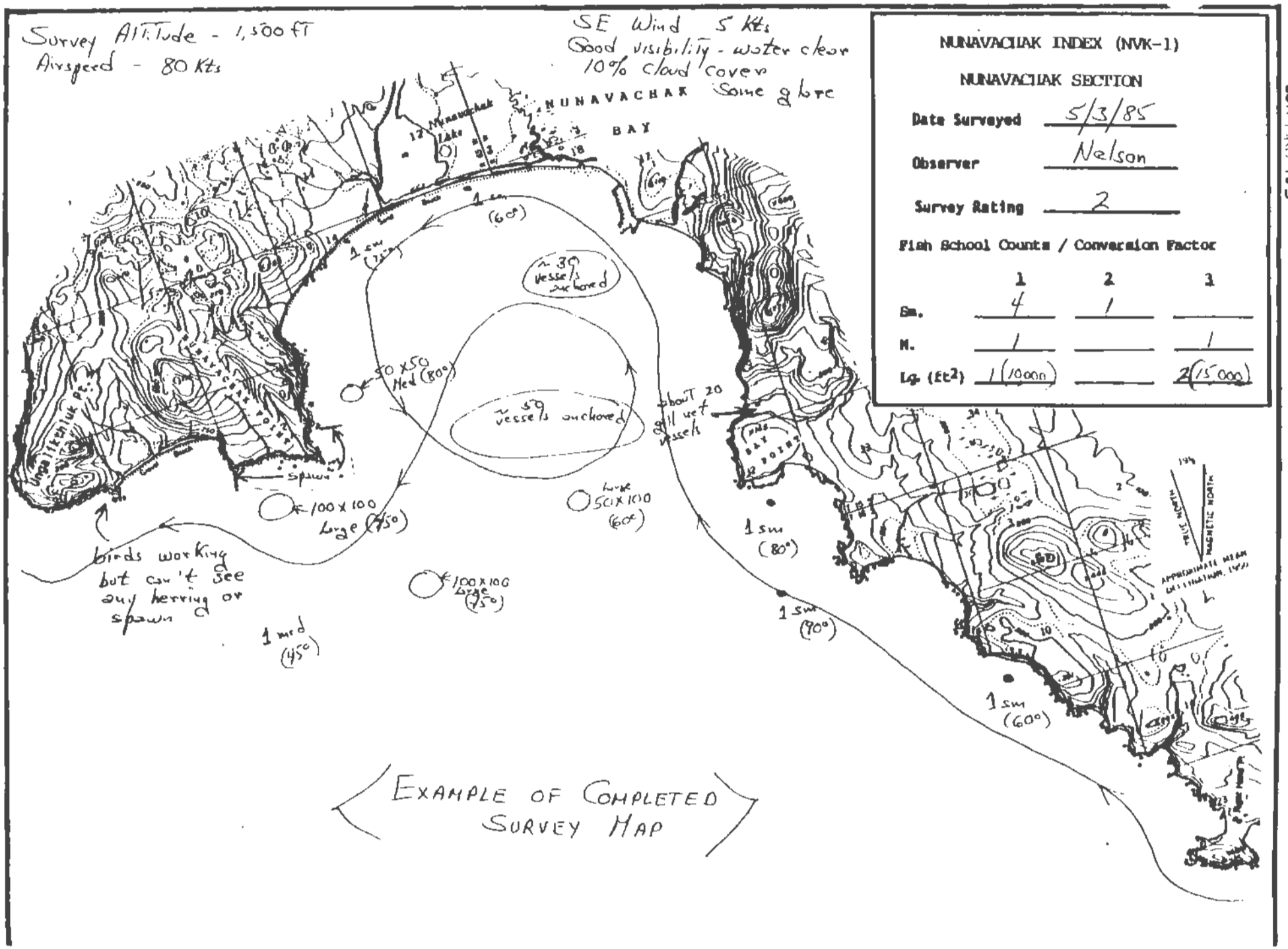
HERRING AERIAL SURVEY TABLES

For ALTITUDE of 3000 feet.

CLINOMETER READING deg.	OBSERV. ANGLE deg.	OBSERV. DISTANCE feet	OBSERV. DISTANCE miles	HORIZ. DISTANCE feet	HORIZ. DISTANCE miles	SIZE ADJUSTMENT FACTOR
90	0	3,000	0.57	0	0.00	1.000
89	1	3,000	0.57	52	0.01	1.000
88	2	3,002	0.57	105	0.02	1.001
87	3	3,004	0.57	157	0.03	1.001
86	4	3,007	0.57	210	0.04	1.002
85	5	3,011	0.57	262	0.05	1.004
84	6	3,017	0.57	315	0.06	1.005
83	7	3,023	0.57	368	0.07	1.007
82	8	3,029	0.57	422	0.08	1.010
81	9	3,037	0.58	475	0.09	1.012
80	10	3,046	0.58	529	0.10	1.015
79	11	3,056	0.58	583	0.11	1.018
78	12	3,067	0.58	638	0.12	1.022
77	13	3,079	0.58	693	0.13	1.026
76	14	3,092	0.59	748	0.14	1.030
75	15	3,106	0.59	804	0.15	1.034
74	16	3,121	0.59	860	0.16	1.039
73	17	3,137	0.59	917	0.17	1.044
72	18	3,154	0.60	975	0.18	1.049
71	19	3,173	0.60	1,033	0.20	1.054
70	20	3,193	0.60	1,092	0.21	1.060
69	21	3,213	0.61	1,152	0.22	1.066
68	22	3,236	0.61	1,212	0.23	1.073
67	23	3,259	0.62	1,273	0.24	1.079
66	24	3,284	0.62	1,336	0.25	1.086
65	25	3,310	0.63	1,399	0.26	1.094
64	26	3,338	0.63	1,463	0.28	1.101
63	27	3,367	0.64	1,529	0.29	1.109
62	28	3,398	0.64	1,595	0.30	1.117
61	29	3,430	0.65	1,663	0.31	1.125
60	30	3,464	0.66	1,732	0.33	1.134
59	31	3,500	0.66	1,803	0.34	1.143
58	32	3,538	0.67	1,875	0.36	1.152
57	33	3,577	0.68	1,948	0.37	1.161
56	34	3,619	0.69	2,024	0.38	1.171
55	35	3,662	0.69	2,101	0.40	1.181
54	36	3,708	0.70	2,180	0.41	1.191
53	37	3,756	0.71	2,261	0.43	1.201
52	38	3,807	0.72	2,344	0.44	1.212
51	39	3,860	0.73	2,429	0.46	1.223
50	40	3,915	0.74	2,517	0.48	1.234
49	41	3,973	0.75	2,608	0.49	1.245
48	42	4,037	0.76	2,701	0.51	1.257
47	43	4,102	0.78	2,798	0.53	1.269
46	44	4,170	0.79	2,897	0.55	1.281
45	45	4,243	0.80	3,000	0.57	1.293
44	46	4,319	0.82	3,107	0.59	1.305
43	47	4,399	0.83	3,217	0.61	1.318
42	48	4,483	0.85	3,332	0.63	1.331
41	49	4,573	0.87	3,451	0.65	1.344
40	50	4,667	0.88	3,575	0.68	1.357
39	51	4,767	0.90	3,705	0.70	1.371
38	52	4,873	0.92	3,840	0.73	1.384
37	53	4,985	0.94	3,981	0.75	1.398
36	54	5,104	0.97	4,129	0.78	1.412
35	55	5,230	0.99	4,284	0.81	1.426
34	56	5,365	1.02	4,446	0.84	1.441
33	57	5,508	1.04	4,620	0.87	1.455
32	58	5,661	1.07	4,801	0.91	1.472
31	59	5,825	1.10	4,993	0.95	1.488
30	60	6,000	1.14	5,196	0.98	1.520
29	61	6,188	1.17	5,412	1.03	1.5[illegible]
28	62	6,390	1.21	5,642	1.07	1.521
27	63	6,608	1.25	5,888	1.12	1.546
26	64	6,844	1.30	6,151	1.16	1.562
25	65	7,099	1.34	6,434	1.22	1.577
24	66	7,375	1.40	6,738	1.28	1.593
23	67	7,678	1.45	7,068	1.34	1.609
22	68	8,008	1.52	7,425	1.41	1.625
21	69	8,371	1.59	7,815	1.48	1.642
20	70	8,771	1.66	8,242	1.56	1.658
19	71	9,215	1.75	8,713	1.65	1.674
18	72	9,708	1.84	9,233	1.75	1.691
17	73	10,261	1.94	9,813	1.86	1.726
16	74	10,884	2.06	10,462	1.98	1.724
15	75	11,591	2.20	11,196	2.12	1.741
14	76	12,401	2.35	12,032	2.28	1.759
13	77	13,336	2.53	12,994	2.46	1.778
12	78	14,423	2.73	14,114	2.67	1.798
11	79	15,723	2.98	15,434	2.92	1.829
10	80	17,275	3.27	17,014	3.22	1.855
9	81	19,177	3.63	18,941	3.59	1.944
8	82	21,556	4.08	21,346	4.04	1.961
7	83	24,616	4.66	24,433	4.62	1.973
6	84	28,730	5.44	28,543	5.41	1.992
5	85	34,421	6.52	34,290	6.49	1.915
4	86	43,007	8.15	42,902	8.13	1.930
3	87	57,322	10.86	57,243	10.84	1.948
2	88	85,961	16.28	85,908	16.27	1.965
1	89	171,894	32.56	171,868	32.55	1.983

Appendix VI

The following maps and survey forms illustrate recommended methods of recording aerial survey data. Record all fish school and spawn measurements in the English system. Although, the metric system is preferred for scientific investigations, most observers may feel more comfortable and are less likely to make errors in working with measurements in feet, miles, etc. English system units can be converted to metric units later. Please complete maps and forms as carefully and neatly as possible to avoid problems in later interpretation. Hopefully the following examples are self-explanatory. During actual surveys, please record any additional information you think would be important and helpful to analysis of the data.



NUNAVACHAK INDEX (NVK-1)

NUNAVACHAK SECTION

Date Surveyed 5/3/85

Observer Nelson

Survey Rating 2

Fish School Counts / Conversion Factor

	1	2	3
Sm.	4	1	
M.	1		1
Lg. (ft²)	1 (10000)		2 (15000)

EXAMPLE OF COMPLETED SURVEY MAP

BSH-MAP/105

BSH-CF/201 (Rev. 2/85)

HERRING AERIAL SURVEY SUMMARY: TOGIAK DISTRICT - BRISTOL BAY 1/

Flight No. _____ Date _____ Observer(s) _____ Aircraft _____

S Time: Start _____ End _____ This flight _____ Accumulated _____

Index Area 2/		Survey 3/ Rating	Spawn Number	Spawn Length (mi)	Number of Schools 4/ Small	Med.	Large	Total Surface Area (ft^2) of lrg. sch.	R.A.L. UNITS Small (x1)	Med. (x5)	Large (+53%)	Total	Corr. 5/ Factors	Biomass Estimate (st)
NUS	1													
	2													
	3													
KUK	1													
	2													
	3													
MET	1													
	2													
	3													
NVK	1													
	2													
	3													
UGL	1													
	2													
	3													
TOG	1													
	2													
	3													
TNG	1													
	2													
	3													
MTG	1													
	2													
	3													
OSK	1													
	2													
	3													
PYR	1													
	2													
	3													
CN	1													
	2													
	3													
HAG	1													
	2													
	3													
Total														

1/ Footnotes and comment section on reverse side.

HERRING AERIAL SURVEY SUMMARY: TOGIAK DISTRICT - BRISTOL BAY 1/

Flight No. 3 Date 5/3/85 Observer(s) Nelson Aircraft C 185

Survey Time: Start 9:00 am End 11:30 am This flight 2.5 h Accumulated 7.5 h

Index Area 2/	Survey Rating 3/	Spawn Number	Spawn Length (mi)	Number of Schools 4/ Small	Med.	Large	Total Surface Area (ft²) of lrg. sch.	R.A.I. UNITS Small (x1)	Med. (x5)	Large (+538)	Total	Conv. 5/ Factors	Biomass Estimate (st)
NUS 1	4	0	0		0		0	0	0	0	0	0	0
2													
3													
KUK 1	3	0	0	1	2	0	0	1	10	0	11	2.58	28
2													
3													
MET 1	2	1	0.1	2	0	0	0	2	0	0	2	1.52	3
2							0						
3													
NVK 1	2	1	1.5	4	1	1	10,000	4	5	19	28	1.52	43
2				1	0	0		1	0	0	1	2.58	3
3				0	1	2	15,000	0	5	28	33	2.83	93
UGL 1	2	3	2.5	2	0	1	6,400	2	0	12	14	1.52	21
2				0	1	0	0	0	5	0	5	2.58	13
3													
TOG 1	3	0	0	6	1	0	0	6	5	0	11	1.52	17
2													
3													
1	4	0	0	0	0	2	44,000	0	0	82	82	2.58	212
2													
3													
MTG 1	5	0	0		0								
2													
3													
OSK 1													
2													
3													
PYR 1													
2													
3													
CN 1													
2													
3													
HAG 1													
2													
3													
T	2-5	5	4.1	16	6	6	75,400	16	30	141	187		433

1/ Footnotes and comment section on reverse side.

2/ Index Areas:

Kulukak Section

NUS = Nushagak - Cape Constantine to western spit of Tvativak Bay.
KUK = Kulukak - western spit of Tvativak Bay to eastern point of Metervik Bay.
MET = Metervik - eastern point of Metervik Bay to Right Hand Point.

Nunavachak Section

NWK = Nunavachak - Right Hand Point to Ungalikthluk Point.
UGL = Ungaliktnluk - Ungaliktnluk Point to Anchor Point including Summit Island.

Togiak Section

TOG = Togiak - Anchor Point to Togiak Reef.
TNG = Tongue Point - Togiak Reef to Tongue Point.

Hagemeister Section

NTG = Notogak - Tongue Point to Estus Point.
OSK = Osviak - Estus Point to Norseman Lake.
PYR = Pyrite Point - Norseman Lake to Tokomarik Point.
CN = Cape Newennam - Tokomarik Point to Cape Newennam.
HAG = Hagemeister - Hagemeister Island.

3/ Survey Rating:

1 = Excellent (calm, no glare)
2 = Good (light ripple, uneven lighting, easy to spot schools)
3 = Fair (light chop, some glare or shadows, relatively easy to spot schools)
4 = Poor (rough seas, strong glare, difficult to spot schools)
5 = Unsatisfactory

4/ Number of Schools:

Small = less than or equal to 538 ft^2 (50 m^2).
Medium = greater than 538 ft^2 (50 m^2) but less than or equal to 4,841 ft^2 (450 m^2).
Large = greater than 4,841 ft^2 (450 m^2).

5/ Conversion Factors: (subject to change pending new data)

1 - 1.52 st/RAI (1.38mt/RAI) for water depths of 16 ft (5m) or less.
2 - 2.58 st/RAI (2.34mt/RAI) for water depths between 16 ft (5m) and 26 ft (8m).
3 - 2.83 st/RAI (2.57mt/RAI) for water depths greater than 26 ft (8m).

Appendix VII

The following map and forms illustrate the recommended method of recording biomass conversion estimates. Use a survey map to indicate location of the school and purse seine set. In most cases, information will be gathered by ADF&G aerial observer(s), the commercial spotter pilot and the commercial purse seine vessel operator. In some instances an ADF&G ground observer may also be present aboard the charter vessel. Hopefully, most catches will be landed so that catch weight can be obtained during the unloading process. Instances may occur in which (1) the net is ripped or fouled and catch lost, or (2) the catch is predominantly spawnouts, cannot be sold and must be released. In such cases biomass conversion factors will be calculated using a catch weight estimate provided by the spotter plane pilot or charter vessel operator. Make every effort to avoid such occurrences by contracting experienced seine vessel operators and making arrangement with buyers/processors prior to conducting a biomass conversion estimate.

BSH-MAP/106

Biomass Conversion
Test Set

UNGALIKTHLUK INDEX (UGL-1)

NUNAVACHAK & TOGIAK SECTIONS

Date Surveyed 5/10/85

Observer Lebide

Survey Rating 2

Fish School Counts / Conversion Factor

	1	2	3
Sm.			
M.			
Lg. (ft²)			

Med. 20
50x75
(3,750 ft²)

BSH- _, 204

HERRING BIOMASS CONVERS. .TIMATE WORSHEET

Date 5/10/85 Time 1:30pm Location UGL-1 Survey Rating 2 Observer(s) Lebida Aircraft Helicopter

Airspeed Variable Altitude 1,500 ft % Cloud Cover 15 Wind NE 5 Kts Water Clarity Good Tide Stage Ebbing

Vessel F/V Scout Operator/Crew Jonas Ahab Spotter Plane PA-18 (N2242P) Pilot Snoopy Smith

Tender Lollipop Processing Vessel Kettle Company Popsicle Fish Ticket Number T 552535

	Water Depth	Distance from shore (Mi)	School Surface Area (ft2)	Percent Captured	Maturity Stage	Weight of Catch (st)	Conversion Factor (st/538 ft2)
ADF&G							
Aerial		1 mi	A= 3,750 ft²	90			C/A X 538 = 2.87
Ground							
Charter							
Spotter			4,000 ft² (40x100)	90		50	
Vessel	4 fathoms	1 mi			Ripe	20-30	
Processor					11% Roe	C= 20	

Since only ~ 90% captured factor closer to 3.16 st/538 ft²

Remarks: Good set, but some escaped and were visible outside of net
3,750 ft² = Med = 5 RAI units
5 X 2.83 = 14 st estimated ton e

BSH-C . .05 HERRING BIOMASS CONVERSI STIMATE SUMMARY Ye 285

Date	Survey Rating 1/	Charter Code	Location	Water Depth	School Surface Area Est. (ft2) ADF&G	School Surface Area Est. (ft2) Spotter	Tonnage Est. (st) ADF&G	Tonnage Est. (st) Spotter	% School Captured	Maturity Stage	Landed Weight (st)	st/538 ft2
5/4	3	A	TOG-1	~15 ft	5,500	8,600	20	25	100	Ripe	23	2.25
5/10	2	B	UGL-1	~26 ft	3,750	4,000	14	50	90	Ripe	20	2.87

1/ 1=Excellent (calm, no glare)
2=Good (light ripple, uneven lighting, easy to see schools)
3=Fair (light chop, some glare or shadows relatively easy to spot schools)
4=Poor (rough seas, strong glare, difficult to spot schools)
5=Un ctory

BSH-C 5

HERRING INDEX A .OMASS SUMMARY

District TOGIAK

Year 1985

Date	(Time)	Survey Conditions	Milt Sightings No.	Milt Sightings Length (mi)	Estimated Biomass (st) By Index Area NUS	KUK	MET	NUK	UGL	TOG	TNG	MIG	HAG	OSK	PYR	CN	Daily Total
4/30	(am)	1	0	0	0	0	0	0	0	0	0	0	0	0	—	—	0
5/2	(am)	3	0	0	0	0	0	0	0	0	0	0	0	0	—	—	0
5/3	(am)	3	5	4.1	0	25	48	100	85	130	45	0	—	—	—	—	433

BSH-CF/202 (Rev. 2/85)

HERRING AERIAL SURVEY DISTRICT SUMMARY

District TOGIAK

Year 1985

Date (Time)	Flight Number	Survey Rating	Index Areas	Number of Schools				Biomass Estimates (st)		Spawn		
				Sm	Med	Lg	Total	Formula	Nelson	No.	Mi.	Cum. Mi.
4/30 (AM)	1	1	NUS-OSK	–	–	–	0	0	0	0	–	–
5/2 (AM)	2	3	NUS-OSK	10	1	1	12	–	–	0	–	–
5/3 (AM)	3	3	NUS-MTG	16	6	6	28	433	500	5	4.1	4.1