Fishery Data Series No. 13-38

Abundance, Age, Sex, and Size Statistics for Pacific Herring in Togiak District of Bristol Bay, 2012

by

Gregory B. Buck

August 2013

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 13-38

ABUNDANCE, AGE, SEX, AND SIZE STATISTICS FOR PACIFIC HERRING IN TOGIAK DISTRICT OF BRISTOL BAY, 2012

by
Gregory B. Buck
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

August 2013

ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.adfg.alaska.gov/sf/publications/ This publication has undergone editorial and peer review.

Gregory B. Buck,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, Alaska, 99518 USA

This document should be cited as:
Buck, G. B. 2013. Abundance, age, sex, and size statistics for Pacific herring in Togiak District of Bristol Bay, 2012. Alaska Department of Fish and Game, Fishery Data Series No. 13-38, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

The Pacific herring *Clupea pallasii* total run in Togiak District of Bristol Bay was monitored for abundance/biomass and sampled for age, size, and sex composition in 2012. Abundance was estimated from aerial surveys with chartered aircraft. Commercial harvest was measured through landing reports filed by commercial fish processors to the Alaska Department of Fish and Game. Samples were collected from commercial purse seine and gillnet harvests at the processors. The 2012 run biomass was estimated at 167,738 tons (152,171 tonnes). Total commercial harvest was 18,828 tons (17,021 tons from the sac roe fisheries with 12,994 tons harvested by purse seine and 4,027 tons by gillnet and 1,807 tons harvested by the Dutch Harbor food and bait fishery). The preseason allowable exploitation rate is regulated to be 20% and the final exploitation rate was estimated at 11%. A total of 6,970 herring were sampled for age, sex, length, weight and sexual maturity information between 14 May and 25 May 2012. The 2012 inshore herring ages ranged from 3 to 16 years, with purse seine harvest dominated by age-7 (37%), and -8 (16%) fish, while gillnet harvest was dominated by age-8 (26%), and -9 (22%) fish. Mean length and weight of herring from the purse seine fishery samples were 297 mm and 308 g, while fish sampled from the gillnet fishery averaged 325 mm and 422 g.

Key words: Pacific herring, *Clupea pallasii*, age, length, weight, sex, food and bait, sac roe, abundance, spawning biomass, commercial herring fishery, Bristol Bay, Togiak District, Dutch Harbor

INTRODUCTION

Commercially exploited quantities (or stocks) of Pacific herring *Clupea pallasii* are found along the coast of Alaska from its southern boundary at Dixon Entrance to Norton Sound (Woodby et al. 2005). One of the most important of these exploited stocks is the Bristol Bay-Alaska Peninsula stock. The Bristol Bay-Alaska Peninsula herring stock is managed as a single spawning population as established in the *Bristol Bay Herring Management Plan* (5 AAC 27.865). This plan, originally adopted in 1980, sets a maximum 20% exploitation rate of the available spawning biomass as the management target. Of this potential harvest, a fixed allocation of 1,500 tons (1,361 tonnes) is set aside for a spawn-on-kelp harvest in Togiak District and 7% of the remaining available biomass for a food and bait fishery operated out of Dutch Harbor. Remaining available biomass is reserved for the Togiak sac roe fishery with a gear allocation target of 30% reserved for the gillnet fleet and 70% for the purse seine fleet (Sands 2009).

The primary commercial fishery targeting this stock occurs in the Togiak District, which consists of all state waters between the longitude at the tip of Cape Constantine and the tip of Cape Newenham and extending south to the latitude of Cape Menshikof (approximately 4,116 km^2; Figure 1). This fishery occurs as fish move inshore prior to spawning and targets the ripened ovaries (sac roe) of female herring prior to spawning. Biomass estimates of this spawning aggregation have been conducted annually using aerial surveys since 1978. The largest was 239,022 tons (216,839 tonnes) in 1979 and has averaged 144,344 tons (130,948 tonnes) between 2002 and 2011 (McBride and Whitmore 1981; McBride et al. 1981; Fried et al. 1982–1984; Lebida et al. 1985a, 1985b; Lebida 1987; Sandone and Brannian 1988; Lebida and Sandone 1990; Rowell et al. 1991; Rowell 1995, 2002a, 2002b; West 2002; West et al. 2003; Schwanke 2003, 2004; Brazil 2007a, 2007b, 2007c; Brazil et al. 2009; Buck 2010a, 2010b, 2012, 2013; Table 1).

Commercial harvest was first documented in Togiak District in 1968. Passage of the Fisheries Conservation and Management Act in 1976 and the resulting inability of Japanese fishermen to

harvest sac roe from U.S. waters prompted increased interest in the Togiak fishery by U.S. fishermen. The 20-year mean sac roe harvest is presently 22,067 tons[1] (20,019 tonnes[2]; Table 1). During this period, the harvest ranged from a high of 30,315 tons (27,502 tonnes) in 1994 to a low of 17,049 tons (15,467 tonnes) in 2002. In addition to the sac roe fishery, wild spawn-on-kelp has historically been harvested as well either by hand or rake. First documented in 1967, this fishery has been intermittent in recent years because of low demand and did not occur in 1997, 1998, 2000, 2001, and from 2004 to the present (Table 1).

Each spring, herring from the Bristol Bay-Alaska Peninsula stock migrate from their overwinter habitat north of the Pribilof Islands to spawning locations along the eastern Bering Sea coast, primarily in the Togiak region east of Cape Newenham (Tojo 2007; Figure 2). The shoreline in this region is characterized by a wide intertidal zone and shallow bays with diurnal tidal ranges up to 4.6 m (Selkregg 1976). The primary marine vegetation consists of ribbon kelp *Laminaria* spp., rockweed *Fucus* spp., and eelgrass *Zostera* spp. Rockweed is the most visible species of aquatic vegetation because it grows on cobble substrate in intertidal areas and upon rocky outcroppings. Spawning occurs throughout the Togiak fishing district, particularly in areas where eelgrass and rockweed are present and occurs from late April through early June. After spawning, the fish continue their clockwise migration along the Alaska Peninsula to feeding areas near Unalaska Island. In August and September, these fish move north to overwintering grounds north of the Pribilof Islands (Shaboneev 1965; Rumyantsev and Darda 1970; Wespestad and Barton 1981; Funk 1990).

After leaving Togiak District, fish from this stock are susceptible to one other directed fishery during their post-spawn migration. This is a food and bait fishery occurring mid- to late-summer around Unalaska Island with boats operating out of Dutch harbor. Harvests in this fishery began in 1929 and peaked at 3,006 tons (2,727 tonnes) in 1932 (Jackson 2008). The fishery declined and ended by 1938 because of poor market demand. This fishery was renewed in 1981 whereupon harvest quickly peaked in 1984 at 3,578 tons (3,246 tonnes) and has since trended down with the most recent 10-year average at 1,433 tons (1,300 tonnes; Table 1).

In addition to the managed harvest, Togiak herring occur as bycatch in fisheries targeting groundfish in the southeastern Bering Sea. Foreign vessels first developed this fishery but domestic fishermen have recently been more dominant. These fisheries occur in areas that include the migratory route of feeding herring (Rowell et al. 1991). In the Bering Sea and Aleutian Islands Management Area, a 1% cap of available (forecasted) herring biomass has been established for this fishery (NPFMC 2009).

OBJECTIVES

The specific objectives for assessing Togiak herring were to:

1) Estimate the run biomass of spawning herring within Togiak District.

[1] The Alaska Board of Fisheries requires that inseason catch and aerial survey biomass estimates be calculated and reported in short tons. The English short ton = 2,000 lb or 907.2 kg.

[2] The metric tonne (1,000 kg or 2,205 lbs) = tons/1.1023.

2) Document the commercial harvest (including deadloss and test fishing) of herring within Togiak District by time period (date), gear type, and district subsection.

3) Characterize the age composition as well as length and weight at age of the run, harvest (by gear type), and escapement.

4) Estimate the total exploitation rate of herring in Togiak District and the Dutch Harbor food and bait fishery.

5) Sample the run biomass for the presence of 3 pathogens common to Pacific herring: Viral Hemorrhagic Septicemia Virus, Viral Erythrocytic Necrosis Virus, and *Ichthyophonus hoferi*.[3]

METHODS

BIOMASS

Run biomass within Togiak District was estimated following aerial survey procedures outlined by Lebida and Whitmore (1985). Surveys were flown daily at low tide within the constraints of aircraft availability and weather. The district was divided into 13 aerial survey sections (Figure 3). Daily biomass estimates were made by summing survey section estimates. Peak inseason biomass was the maximum daily estimate during the fishing season and run biomass was the sum of all daily biomass estimates judged to be composed of fish not accounted for in any other survey plus all harvest that occurred prior to the first usable daily biomass estimate. In a typical fishing season, this will be the peak biomass estimate combined with an immediate postseason estimate combined with all pre-peak harvest.

HARVEST

Fish tickets (sales receipts) completed by buyers for each commercial delivery were the primary source for documenting harvest. Fish ticket information included date of harvest, gear type, biomass (tons), and location by management section. Estimates of waste and or discarded herring observed during aerial surveys or reported by fishermen or processors were added to the fish ticket database and counted as harvest when calculating exploitation rates.

AGE, SIZE, AND SEX COMPOSITION

We attempted to sample the commercial catch for age composition from each management section during every commercial fishing period (usually consisting of a single day). Sampling staff collected samples at the close of each commercial fishing period from processors, tenders, or individual fishing vessels and labeled them by gear type, processor, location and harvest date. Attempts were made to collect samples from multiple vessels and or processors to ensure samples came from a maximum number of schools. Samples collected from each gear type were used to characterize the harvest of each gear type, while only fish captured by purse seine gear were used to characterize aerial survey biomass estimates because purse seines are less size-selective than gillnets.

[3] Pathology sampling occurred in 2011 and 2012. The results for both years are included in this report.

To determine age, samplers removed a scale from the preferred left side of each fish approximately 2.5 cm behind the operculum and 2.5 cm below the lateral line for later interpretation. If scales were absent from this preferred area, they removed a scale from the right side of the fish in the same location or any other area where readable scales were present. Removed scales were dipped in a 10% mucilage solution, mounted sculptured side up on glass slides, and read by annuli interpretation at low (~10x) magnification using a microfiche reader or dissecting microscope. Age was estimated by counting the compressed annuli formation at the end of winter prior to spawning (Shaboneev 1965). Because samples were collected during the spawning migration, the outer edge of the scale was considered an annulus.

In addition to age, standard length (tip of snout to the hypural plate) of each fish was measured to the nearest millimeter. We weighed each herring to the nearest 0.5 g and determined sex and maturity for each herring by visually examining the gonads. We rated maturity using an abbreviated version of the 8-scale guideline outlined in Barton and Steinhoff (1980), combining categories as green (not ready to spawn), ripe (ready to spawn), or spent (already spawned).

Adequate sample sizes ensured that age composition estimates for a multinomial population resulted in a solution whereby each age category would simultaneously fall within 5% (δ =0.05) of the true population age proportions 90% of the time (Thompson 1987). A sample size of 400 fish provides this level of precision and accuracy. We attempted to collect this amount daily from each section where commercial purse seine fishing occurred and every other day where gillnet fishing occurred.

Harvest sample group assignment was accomplished by considering the earliest samples and sequentially adding samples from subsequent days and or adjacent fishing sections if they did not differ significantly (χ^2, P<0.05) or if additional samples were needed in a step-wise process until the minimum sample size was achieved. This process resulted in 6 sampling groups for the purse seine harvest and 3 for gillnet harvest (Table 2; Figures 4 and 5).

Age composition and related information was calculated by matching sampling groups with corresponding harvest and aerial survey biomass estimates. The mean weight-at-age, $\overline{W}_a$, for herring for each gear-time-area stratum is estimated as

$$\overline{W}_a = \frac{\sum_{i=1}^{n_a} W_{ai}}{n_a}, \tag{1}$$

where:

W_{ai} = the individual weight of herring in sample n of age a, and

n_a = the number of herring in the sample of age a.

The mean length at age is calculated by substituting the individual length, L_{ai}, of herring for the individual weight, W_{ai}. Biomass by age, B_a, is estimated as

$$B_a = \left[\frac{n_a \overline{W}_a}{\sum_{a=1}^{\max_a} (n_a \overline{W}_a)} \right] B, \tag{2}$$

where:

B_a = the biomass for age a,

n_a = the number of herring in the sample of age a, and

B = aerial survey or harvest biomass estimate.

The estimated run biomass is calculated by summing B_a for all ages. This can also be converted to numbers of fish for each age class, N_a, as

$$N_a = \frac{B_a}{W_a}. \quad (3)$$

The sum across all age classes of the difference between the run biomass at age B_a and the combined purse seine and gillnet harvests at age C_a, which is defined as the escapement biomass, E_{tot}:

$$E_{tot} = \sum_{a=1}^{\max} (B_a - C_a). \quad (4)$$

An age-structured analysis model (Funk and Rowell 1995) was used to forecast the 2012 run (Appendix D). The most recent biomass estimate included in the 2012 forecast model occurred in 2010.

EXPLOITATION RATE

The exploitation rate, U, is estimated as

$$U = \frac{C}{B}, \quad (5)$$

where:

C = total Togiak sac roe harvest and Dutch Harbor food and bait harvest, and

B = run biomass.

PATHOLOGY

While no evidence of infectious pathology has been noted in the Bristol Bay-Alaska Peninsula herring stock, concern over our lack of detection effort led us to sample this population in 2011 and 2012. Approximately 60 individuals were sampled from the harvest each year and examined for evidence of Viral Hemorrhagic Septicemia Virus, Viral Erythrocytic Necrosis Virus, and *Ichthyophonus hoferi* using Alaska Department of Fish and Game (ADF&G) pathology protocol (Meyers 2010).

RESULTS

BIOMASS

Aerial surveys began on 9 May (Table 3). Observers first spotted herring on 14 May during a survey that documented 42,173 tons (38,259 tonnes). Biomass increased through 22 May when

the inseason biomass peaked at 124,529 tons (112,972 tonnes) then fell to 31,594 tons (28,662 tonnes) on the final survey of 31 May. Spawning was concentrated in the center of Togiak District (Figures 3 and 6).

Aerial survey conditions ranged from fair to excellent throughout the season, with good to excellent conditions during the peak inseason survey (Table 3). We estimated run biomass at 167,738 tons (152,171 tonnes) by combining the peak inseason biomass estimate of 22 May with the final biomass estimate from 31 May and all harvest that occurred prior to the peak biomass survey (Table 1). We assume that the spawning biomass in the district experienced a complete turn-over between the 2 surveys used in this estimate. Spawn occurred for 30.5 miles (49.1 km) along the coastlines in Togiak District in 2012, with a little more than half of it observed during the 15 May survey (Tables 3 and 4).

HARVEST

Commercial openings between 14 May and 1 June produced a total harvest of 17,021 tons (15,441 tonnes) within Togiak District (Table 5) in 2012. Historically, this fishery commences around 7 May; however, there is annual temporal variation, with fishing commencing as early as 25 April (in 2003) and as late as 16 May (in 2008 and 2009) within the last 10 years (Table 6). This temporal variation is thought to be largely a function of the spring ice break-up and related water temperatures in the eastern Bering Sea (Tojo 2007). Fishing opened on 14 May and ended on 6 June, making for a relatively late and long 23-day fishing season. Fishing with purse seine gear was open from 14 May to 28 May with the exception of 22 May. Fishing with gillnet gear was open continuously from 14 May through 1 June. The total commercial harvest in the Togiak District sac roe fishery of 17,021 tons (15,441 tonnes) represents 82% of the 10-year average and 77% of the 20-year average (Table 1). Catches from Hagemeister Section accounted for the largest percentage (45%) of the total commercial harvest, followed by Nunavachak (35%), Kulukak (16%), Pyrite Point (3%), and Togiak (1%) sections (Table 5; Figure 7).

Roe percentages ranged from 14.4% for herring harvested by gillnet in Kulukak Section on 14 May to 7.8% for herring harvested by purse seine in Nunavachak Section on 19 May and Pyrite Point Section on 21 May (Table 5).

Purse Seine

The Togiak purse seine fishery opened at 6:00 p.m. on 14 May after AFD&G staff documented 42,000 tons (38,102 tonnes) on the grounds and several areas of active spawning. The relatively small harvests for the first five days of the fishery were due to poor weather, reduced processor participation, and not all processors operating at full capacity. Due to weather issues impacting the gillnet fishery, the area for the purse seine fishery changed several times over the course of the fishery beginning 16 May. These changes consisted of reducing the purse seine area east of Togiak Bay when winds precluded gillnet fishing east of Right Hand Point and adding additional area in Togiak Bay. Poor weather prevented fishing on 17 May so on 18 May the purse seine fishery was extended for 72 hours until 10:00 p.m. 21 May. The fishery progressed over the next 2 days in a steady manner, harvesting approximately 2,450 tons (2,223 tonnes) on 19 and 20 May. By then the purse seine fleet had harvested 55% of their quota and the gillnet fleet had harvested 21% of their quota. Due to this disparity, the department let the purse seine fishery close as scheduled at 10:00 p.m. on 21 May. ADF&G reopened the purse seine fishery at noon on 23 May. Unfortunately, fog that afternoon reduced the effectiveness of the fleet, which harvested 1,267 tons (1,149 tonnes), a relatively small harvest considering the 36-hour purse seine

closure. Over the next several days, harvest was relatively small considering the available processing capacity. The department continued extending the fishery 24 hours at a time, as there was still interest from industry and no biological concerns. The last purse seine harvest was 26 May and the fishery closed at 10:00 p.m. on 28 May. The total purse seine harvest was 12,994 tons of herring or 85.8% of its quota.

There were 11 commercial purse seine openings totaling 316 hours in Togiak District between 14 May and 28 May, harvesting a total of 12,994 tons (11,788 tonnes) during 2012 (Table 5). The first opening lasted 54 hours harvesting 2,349 tones (2,131 tonnes), mostly in the Nunavachak Section. A total of 59% of the harvest occurred in Hagemeister Section. No deadloss was reported or observed. Purse seine harvests averaged 972 tons (882 tonnes) per fishing day.

Roe accounted for 9.4% (by weight) of the commercial purse seine fishery and ranged from 7.8% in Nunavachak Section on 19 May to 10.3% in Pyrite Point Section on 23 May (Table 5). The total average roe percentage (9.4%) for purse seine herring was 0.1% higher than the most recent 10-year average and identical to the 20-year average (Table 6).

Gillnet

The Togiak gillnet fishery opened on 14 May at 6:00 p.m. although it was 18 May before all three processors were buying gillnet fish due to the relatively few boats participating in 2012 and the inclement weather. The gillnet fleet harvested 537 tons (487 tonnes) through 18 May. On 19 May processors imposed restrictions on their gillnet fleets that limited harvest. Peak gillnet harvest occurred on 20 May with a harvest of 648 tons (588 tonnes). ADF&G closed the purse seine fishery at 10:00 p.m. on 21 May while leaving gillnet fishing open in order to bring the gear type harvest quotas closer to the ratio dictated by the management plan. The gillnet fleet remained unrestricted by processors for the remainder of the season while the purse seine fishery reopened at noon on May 23 after a 36 h break. The gillnet harvest dropped off quickly after 30 May and by 3 June the entire gillnet fleet had stopped fishing and the season closed at 10:00 p.m. on 5 June. The gillnet fleet of 18 vessels harvested 4,027 tons (3,653 tonnes) or 62.1% of its quota.

There were 15 commercial gillnet openings totaling 534 hours in Togiak District between 14 May and 5 June, harvesting a total of 4,027 tons (3,653 tonnes; Table 6). The first opening lasted 102 hours harvesting 537 tones (487 tonnes), mostly in Nunavachak Section. A total of 69% of the harvest occurred in Kulukak Section. No deadloss was reported or observed. Purse seine harvests averaged 181 tons (164 tonnes) per fishing day.

Roe accounted for 12.1% (by weight) of the commercial gillnet fishery. Roe percentages ranged from a low of 8.9% on 25 May in Kulukak Section, to a high of 14.4% between 14 and 18 May in the same section (Table 5). The total average roe percentage (weighted) for gillnet harvested in 2011 was 113% of the 10-year and 110% of the 20-year average (Table 6).

Spawn on Kelp

There was no commercial harvest for spawn-on-kelp in 2012, as there were no registered buyers (Table 1). This fishery last occurred in 2003.

AGE, SIZE, AND SEX COMPOSITION

A total of 5,570 samples collected from the commercial purse seine fishery (all sections) produced 4,656 readable scales of the 5,772 total readable scales from all gear types (Table 7; Appendices B1–B4). A total of 3,600 samples collected between 17 and 25 May in Hagemeister Section produced 3,004 (52%) of the total readable scales (Appendices B1 and B4). A total of 1,521 samples were collected from purse seine catches between 16 and 21 May in Nunavachak Section produced 1,259 (22%) of the total readable scales (Appendices B2 and B4). A total of 449 samples collected from catches on 21 May in Togiak Section produced 393 (7%) of the total readable scales (Appendices B3 and B4).

A total of 1,400 herring sampled from the commercial gillnet fishery between 14 and 25 May produced 1,116 (19%) of the total readable scales (Table 7; Appendices C1–C3). A total of 470 samples collected on 14 and 19 May in Nunavachak Section produced 369 (6%) of the total readable scales (Appendices C1 and C3). A total of 930 samples collected between 20 and 25 May from Kulukak Section produced 747 (13%) of the total readable scales (Appendices C2 and C3). Standard sampling protocol accounted for the typical percentage of non-readable scales and was designed to meet the sample size goal of readable scales.

Total Run

The 2012 biomass estimate was the sum of aerial survey estimates conducted on 22 and 31 May and all harvest occurring prior to the 22 May survey. The survey on 22 May recorded the largest biomass of the season and by the 31 May survey only 2% of the harvest remained. We assumed that fish present on 31 May had arrived on the spawning grounds after 22 May and that no fish present during the 22 May survey were still present on the spawning grounds during the 31 May survey. The age composition of the 136,144 tons (123,509 tonnes) that represent peak biomass in addition to harvest up to that point in the run were characterized using 3,776 purse seine samples collected through 18 May. The age composition of the 31,594 tons (28,662 tonnes) estimated during the 31 May survey were characterized using 476 herring sampled from the purse seine harvest on 24 and 25 May.

Age classes composing more than 10% of the run either in abundance or run biomass were age-6, -7, -8 and -9 fish, which comprised 17%, 36%, 18% and 10% (respectively) of the run by weight and 19%, 38%, 16%, and 8% by number (Table 8; Figure 8; Appendix A1). The mean lengths were larger than historical means (Figure 9) while weights of these important age classes were similar to the historical mean (Figure 10).

Typically, the Bristol Bay-Alaska Peninsula herring stock biomass experiences a shift towards younger age classes as the season progresses. In 2012 age-7 was the dominant age class, comprising 38% of spawning run as a whole. However, there was a slight shift towards younger fish later in the run, with 62% of the run through the peak being age-7 or younger while 85% of the later run was age-7 or younger.

Commercial Harvest

Abundant age classes (>10% of the harvest in abundance or harvest biomass) were age-6, -7, -8 and -9 fish, which comprised 15%, 32%, 19% and 12% (respectively) of the harvest by weight and 18%, 34%, 17% and 10% by number (Table 8; Appendix A1). The gillnet harvest was markedly older than those in the purse seine harvest (Figures 11 and 12; Table 8).

The average length and weight of fish harvested in the commercial fishery was 303 mm and 330 g. Samples collected from commercial purse seine and gillnet harvests were 51% male and 49% female, varying in composition by time and location ($\chi 2=1.3e^{4}$, $P=2.2e^{-16}$).

Purse Seine

Samples were collected from the commercial purse seine harvest between 16 and 25 May from Hagemeister, Nunavachak and Togiak sections (Appendices B1–B4). Herring sampled from the purse seine fishery ranged from age 3 to 16 (Table 8). Age-5, -6, -7 and -8 fish comprised 8%, 18%, 36%, and 17% of the commercial purse seine harvest by weight and 10%, 21%, 38%, and 15% by number (Table 8; Appendices A2 and B4). Samples from the 2012 purse seine harvest had a mean length of 297 mm and mean weight of 308 g (Table 9), and were 53% male and 47% female and varied by harvest date ($\chi 2=26.8$, $P=3.5e^{-4}$) and location ($\chi 2=14.9$, $P=5.7e^{-4}$).

Gillnet

Samples were collected from the commercial gillnet harvest between 14 and 25 May from Nunavachak and Kulukak sections (Appendices C1–C3). Herring sampled from the gillnet fishery ranged from age 4 to 15 (Table 8), with age-7, -8, -9 and -10 fish representing 17%, 24%, 21%, and 14% of the commercial gillnet harvest by weight and 19%, 25%, 20% and 13% by number (Table 8; Appendices A3 and C3). Samples from the 2012 gillnet harvest had a mean length of 325 mm and mean weight of 422 g (Table 9). Herring sampled from the gillnet harvest were 45% male and did not vary by harvest date ($\chi 2=1.5$, $P=.92$) or location ($\chi 2=0.09$, $P=.76$) but did vary by time and location ($\chi 2=1151.3$, $P=2.2e^{-16}$).

EXPLOITATION RATE

We estimate the 2012 exploitation rate of the Bristol Bay-Alaska Peninsula herring stock at 11% by dividing the combined Togiak District commercial sac roe harvest of 17,021 tons (15,441 tonnes) and the Dutch Harbor food and bait harvest of 1,807 tons (1,639 tonnes) by the total run biomass estimate of 167,738 tons (152,171 tonnes; Table 1).

PATHOLOGY

No evidence of Viral Hemorrhagic Septicemia Virus, Viral Erythrocytic Necrosis Virus, or *Ichthyophonus hoferi* was detected in either 2011 (Appendix E1) or 2012 (Appendix E2).

DISCUSSION

The purpose of this report was to estimate total run biomass, spawning escapement, and age, size (weight and length), and sex composition of the Bristol Bay-Alaska Peninsula herring stock that spawn in Togiak District. A sampling crew located at the North Pacific Seafoods plant in Togiak processed samples from this fishery collected from processors throughout the district. This strategy provides managers with inseason age composition estimates in a timely and cost-effective manner.

We estimated the 2012 total run biomass to be 167,738 tons (152,171 tonnes; Objective 1) based on aerial surveys conducted on 22 and 31 May and the harvest prior to the 22 May survey (Table 1; Appendix A1). Spawning activity was first observed during a survey conducted on 14 May (Table 3).

The total Togiak sac roe commercial harvest (Objective 2) of 17,021 tons (15,441 tonnes) was approximately 80% of the 10- and 20-year average (Table 6). The commercial fishery started 7 days later than average, opening on 14 May (Table 6). The average roe percent was above average for gillnet harvest and average for purse seine harvest.

Over the last decade or so, changes in agency and industry management (processor co-ops) as well as global market conditions have driven several trends in this fishery. Beginning around the turn of the century, fishing seasons have become longer as fishing effort has declined. At 23 days, the 2012 fishery was one day shorter than in 2011 and effort in both gillnet and purse seine fleets was lower than last year (Table 6). These trends allow purse seine fishermen to inspect their catches more closely and harvest only the most valuable fish.

The commercial purse seine harvest of 12,994 tons (11,788 tonnes) was 86% of the 10-year average and 79% of the 20-year average while the commercial gillnet harvest of 5,907 tons (5,359 tonnes) was 71% of the 10- and 20-year average (Table 6).

The number of readable scales (5,772) collected from the 2012 commercial fishery was 119% of the 5-year average of readable scales (Table 7). This sampling effort was sufficient to characterize the Togiak District herring spawning biomass.

Age-7 herring dominated the total run and the harvest in 2012 (Objective 3), accounting for 32% to the total harvest biomass and 34% of the harvest abundance, as well as 36% of the total run biomass and 38% of all fish in the 2012 run (Table 8). There was a slight shift towards younger fish over the course of the 2012 run with 62% of the early run composed of age-7 or younger herring and 85% of the later run composed of the same age classes.

A major problem with estimating recruitment in any given year is the lack of postseason sampling necessary to detect younger fish. The 2012 season was both longer than normal at 23 days and closed later (5 June) than any season since 1992. Personnel and budget constraints precluded any sampling of fish caught after 25 May and no postseason survey or sampling was conducted. This makes the detection of younger recruit age classes, such as age-4 and age-5, which generally spawn later than older fish difficult. While age-4 and -5 herring were present at low levels they were well below the elevated levels seen during the last significant recruitment event experienced by this biomass that occurred in 2008 and 2009 (Table 8; Figure 13; Appendix C1). Togiak herring typically experience large recruitment events every 8–10 years.

The total exploitation rate (Objective 4) in Togiak District was 11% (Table 1), which was lower than the management target exploitation rate of 20%, and the 15% and 17% average exploitation rates over the last 10 to 20 years.

We conducted tests of the Togiak Pacific herring population in 2011 and 2012 for 3 common pathogens found in other Alaska herring populations (Marty et al. 2003; Objective 5). Samples were tested for the presence of Viral Hemorrhagic Septicemia Virus, Viral Erythrocytic Necrosis Virus, and *Ichthyophonus hoferi*. These pathogens were not detected in 2011 (Appendix E1) or 2012 (Appendix E2).

ACKNOWLEDGEMENTS

Thanks go to several Alaska Department of Fish and Game, Division of Commercial Fisheries personnel for contributing to this report. Jedediah Smith, Hannah Hilowitz and Adam Kane collected the data contained in this report. Tim Sands and Matt Jones provided daily biomass

estimates. Karen Brito and Phil Carpenter provided logistical and administrative support. Charles Brazil and Fred West provided critical review of the manuscript. Thanks also goes to North Pacific Seafoods at Togiak for hosting our sampling program and the other fishermen and processors who provided herring samples.

REFERENCES CITED

Barton, L. H., and D. L. Steinhoff. 1980. Assessment of spawning herring *(Clupea harengus pallasii)* stocks at selected coastal areas in the eastern Bering Sea. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 78, Juneau.

Bernard, A. C. 2011. Alaska Peninsula-Aleutian Islands management area herring sac roe and food and bait fisheries annual management report, 2010. Alaska Department of Fish and Game, Fishery Management Report No. 11-06, Anchorage.

Brazil, C. 2007a. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-20, Anchorage.

Brazil, C. 2007b. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 07-36, Anchorage.

Brazil, C. 2007c. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-26, Anchorage.

Brazil, C., T. T. Baker, and G. B. Buck. 2009. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2007. Alaska Department of Fish and Game, Fishery Data Series No. 09-48, Anchorage.

Buck, G. B. 2010a. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2008. Alaska Department of Fish and Game, Fishery Data Series No. 10-34, Anchorage.

Buck, G. B. 2010b. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2009. Alaska Department of Fish and Game, Fishery Data Series No. 10-99, Anchorage.

Buck, G. B. 2012. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2010. Alaska Department of Fish and Game, Fishery Data Series No. 12-19, Anchorage.

Buck, G. B. 2013. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2011. Alaska Department of Fish and Game, Fishery Data Series No. 13-03, Anchorage.

Fried, S. M., C. Whitmore, and D. Bergstrom. 1982a. Age, sex, and size composition of Pacific herring, *Clupea harengus pallasii*, from eastern Bering Sea coastal spawning sites, Alaska, 1981. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 78, Juneau.

Fried, S. M., C. Whitmore, and D. Bergstrom. 1982b. Age, sex, and size composition of Pacific herring, *Clupea harengus pallasii*, from eastern Bering Sea coastal spawning sites, Alaska, 1982. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 79, Juneau.

Fried, S. M., C. Whitmore, and D. Bergstrom. 1983a. Age, sex, and size composition of Pacific herring, *Clupea harengus pallasii*, from eastern Bering coastal spawning sites, Alaska, 1964–1976. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 84, Juneau.

Fried, S. M., C. Whitmore, and D. Bergstrom. 1983b. Age, sex, and size composition of Pacific herring, *Clupea harengus pallasii*, from eastern Bering coastal spawning sites, Alaska, 1977–1978. Alaska Department of Fish and Game, Division of Commercial fisheries, Technical Data Report No. 85, Juneau.

Fried, S. M., C. Whitmore, and D. Bergstrom. 1984. Age, sex, and size composition of Pacific herring, *Clupea harengus pallasii*, from eastern Bering Sea coastal spawning sites, Alaska, 1983. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 105, Juneau.

REFERENCES CITED (Continued)

Funk F. 1990. Migration of eastern Bering Sea herring as inferred from 1983–1990 joint venture and foreign trawl bycatch rates. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J90-04, Juneau.

Funk, F., and K. A. Rowell. 1995. Population model suggests new threshold for managing Alaska's Togiak Fishery for Pacific Herring in Bristol Bay. Alaska Fishery Research Bulletin 2(2):125–136.

Jackson, J. V. 2008. Alaska Peninsula-Aleutian Islands management area herring food and bait fishery management plan, 2008. Alaska Department of Fish and Game, Fishery Management Report No. 08-61, Anchorage.

Jones, M., T. Sands, S. Morstad, P. Salomone, G. Buck, F. West, T. Baker, and T. Kreig. 2012. 2011 Bristol Bay area annual management report. Alaska Department of Fish and Game, Fishery Management Report No. 12-21, Anchorage.

Lebida, R. C. 1987. Age, size and sex composition of Pacific herring (*Clupea harengus pallasii)* from eastern Bering Sea coastal spawning sites, 1986. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 216, Juneau.

Lebida, R. C., and G. J. Sandone. 1990. Age, size and sex composition of Pacific herring *(Clupea harengus pallasii)* from eastern Bering Sea coastal spawning sites, 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report No. 88-06, Juneau.

Lebida, R. C., and D. C. Whitmore. 1985. Bering Sea herring aerial survey manual. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report No. 85-2, Anchorage.

Lebida, R. C., D. C. Whitmore, and G. J. Sandone. 1985a. Age, sex and size composition of Pacific herring, *Clupea harengus pallasii* from eastern Bering Sea coastal spawning sites, Alaska, 1984. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 138, Juneau.

Lebida, R. C., D. C. Whitmore, and G. J. Sandone. 1985b. Pacific herring stocks and fisheries in the eastern Bering Sea, Alaska, 1985. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 187, Juneau.

Marty, G. D., T. J. Quinn II, G. Carpenter, T. R. Meyers, and N. H. Willits. 2003. Role of disease in abundance of a Pacific herring (*Clupea pallasii*) population. Canadian Journal of Fisheries and Aquatic Sciences 60(10): 1258-1265.

McBride, D., and C. Whitmore. 1981. Age composition of Pacific herring, *Clupea harengus pallasii* (Valenciennes) in the Togiak District of Bristol Bay during the 1979 and 1980 spawning seasons. Alaska Department of Fish and Game, Division of Commercial Fisheries, Information Leaflet No. 191, Juneau.

McBride, D., C. Whitmore, and D. Bergstrom. 1981. Age, sex, and size composition of Pacific herring, *Clupea harengus pallasii* (Valenciennes) from selected coastal spawning sites along the eastern Bering Sea, 1979–1980. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 61, Juneau.

Meyers, T. 2010. Regulation changes, policies and guidelines for Alaska fish and shellfish health and disease control. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J10-01, Juneau.

NPFMC (North Pacific Management Council). 2009. Fishery management plan for groundfish of the Bering Sea and Aleutian Islands management area. Seattle, Washington.

Rowell, K. A. 1995. Abundance, age, sex and size statistics for Pacific herring, in the Togiak District of Bristol Bay, 1988. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report No. 95-11, Juneau.

REFERENCES CITED (Continued)

Rowell, K. A. 2002a. Abundance, age, sex and size statistics for Pacific herring, in the Togiak District of Bristol Bay, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report No. 99-12, Anchorage.

Rowell, K. A. 2002b. Abundance, age, sex and size statistics for Pacific herring, in the Togiak District of Bristol Bay, 1990–1992. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A02-15, Anchorage.

Rowell, K. A., H. J. Geiger, and B. G. Bue. 1991. Stock identification of Pacific herring in the eastern Bering Sea trawl bycatch. Pages 255 to 278 [*In*] Proceedings of the International Herring Symposium. Alaska Sea Grant Report No. 91-01.

Rumyantsev, A. I., and M. A. Darda. 1970. Summer herring in the eastern Bering Sea. Pages 409–441 [*In*] P. A. Moiseev, editor. Soviet fisheries investigations in the northeastern Pacific, Part V: 409–41.

Sandone, G. J., and L. K. Brannian. 1988. Estimated age-class contribution of Pacific herring to the commercial sac-roe harvests of Togiak District, 1980–1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A88-12, Anchorage.

Sands, T. 2009. Overview of the Togiak District herring sac roe and spawn-on-kelp fisheries of Bristol Bay, Alaska, 2009; a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Special Publication No. 09-15, Anchorage.

Schwanke, C. J. 2003. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A03-16, Anchorage.

Schwanke, C. J. 2004. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A04-09, Anchorage.

Selkregg, L. L. 1976. Alaska regional profiles – Southcentral. University of Alaska, Arctic Environmental and Information Data Center, Anchorage.

Shaboneev, I. E. 1965. Biology and fishing of herring in the eastern part of the Bering Sea. Pages 130–154 [*In*] P. A. Moiseev, editor. Soviet fisheries investigations in the northeastern Pacific.

Thompson, S. K. 1987. Sample sizes for estimating multinomial proportions. The American Statistician 41:42–46.

Tojo, N., G. H. Kruse, and F. C. Funk. 2007. Migration dynamics of Pacific herring (*Clupea pallasii*) and response to spring environmental variability in the southeastern Bering Sea. Deep-Sea Research II. 54:2832–2848.

Wespestad, V. G., and L. H. Barton. 1981. Distribution, biology and stock assessment of Pacific herring. Pages 509–525 [*In*]: D.W. Hood, and J. A. Calder, editors. The Eastern Bering Sea shelf: oceanography and resources, Vol. I. U.S. Department of Commerce, NOAA, Office of Marine Pollution Assessment, Juneau.

West F. W. 2002. Abundance, age, sex and size statistics for Pacific herring in the Togiak District of Bristol Bay, 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A02-23, Anchorage.

West, F. W., D. L. Crawford, and C. J. Schwanke. 2003. Abundance, age, sex and size statistics for Pacific herring, in the Togiak District of Bristol Bay, 1993–2000. Alaska Department of Fish and Game Division of Commercial Fisheries, Regional Information Report 2A03-19, Anchorage.

Woodby, D., D. Carlile, S. Siddeek, F. Funk, J. H. Clark, and L. Hulbert. 2005. Commercial Fisheries of Alaska. Alaska Department of Fish and Game, Special Publication No. 05-09, Anchorage.

TABLES AND FIGURES

Table 1.–Historical total run biomass and commercial harvests (tons) of herring returning to Togiak District, Bristol Bay, 1992–2012.

	Togiak		Spawn-on-Kelp			Dutch Harbor	
Year	Total Run Biomass (tons)	Sac Roe Harvest (tons)	Harvest (lbs)	Harvest (tons)	Herring Equivalent (tons)	Food and Bait Harvest (tons)	Exploitation Rate
1992	156,957	25,808	363,600	182	1,482	1,982	18.6%
1993	193,847	17,956	383,000	192	1,481	2,824	11.5%
1994	185,412	30,315	308,400	154	1,134	3,349	18.8%
1995	149,093[a]	26,732	281,600	141	996	1,705	19.7%
1996	135,585[a]	24,871	455,800	228	1,899	2,279	21.4%
1997	144,887	23,813				1,950	17.8%
1998	121,000[a]	22,776				1,994	20.5%
1999	157,028	19,878	419,563	210	1,605	2,437	15.2%
2000	130,904[a]	20,421				2,014	17.1%
2001	115,155	22,330				2,437	21.5%
2002	120,196[a]	17,049	67,793	34	260	2,014	16.1%
2003	126,213[a]	21,663	[b]	[b]	[b]	1,332	18.2%
2004	143,124[a]	18,868				1,038	13.9%
2005	163,737	20,912				1,159	13.5%
2006	179,580	23,953				952	13.9%
2007	143,827	17,132				1,248	12.8%
2008	136,839	20,523				1,536	16.1%
2009	142,154	17,107				1,310	13.0%
2010	146,913	26,355				1,941	19.3%
2011	140,860[a]	22,877				1,795	17.5%
2012	167,738	17,021				1,807	11.2%
2002-2011 Average	144,344	20,644	67,793	34	260	1,433	15.4%
1992-2011 Average	146,665	22,067	325,679	163	1,265	1,865	16.8%

Sources: Jones et al. 2012; Bernard 2011; ADF&G fish tickets.

Note: Blank cells indicate no fishery occurred that year.

[a] Total biomass estimate based on preseason forecast as inseason biomass could not be estimated due to poor aerial survey conditions during the season.

[b] Data confidential under Alaska Statute 16.05.815.

Table 2.–Herring samples with harvest by gear type and associated sampling groups, Togiak District, 2012.

	Purse Seine														
	Available Samples					Harvest (tons)					Sample Group				
Date	KUK	NUN	TOG	HAG	PYR	KUK	NUN	TOG	HAG	PYR	KUK	NUN	TOG	HAG	PYR
5/14							2,120		229			1		1	
5/16		608					1,046					1			
5/17				945					929					2	
5/19				321			258		1,888			4		3	
5/20		363		547			897		996			4		3	
5/21		288		352			363		900	34		4		5	
5/23				363	393			199	679	389		5	5	5	
5/24				308					606				6		
5/25				168					797				6		
5/26									663				6		
	Gillnet														
5/14		187				18	520				1	1			
5/19		182					206					1			
5/20	179					530	118				2	2			
5/21	195					401	163				2	2			
5/22	163					365	63				3	3			
5/23						111					3				
5/24						26					3				
5/25	210					16					3				
5/26						49					3				
5/27						88	109				3	3			
5/28						99	62				3	3			
5/29						147					3				
5/30						375					3				
5/31						217					3				
6/1						347					3				

Note: Fishing section abbreviations: KUK= Kulukak, NUN=Nunavachak, TOG=Togiak, HAG=Hagemeister, PYR=Pyrite Point.

Table 3.–Aerial survey estimates (tons) of herring by index area, Togiak District, 2012.

Date	Start Time	Survey Rating [b]	Miles of Spawn	Estimated Biomass by Index Area[a]													Daily Total
				NUS	KUK	MET	NVK	UGL	TOG	TNG	MTG	OSK	PYR	CPN	HAG	WAL	
5/9	1000	3.0															0
5/14	1000	1.5	2.1	1,194	3,778	5,353	9,901	3,030	5,815	4,075	2,986	2,754			1,782	1,505	42,173
5/15	1630	2.5	16.0	6,180	24,463	9,820	7,943	12,005	21,538	1,017	7,022						89,988
5/20	1000	3.0	10.7	3,444	16,072	588	3,246	5,846	55,640	5,733	1,585	64			106		92,324
5/22	1000	1.5	1.5	15,858	11,962	36	259	63	85,542	5,117	5,689		3				124,529
5/31	1000	1.5	0.2	65	7,305	1,028	1,817	2,080	17,845	1,454							31,594
Total linear miles of spawn			30.5										Peak biomass estimate				124,529

Note: Blank cells represent no biomass observed.

[a] Index areas: NUS - Nushagak Peninsula; KUK - Kulukak; MET - Metervik; NVK - Nunavachak; UGL - Ungalikthluk/Togiak; TOG - Togiak; TNG - Tongue Pt.; MTG - Matogak; HAG - Hagemeister; OSK - Osviak; PYR - Pyrite Point; CPN - Cape Newenham; WAL – Walrus Islands.

[b] Average survey rating for all sections surveyed: 1= Excellent, 2 = Good, 3 = Fair, 4 = Poor, 5 = Unsatisfactory.

Table 4.–Aerial survey estimates of herring spawn deposition, Togiak District, 1992–2012.

	Spawn Estimates	
Year	Observations[a]	Miles
1992	160	96.9
1993	76	53.4
1994	80	71.9
1995	70	58.7
1996	99	72.9
1997	79	59.1
1998	42	33.0
1999	33	56.0
2000	71	46.0
2001	100	57.0
2002	79	32.0
2003	182	94.7
2004	47	36.4
2005	106	27.6
2006	66	17.8
2007	43	18.9
2008	38	48.6
2009	32	15.3
2010	9	8.4
2011	43	49.1
2012	NA	30.5
2002-2011 Average	64.5	34.9
1992-2011 Average	72.8	47.7

[a] Collection of this data discontinued after 2011.

Table 5.–Commercial herring harvest (tons) and roe (%) by fishing section and gear type, Togiak District, Bristol Bay, 2012.

Start			Kulukak		Nunavachak		Togiak		Hagemeister		Pyrite Point		Cape Newenham		Total	
Date	Duration	Period	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %
Purse Seine																
5/14	54:00	1			2,120.0	10.3			229.0	9.7					2,349.0	10.2
5/17	48:00	2			1,046.4	9.8			929.2	9.6					1,975.6	9.7
5/19	24:00	3			258.4	7.8			1,887.6	9.7					2,146.0	9.5
5/20	24:00	4			897.2	9.0			996.0	9.7					1,893.2	9.4
5/21	24:00	5			362.8	9.5			899.5	8.5	33.8	7.8			1,296.1	8.8
5/23	12:00	6					199.4	8.6	679.1	8.9	388.7	10.3			1,267.2	9.3
5/24	24:00	7							606.1	8.4					606.1	8.4
5/25	24:00	8							797.4	9.2					797.4	9.2
5/26	24:00	9							663.1	8.2					663.1	8.2
5/27	24:00	10														
5/28	46:00	11														
Subtotal	328:00				4,684.8	9.7	199.4	8.6	7,687.0	9.2	422.5	10.1			12,993.7	9.4

-continued-

Table 5.–Page 2 of 3.

Start Date	Duration	Period	Kulukak Tons	Kulukak Roe %	Nunavachak Tons	Nunavachak Roe %	Togiak Tons	Togiak Roe %	Hagemeister Tons	Hagemeister Roe %	Pyrite Point Tons	Pyrite Point Roe %	Cape Newenham Tons	Cape Newenham Roe %	Total Tons	Total Roe %
Gillnet																
5/14	102:00	1	17.7	14.4	519.6	12.0									537.3	12.079
5/19	24:00	2			205.9	11.4									205.9	11.4
5/20	24:00	3	529.9	11.9	118.2	10.3									648.1	11.608
5/21	24:00	4	400.9	11.6	162.8	12.0									563.7	11.716
5/22	24:00	5	364.8	11.2	62.6	12.2									427.4	11.346
5/23	24:00	6	111.1	11.1											111.1	11.1
5/24	24:00	7	26.0	10.7											26.0	10.7
5/25	24:00	8	15.8	8.9											15.8	8.9
5/26	24:00	9	49.0	10.9											49.0	10.9
5/27	24:00	10	87.7	13.4	108.5	11.0									196.2	12.073
5/28	24:00	11	98.6	13.0	61.9	12.6									160.5	12.846
5/29	24:00	12	147.3	13.7											147.3	13.7
5/30	24:00	13	374.9	13.6											374.9	13.6
5/31	24:00	14	217.1	12.7											217.1	12.7
6/1	120:00	15	346.9	12.6											346.9	12.6
Subtotal	534:00		2,787.7	12.3	1,239.5	11.7									4,027.2	12.1

-continued-

Table 5.–Page 3 of 3.

Start Date	Duration	Period	Kulukak Tons	Kulukak Roe %	Nunavachak Tons	Nunavachak Roe %	Togiak Tons	Togiak Roe %	Hagemeister Tons	Hagemeister Roe %	Pyrite Point Tons	Pyrite Point Roe %	Cape Newenham Tons	Cape Newenham Roe %	Total Tons	Total Roe %
Combined																
5/14			17.7	14.4	2,639.6	10.6			229.0	9.7					2,886.3	10.6
5/17					1,046.4	9.8			929.2	9.6					1,975.6	9.7
5/19					464.3	9.4			1,887.6	9.7					2,351.9	9.6
5/20			529.9	11.9	1,015.4	9.2			996.0	9.7					2,541.3	9.9
5/21			400.9	11.6	525.6	10.3			899.5	8.5	33.8	7.8			1,859.8	9.7
5/22			364.8	11.2	62.6	12.2									427.4	11.3
5/23			111.1	11.1			199.4	8.6	679.1	8.9	388.7	10.3			1,378.3	9.4
5/24			26.0	10.7					606.1	8.4					632.1	8.5
5/25			15.8	8.9					797.4	9.2					813.2	9.2
5/26			49.0	10.9					663.1	8.2					712.1	8.4
5/27			87.7	13.4	108.5	11.0									196.2	12.1
5/28			98.6	13.0	61.9	12.6									160.5	12.8
5/29			147.3	13.7											147.3	13.7
5/30			374.9	13.6											374.9	13.6
5/31			217.1	12.7											217.1	12.7
6/1			346.9	12.6											346.9	12.6
Total			2,787.7	12.3	5,924.3	10.1	199.4	8.6	7,687.0	9.2	422.5	10.1			17,020.9	10.0

Note: Blank cells represent no data due to area closures or no fishing.

Table 6.–Sac roe herring industry participation, fishing effort and harvest, Togiak District, 1992–2012.

			Fishery Dates			Gillnet				
Year	Buyers	Daily Capacity[a]	Start	Close	Days	Effort[b]	Duration (hours)	Harvest[c]	CPUE	Roe %
1992	18	3,700	5/20	5/27	8	274	26	5,030	0.7	8.8
1993	12	2,500	4/27	5/12	16	75	145	3,564	0.3	10.1
1994	16	3,300	5/11	5/20	10	146	76	7,462	0.7	12.0
1995	22	4,350	5/7	5/15	9	250	34	6,995	0.8	12.0
1996	19	4,850	5/5	5/8	4	461	18	6,863	0.8	11.1
1997	18	4,200	5/2	5/6	5	336	24	5,164	0.6	11.8
1998	15	2,475	4/29	5/10	12	152	46	5,952	0.9	12.5
1999	12	2,400	5/18	5/26	9	171	28	4,858	1.0	11.5
2000	12	2,100	5/6	5/14	9	227	67	5,464	0.4	10.6
2001	11	2,255	5/6	5/13	8	96	84	6,481	0.8	10.6
2002	8	1,920	5/3	5/13	11	82	102	5,216	0.6	10.9
2003	7	1,920	4/25	5/7	13	75	142	6,505	0.6	10.9
2004	6	2,150	4/29	5/9	11	54	162	4,980	0.6	10.4
2005	8	2,330	4/30	5/8	9	56	149	5,841	0.7	11.2
2006	7	2,060	5/12	5/21	10	49	144	7,132	1.0	10.8
2007	5	1,420	5/10	5/25	16	25	366	4,012	0.4	11.2
2008	7	1,950	5/16	5/31	16	27	312	4,832	0.6	11.4
2009	6	2,015	5/16	5/29	14	32	338	4,140	0.4	9.7
2010	6	2,603	5/11	5/27	17	35	338	7,540	0.6	10.1
2011	6	2,413	5/8	5/31	24	25	601	5,907	0.4	12.1
2012	4	1,970	5/14	6/5	23	18	534	4,027	0.4	12.1
2002-2011 Average	7	2,078	5/7	5/20	14	46	265	5,611	0.6	10.9
1992-2011 Average	11	2,646	5/7	5/17	12	132	160	5,697	0.6	11.0

-continued-

Table 6.–Page 2 of 2.

Year	Purse Seine Effort[b]	Duration (hours)	Harvest[c]	CPUE	Roe %	Total Harvest[c]
1992	301	0	20,778	230.1	9.2	25,808
1993	140	34	14,392	3.0	9.6	17,956
1994	240	5	22,853	20.7	9.4	30,315
1995	254	12	19,737	6.4	10.1	26,732
1996	268	2	18,008	27.8	9.0	24,871
1997	231	6	18,649	12.6	9.4	23,813
1998	123	17	16,824	8.3	9.6	22,776
1999	96	5	15,020	33.3	9.2	19,878
2000	90	16	14,957	10.6	10.1	20,421
2001	64	26	15,849	9.5	9.2	22,330
2002	37	58	11,833	5.6	9.3[d]	17,049
2003	35	110	15,158	3.9	8.9[d]	21,663
2004	31	78	13,888	5.7	9.5	18,868
2005	33	83	15,071	5.5	9.6	20,912
2006	28	113	16,821	5.3	9.2	23,953
2007	21	244	13,120	2.6	10.0	17,132
2008	28	292	15,691	1.9	8.4	20,523
2009	21	226	12,967	2.7	9.2	17,107
2010	26	266	18,816	2.7	9.7	26,355
2011	22	270	16,970	2.9	9.6	22,877
2012	16	328	12,994	2.5	9.4	17,021
2002-2011 Average	28	174	15,033	4	9.3	20,644
1992-2011 Average	104	93	16,370	20	9.4	22,067

Note: Blank cells represent no data.

[a] Number of tons per day based on companies registered.

[b] Peak aerial survey count of fishing vessels.

[c] Harvest total includes dead loss and test fish harvest.

[d] Lower than inseason assessment due to more stringent postseason market scrutiny.

Table 7.–Number of herring samples for which age estimations were made by gear type, Togiak District, 2012.

Gear Type	Readable	Missing & Unreadable	Total	Percent unreadable
Commercial Purse Seine	4,656	914	5,570	16.4
Commercial Gillnet	1,116	284	1,400	20.3
Total	5,772	1,198	6,970	17.2

Table 8.–Herring harvest (biomass) by age and gear type, Togiak District, 2012.

Purse Seine					Gillnet					Total Harvest				
	Biomass		Herring			Biomass		Herring			Biomass		Herring	
Age	ST	%	(x1000)	%	Age	ST	%	(x1000)	%	Age	ST	%	(x1000)	%
3	1	0.0	7	0.0	3	0	0.0	0	0.0	3	1	0.0	7	0.0
4	91	0.7	395	1.0	4	1	0.0	4	0.0	4	93	0.5	399	0.8
5	1,008	7.8	3,975	10.3	5	41	1.0	114	1.3	5	1,049	6.2	4,089	8.6
6	2,365	18.2	7,953	20.6	6	211	5.2	528	5.9	6	2,576	15.1	8,480	17.8
7	4,729	36.4	14,647	37.9	7	690	17.1	1,691	19.0	7	5,419	31.8	16,338	34.3
8	2,203	17.0	5,923	15.3	8	963	23.9	2,206	24.8	8	3,166	18.6	8,129	17.1
9	1,118	8.6	2,725	7.0	9	837	20.8	1,793	20.2	9	1,955	11.5	4,517	9.5
10	682	5.3	1,482	3.8	10	565	14.0	1,161	13.1	10	1,248	7.3	2,643	5.6
11	363	2.8	769	2.0	11	377	9.4	748	8.4	11	740	4.3	1,517	3.2
12	202	1.6	399	1.0	12	209	5.2	397	4.5	12	410	2.4	796	1.7
13	151	1.2	272	0.7	13	94	2.3	174	2.0	13	244	1.4	447	0.9
14	60	0.5	100	0.3	14	29	0.7	48	0.5	14	89	0.5	148	0.3
15	15	0.1	27	0.1	15	10	0.3	17	0.2	15	25	0.1	44	0.1
16	7	0.1	12	0.0	16	0	0.0	0	0.0	16	7	0.0	12	0.0
Total	12,994	100	38,688	100	Total	4,027	100	8,881	100	Total	17,021	100	47,569	100

-continued-

Table 8.–Page 2 of 3.

Peak (22 May)					Postseason (31 June)					Total Run				
	Biomass		Herring			Biomass		Herring			Biomass		Herring	
Age	ST	%	(x1000)	%	Age	ST	%	(x1000)	%	Age	ST	%	(x1000)	%
3	0	0.0	0	0.0	3	0	0.0	0	0.0	3	0	0.0	0	0.0
4	462	0.3	1,786	0.5	4	298	0.9	1,323	1.3	4	760	0.5	3,109	0.6
5	6,022	4.4	22,209	5.8	5	5,054	16.0	20,732	19.7	5	11,077	6.6	42,942	8.8
6	20,203	14.8	65,512	17.1	6	8,084	25.6	28,672	27.3	6	28,287	16.9	94,184	19.3
7	48,025	35.3	145,979	38.2	7	11,989	37.9	38,376	36.6	7	60,014	35.8	184,356	37.8
8	25,927	19.0	68,526	17.9	8	3,646	11.5	10,587	10.1	8	29,573	17.6	79,112	16.2
9	15,427	11.3	36,830	9.6	9	693	2.2	1,544	1.5	9	16,120	9.6	38,374	7.9
10	9,395	6.9	20,201	5.3	10	728	2.3	1,544	1.5	10	10,123	6.0	21,744	4.5
11	5,081	3.7	10,826	2.8	11	189	0.6	441	0.4	11	5,270	3.1	11,267	2.3
12	2,383	1.8	4,687	1.2	12	432	1.4	882	0.8	12	2,815	1.7	5,570	1.1
13	1,996	1.5	3,460	0.9	13	222	0.7	441	0.4	13	2,218	1.3	3,901	0.8
14	800	0.6	1,339	0.4	14	259	0.8	441	0.4	14	1,059	0.6	1,780	0.4
15	288	0.2	558	0.1	15	0	0.0	0	0.0	15	288	0.2	558	0.1
16	134	0.1	223	0.1	16	0	0.0	0	0.0	16	134	0.1	223	0.0
Total	136,144	100	382,136	100	Total	31,594	100	104,984	100	Total	167,738	100	487,120	100

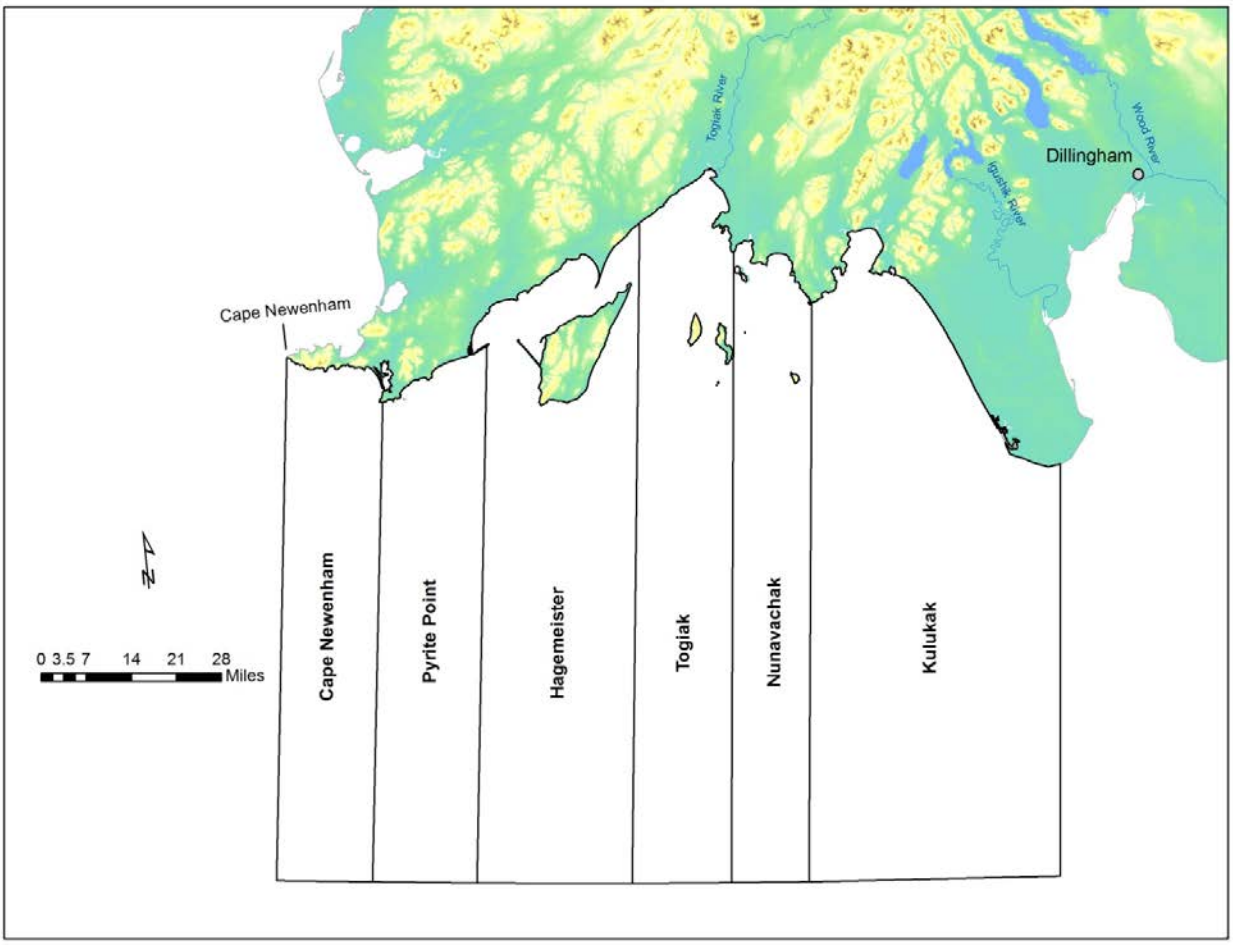
-continued-

Table 8.–Page 3 of 3.

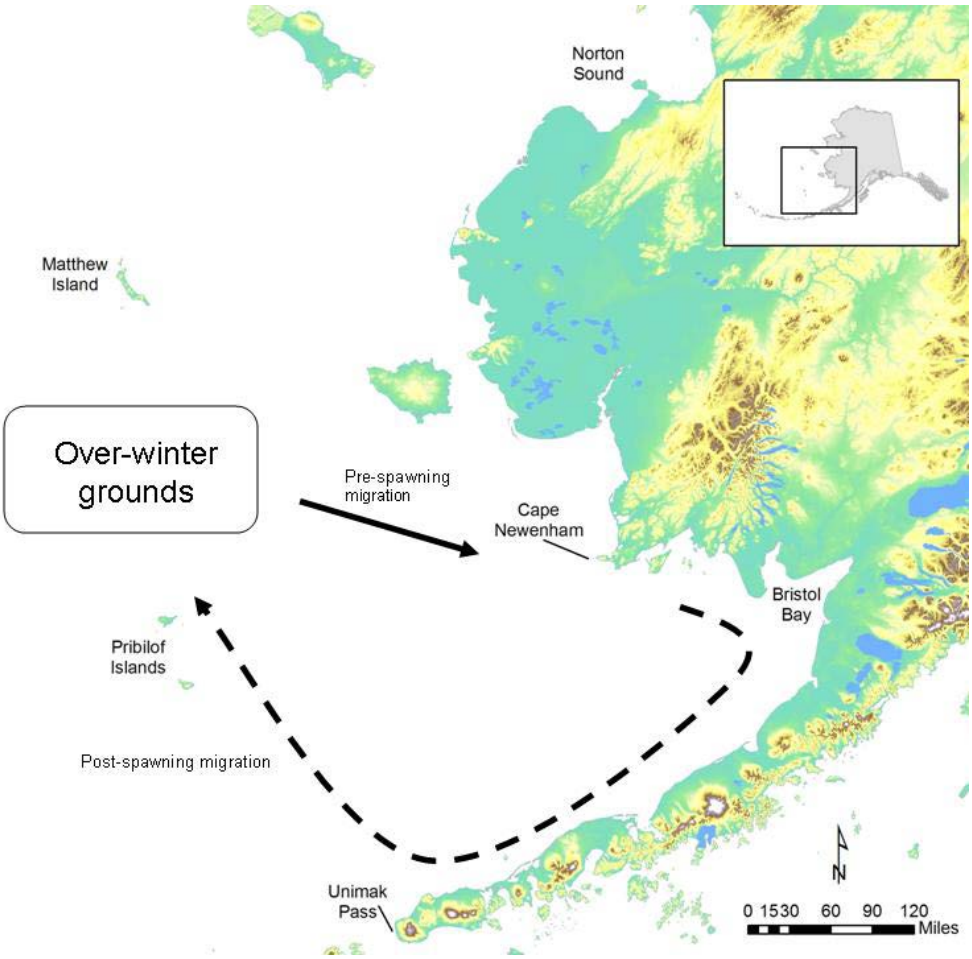
	Escapement			
	Biomass		Herring	
Age	ST	%	(x1000)	%
3	-1	0.0	-7	0.0
4	667	0.4	2,710	0.6
5	10,028	6.7	38,852	8.8
6	25,711	17.1	85,704	19.5
7	54,595	36.2	168,018	38.2
8	26,407	17.5	70,983	16.1
9	14,165	9.4	33,856	7.7
10	8,876	5.9	19,101	4.3
11	4,530	3.0	9,750	2.2
12	2,405	1.6	4,774	1.1
13	1,974	1.3	3,454	0.8
14	971	0.6	1,632	0.4
15	263	0.2	514	0.1
16	127	0.1	211	0.0
Total	150,717	100	439,551	100

Table 9.–Mean length (mm), weight (g), and standard deviation by age for herring of the commercial harvest by gear type, Togiak District, 2012.

Purse Seine						Gillnet					
Age	Sample (n)	Mean Length (mm)	SD	Mean Weight (g)	SD	Age	Sample (n)	Mean Length (mm)	SD	Mean Weight (g)	SD
3	1	262	NA	185	NA	3	0	NA	NA	NA	NA
4	48	267	13.7	207	40.7	4	1	316	NA	304	NA
5	455	276	16.0	229	46.0	5	10	308	19.5	327	62.7
6	924	288	14.5	269	49.6	6	53	314	13.0	365	54.8
7	1719	294	14.4	294	54.0	7	167	317	12.9	377	53.8
8	735	305	18.3	338	69.6	8	288	320	12.2	405	50.8
9	359	314	18.7	377	79.1	9	247	326	12.7	430	50.8
10	200	323	22.0	420	90.5	10	160	331	13.6	448	56.2
11	105	324	22.1	425	94.6	11	98	335	12.9	461	54.9
12	52	333	21.7	462	83.8	12	57	340	12.2	486	59.6
13	37	340	17.7	515	58.4	13	26	343	12.6	493	55.9
14	14	345	10.9	541	57.3	14	7	350	12.5	539	52.8
15	5	328	29.1	468	164.0	15	2	350	2.1	561	41.0
16	2	350	8.5	545	72.1	16	0	NA	NA	NA	NA
Average		297	23.7	308	98.4			325	15.8	422	68.0
Total	4,656						1,116				

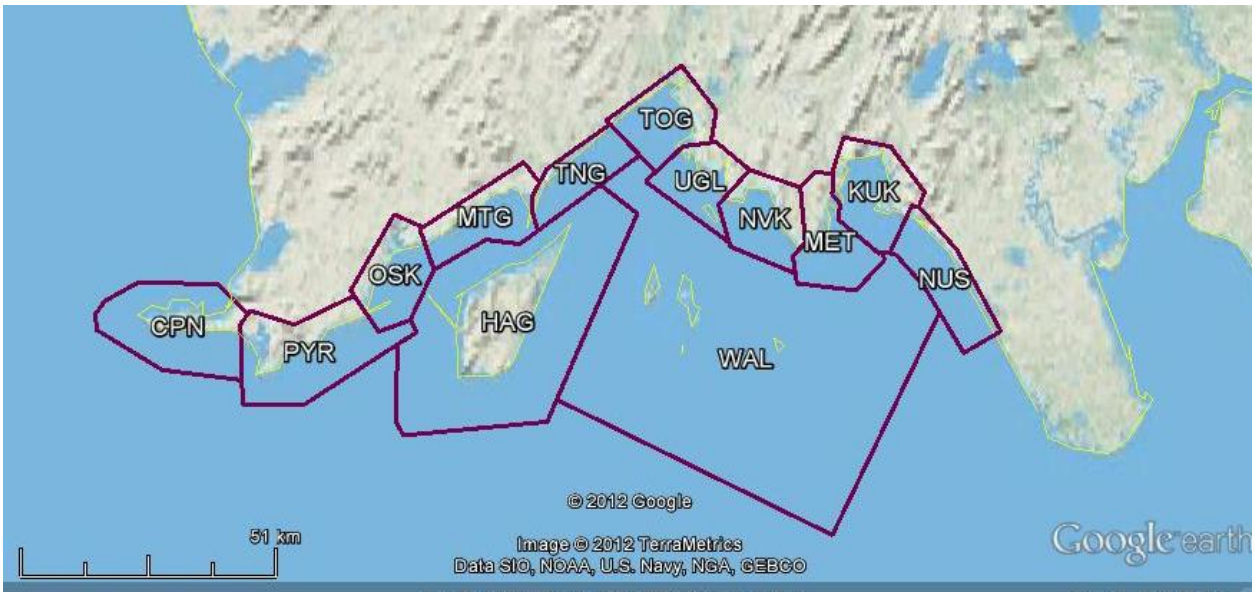


Fgure 1.–Map of Togiak District herring management sections, Bristol Bay.



Source: Adapted from Tojo et al. (2007).

Figure 2.–Southeastern Bering Sea herring migration.



Note: Survey sections abbreviated as NUS - Nushagak Peninsula; KUK - Kulukak; MET - Metervik; NVK - Nunavachak; UGL - Ungalikthluk/Togiak; TOG - Togiak; TNG - Tongue Pt.; MTG - Matogak; HAG - Hagemeister; OSK - Osviak; PYR - Pyrite Point; CPN - Cape Newenham; WAL – Walrus Islands.

Figure 3.–Togiak herring aerial survey sections, Bristol Bay.

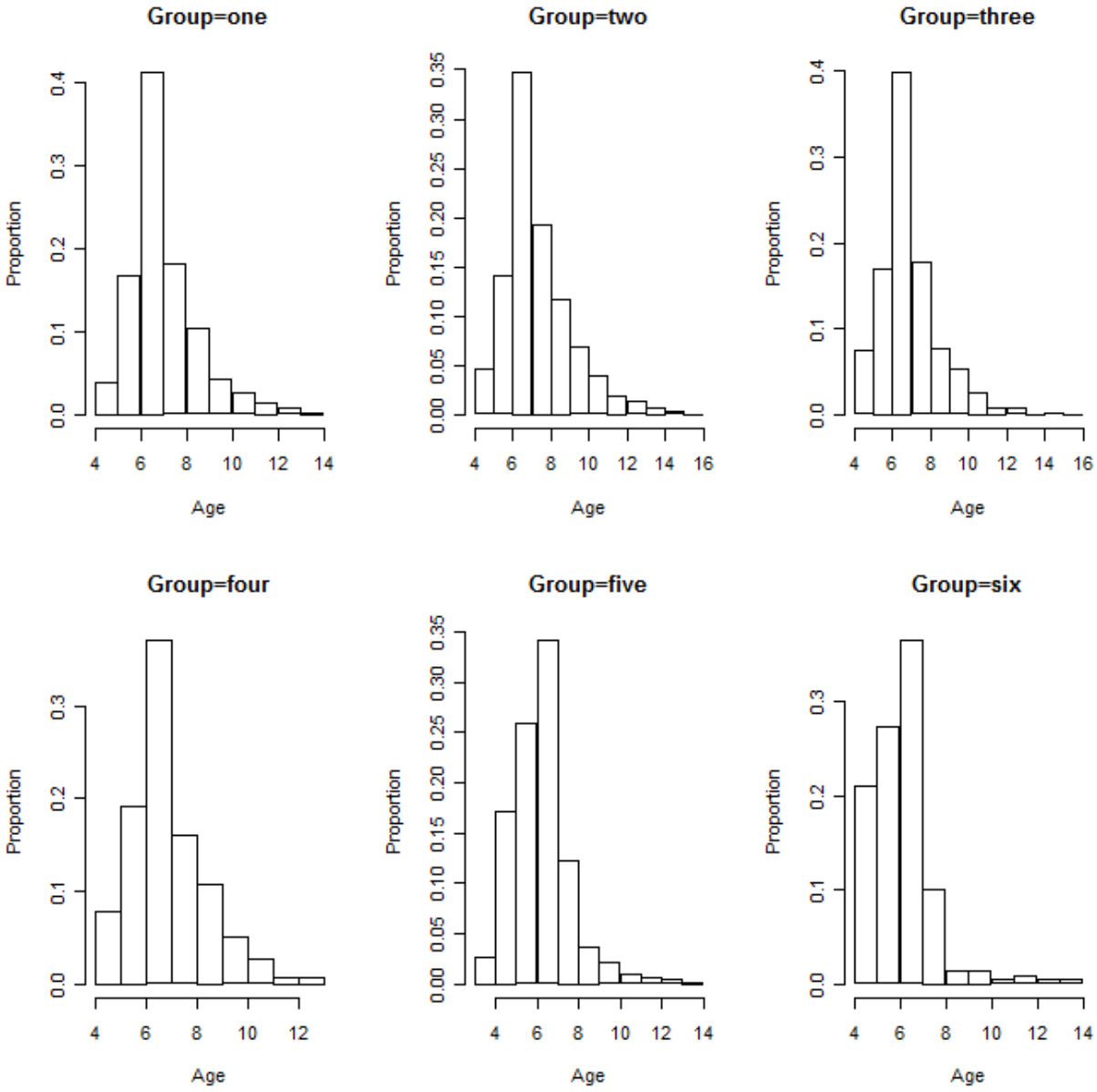


Figure 4.–Age composition of purse seine sample groups, Togiak District, 2012.

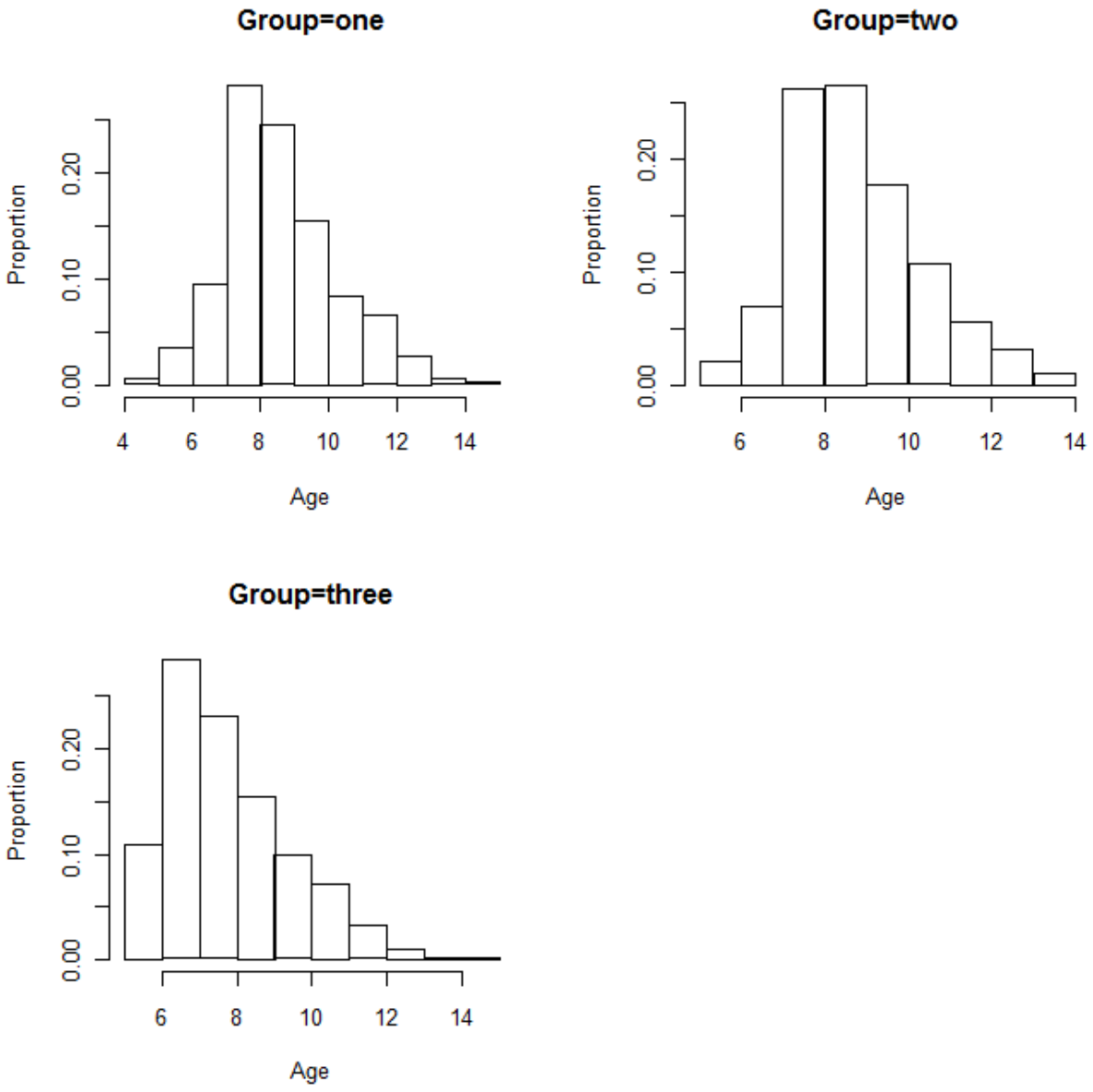


Figure 5.–Age composition of gillnet sample groups, Togiak District, 2012.

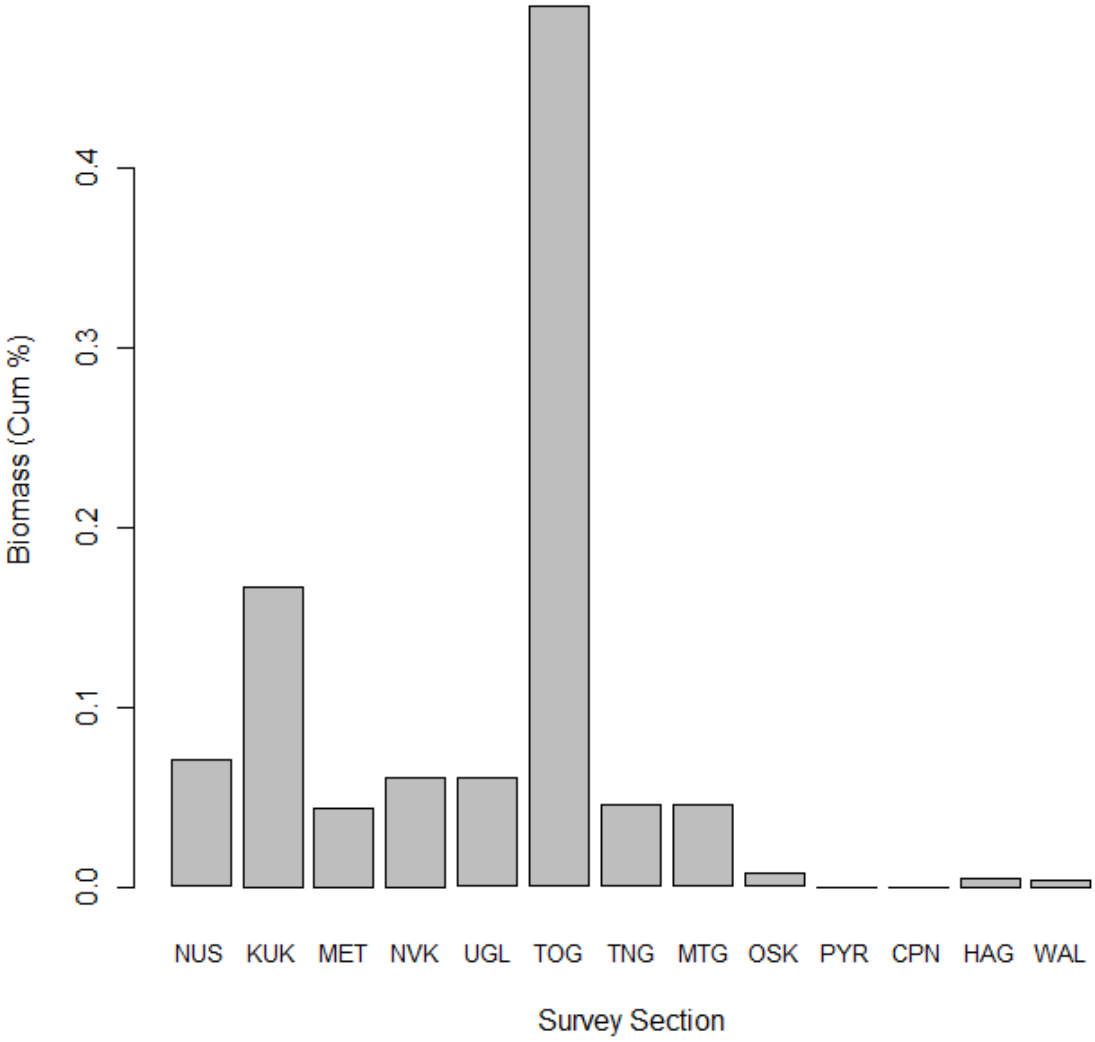


Figure 6.–Cumulative tons of herring estimated in each aerial survey section during all aerial surveys, Togiak District, 2012.

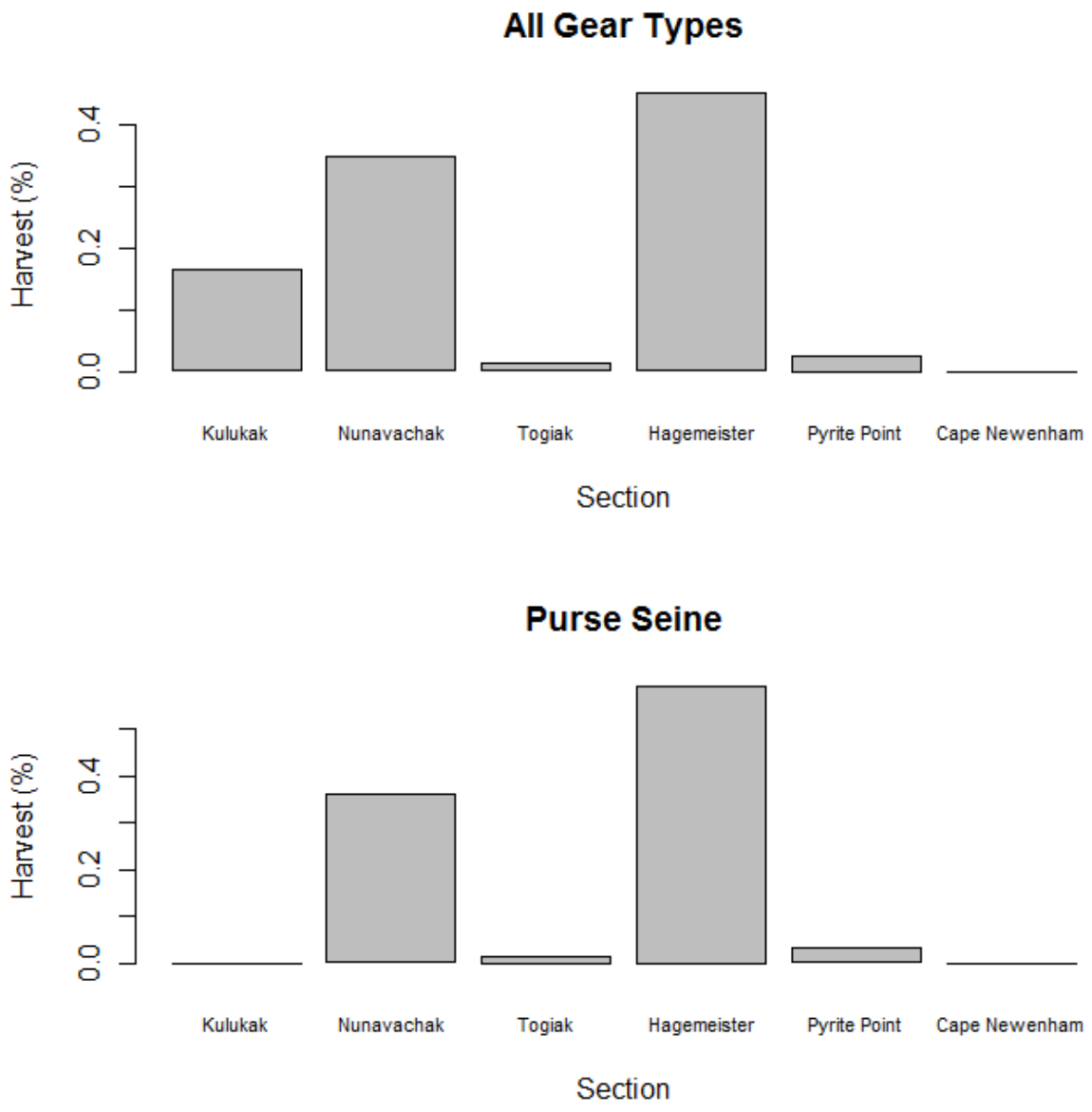


Figure 7.–Commercial herring harvest by reporting section for all gear types (top) and for purse seine only (bottom), Togiak District, 2012.

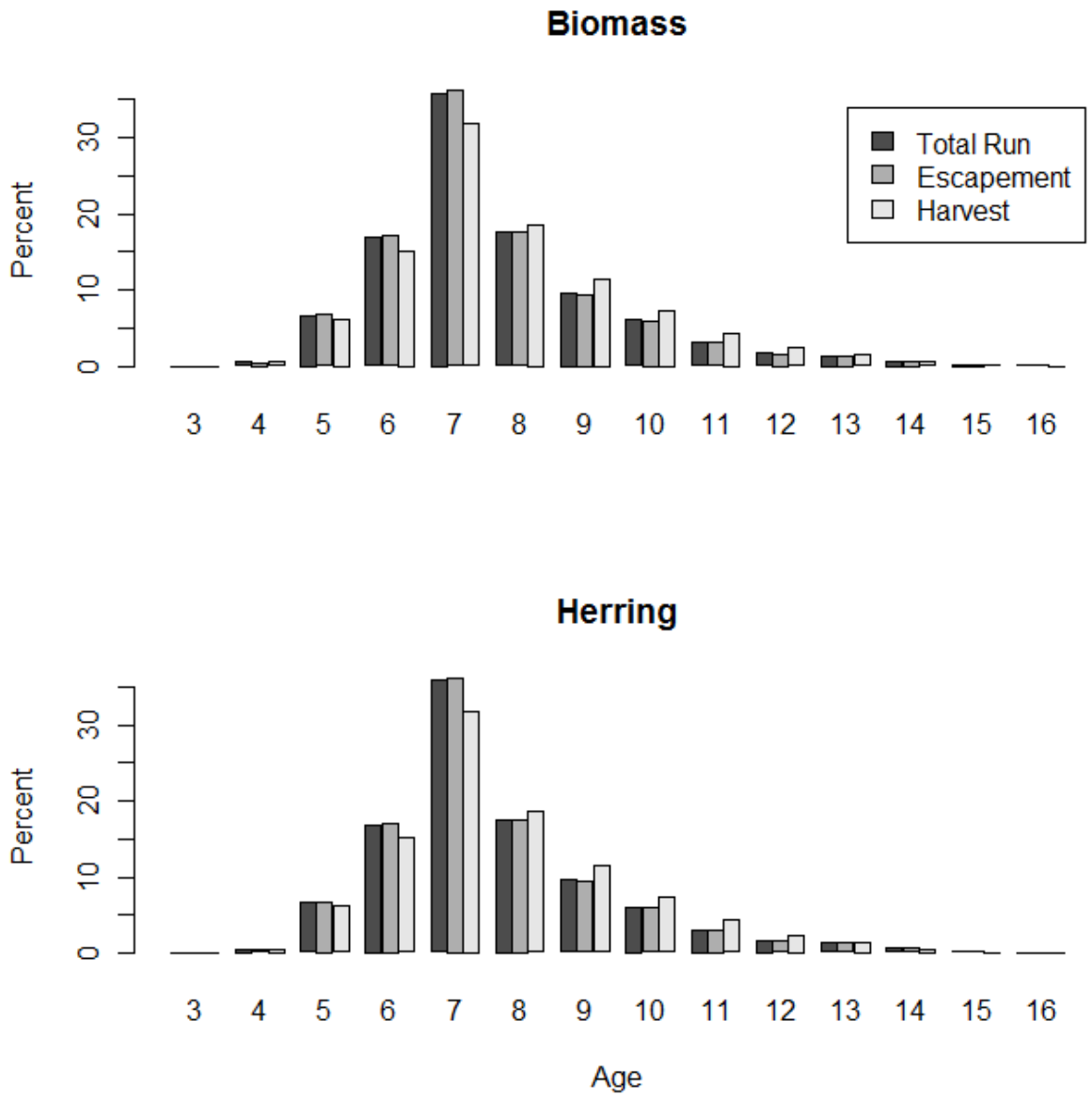


Figure 8.–Age composition of total run, escapement and harvest by biomass (top) and numbers of fish (bottom), Togiak District, 2012.

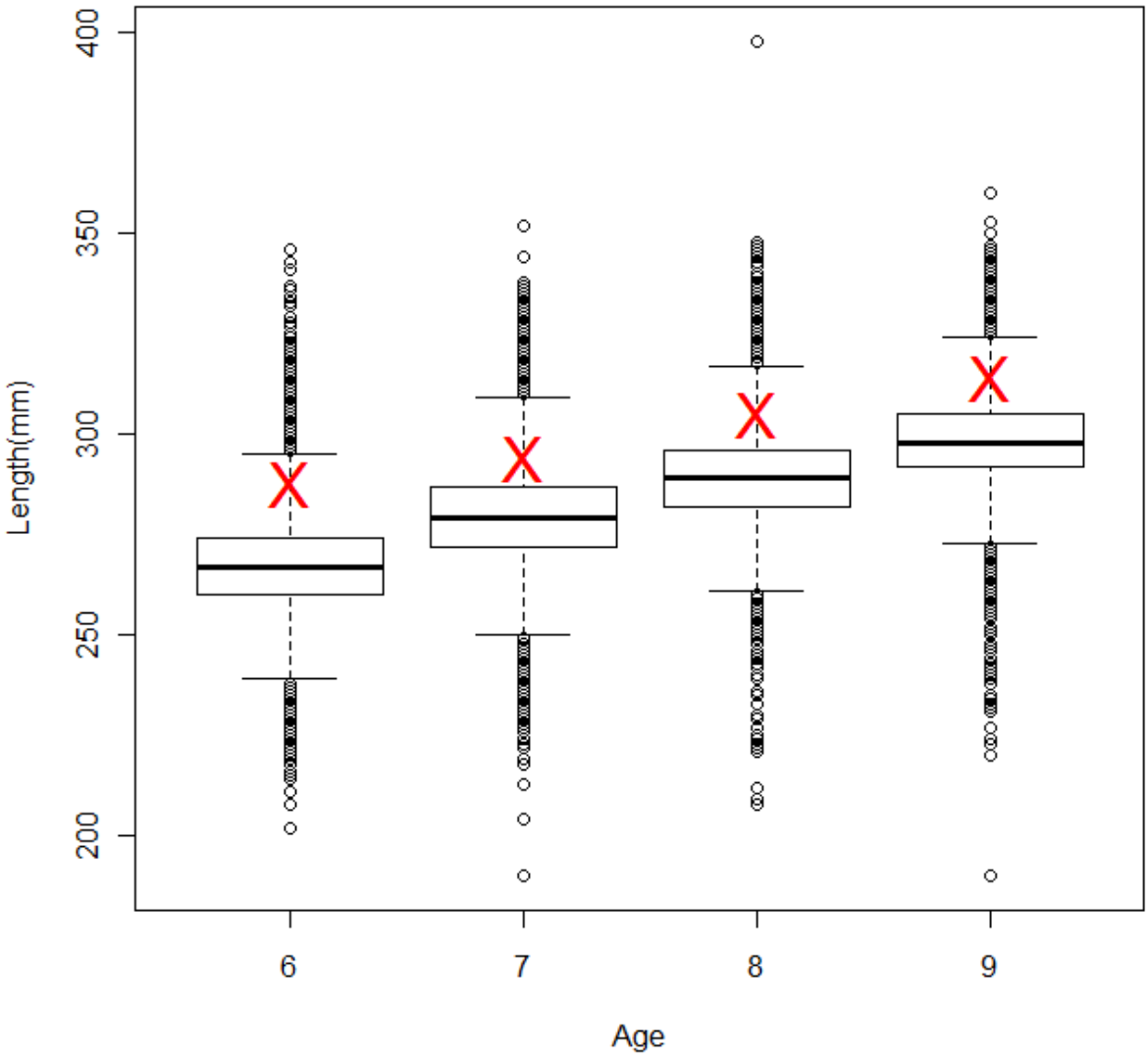


Figure 9.–Average length (denoted as "X") of herring observed in 2012 age-6 through age-9 and distribution (box plot) of historical observations (1981–present).

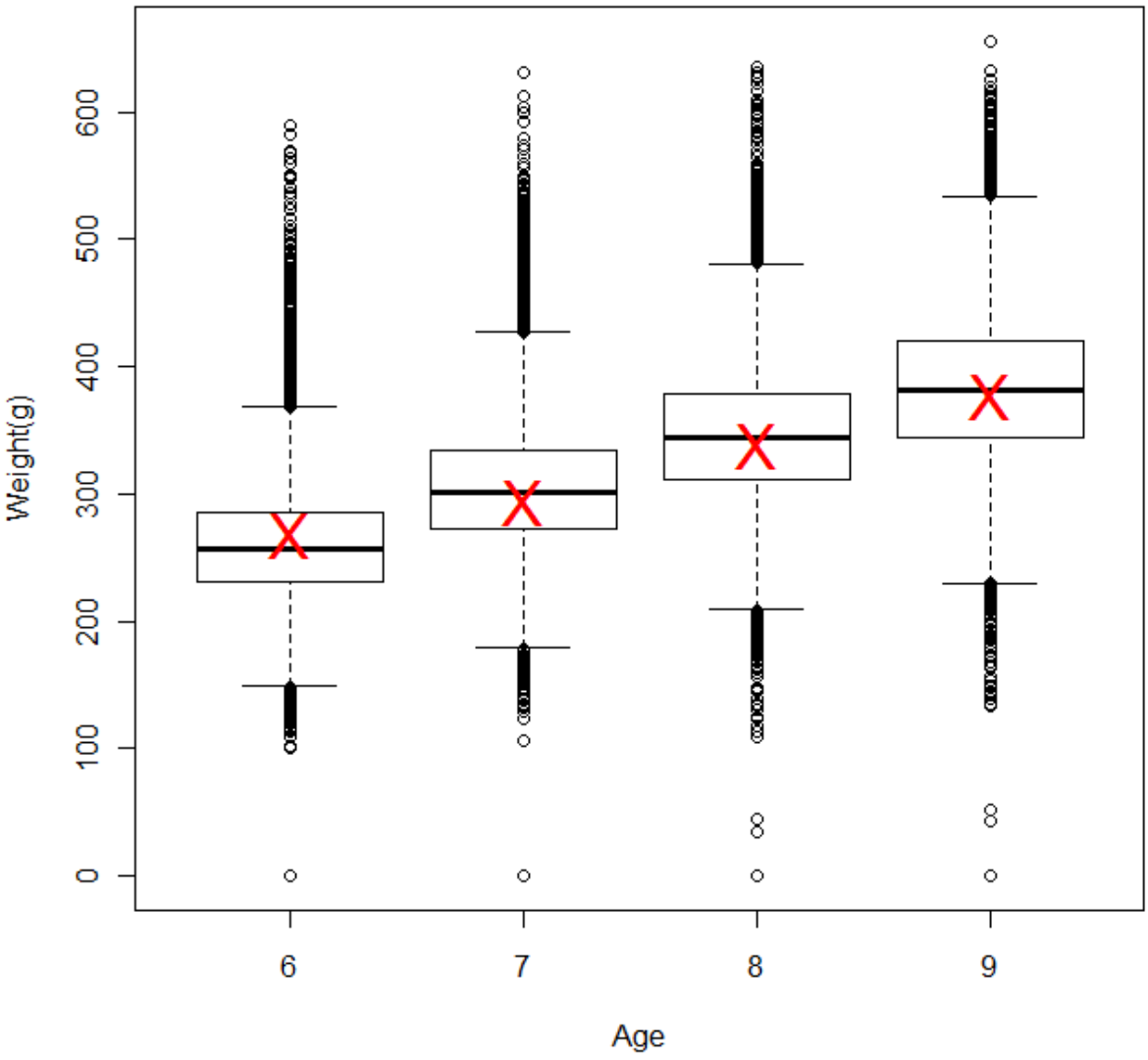


Figure 10.–Average weight (denoted as "X") of herring observed in 2012 age-6 through age-9 and distribution (box plot) of historical observations (1981–present).

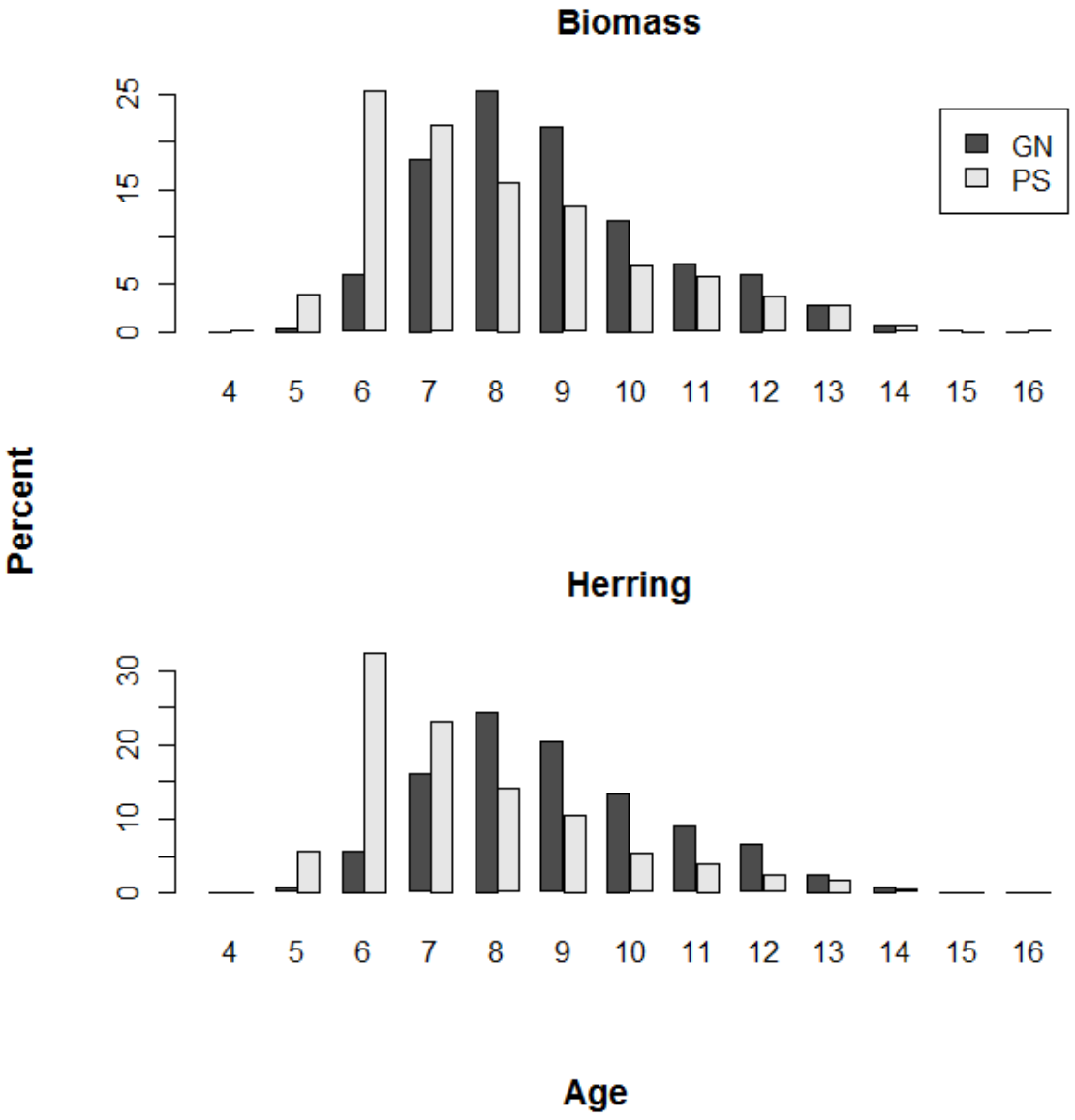


Figure 11.–Percentage composition of the commercial herring harvest by gear type (Purse Seine=PS, Gillnet=GN) by biomass (top) and by numbers of fish (bottom), Togiak District, 2012.

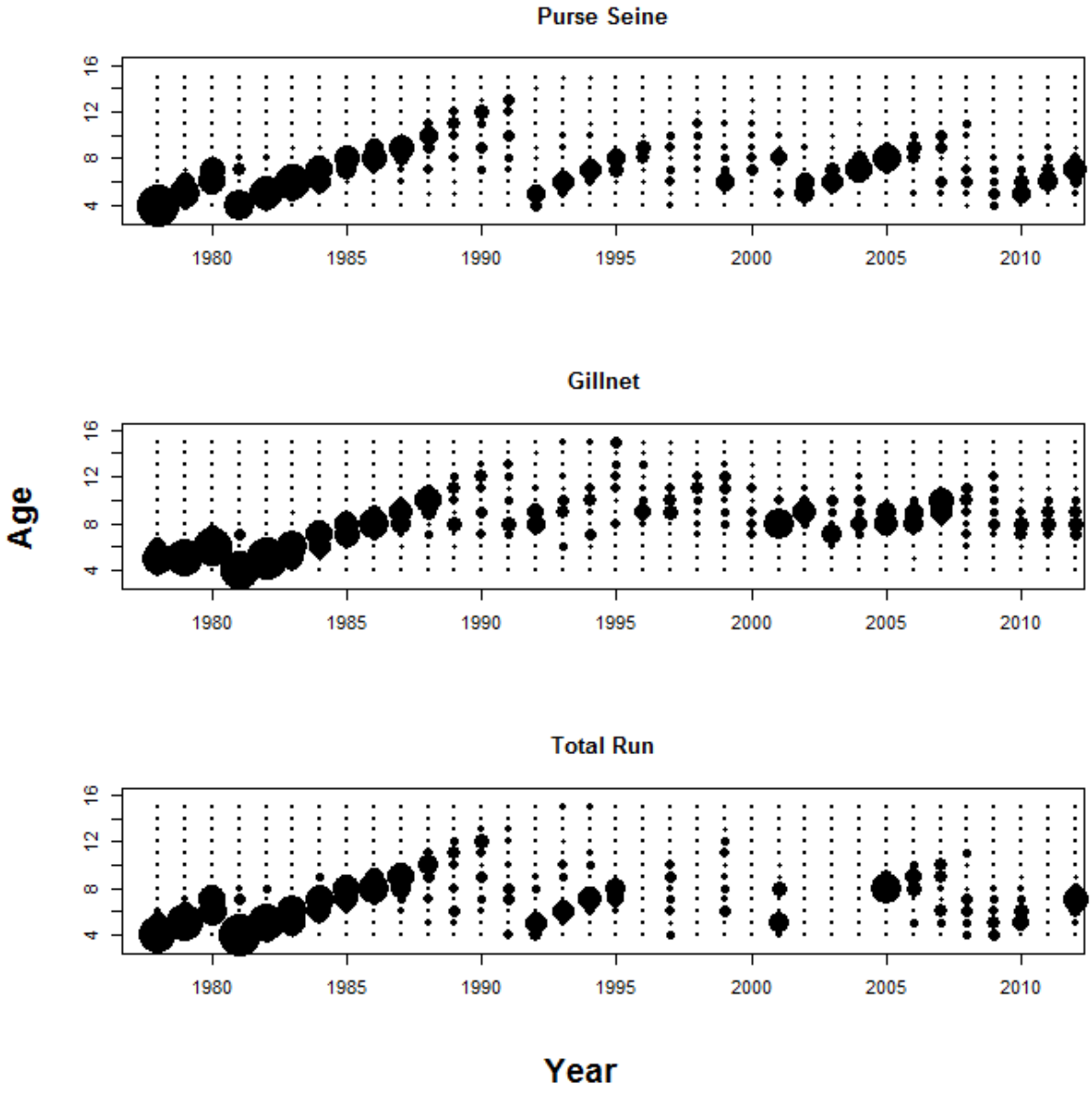


Figure 12.–Relative age class contribution of herring in the purse seine harvest, gillnet harvest and total run, Togiak District, Bristol Bay, 1977–2012.

APPENDIX A: ESTIMATED AGE COMPOSITION

Appendix A1.–Estimated age composition of the Togiak herring run by aerial survey date, Togiak District, 2012.

Survey Date	5/22/12			Survey Date	5/31/12		
Index Section(s):	NUN/HAG			Index Section(s):	HAG		
Survey Biomass:	136,144			Survey Biomass:	31,594		
Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)
4	16	0.5	1,786	4	6	1.3	1,323
5	199	5.8	22,209	5	94	19.7	20,732
6	587	17.1	65,512	6	130	27.3	28,672
7	1,308	38.2	145,979	7	174	36.6	38,376
8	614	17.9	68,526	8	48	10.1	10,587
9	330	9.6	36,830	9	7	1.5	1,544
10	181	5.3	20,201	10	7	1.5	1,544
11	97	2.8	10,826	11	2	0.4	441
12	42	1.2	4,687	12	4	0.8	882
13	31	0.9	3,460	13	2	0.4	441
14	12	0.4	1,339	14	2	0.4	441
15	5	0.1	558	15	0	0.0	0
16	2	0.1	223	16	0	0.0	0
Total	3,424	100.0	382,136	Total	476	100.0	104,984
		Percent Weighted by				Percent Weighted by	
Age	Weight	Weight	Biomass	Age	Weight	Weight	Biomass
4	3,758	0.3	462	4	1,224	0.9	298
5	48,952	4.4	6,022	5	20,790	16.0	5,054
6	164,222	14.8	20,203	6	33,253	25.6	8,084
7	390,376	35.3	48,025	7	49,314	37.9	11,989
8	210,754	19.0	25,927	8	14,996	11.5	3,646
9	125,400	11.3	15,427	9	2,849	2.2	693
10	76,369	6.9	9,395	10	2,996	2.3	728
11	41,302	3.7	5,081	11	776	0.6	189
12	19,370	1.8	2,383	12	1,776	1.4	432
13	16,226	1.5	1,996	13	913	0.7	222
14	6,503	0.6	800	14	1,067	0.8	259
15	2,339	0.2	288	15	0	0.0	0
16	1,090	0.1	134	16	0	0.0	0
Total	1,106,661	100.0	136,144	Total	129,954	100.0	31,594

Note: Sections refers to the following subdistricts within the Togiak District: NUN=Nunavachak, HAG=Hagemeister.

Appendix A2.–Estimated age composition of herring in the commercial purse seine harvest by sample group, date and fishing section(s), Togiak District, 2012.

Sample Group	1			Sample Group	2		
Sample Date(s)	5/16/2012			Sample Date(s)	5/17/2012		
Section(s):	NUN			Section(s):	HAG		
Harvest Biomass:	3,395			Harvest Biomass:	929		
Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)
3	0	0.0	0	3	0	0.0	0
4	1	0.2	15	4	1	0.1	3
5	23	3.8	341	5	43	4.6	110
6	102	16.8	1,514	6	133	14.1	341
7	251	41.3	3,726	7	329	34.8	842
8	110	18.1	1,633	8	183	19.4	469
9	63	10.4	935	9	111	11.7	284
10	26	4.3	386	10	65	6.9	166
11	16	2.6	237	11	37	3.9	95
12	9	1.5	134	12	19	2.0	49
13	5	0.8	74	13	13	1.4	33
14	2	0.3	30	14	7	0.7	18
15	0	0.0	0	15	3	0.3	8
16	0	0.0	0	16	1	0.1	3
Total	608	100	9,025	Total	945	100	2,420
Age	Weight (total g)	Percent by Wt.	Biomass (tons)	Age	Weight (total g)	Percent by Wt.	Biomass (tons)
3	0	0.0	0	3	0	0.0	0
4	254	0.1	4	4	238	0.1	1
5	6,561	3.2	107	5	10,390	3.2	29
6	30,880	14.9	505	6	38,434	11.7	108
7	78,157	37.7	1,279	7	103,252	31.4	291
8	40,010	19.3	655	8	65,007	19.7	183
9	24,360	11.7	399	9	45,173	13.7	128
10	11,799	5.7	193	10	28,886	8.8	82
11	7,647	3.7	125	11	15,929	4.8	45
12	4,107	2.0	67	12	8,922	2.7	25
13	2,628	1.3	43	13	7,294	2.2	21
14	1,117	0.5	18	14	3,746	1.1	11
15	0	0.0	0	15	1,332	0.4	4
16	0	0.0	0	16	596	0.2	2
Total	207,520	100.0	3,395	Total	329,199	100	929

-continued-

Sample Group			3
Sample Date(s)	5/19-5/20		
Section(s):	HAG		
Harvest Biomass:	2,884		
Age	No.	Percent by No.	Numbers (x1,000)
3	0	0.0	0
4	7	0.8	69
5	58	6.7	571
6	148	17.1	1,458
7	346	39.9	3,408
8	154	17.7	1,517
9	67	7.7	660
10	46	5.3	453
11	23	2.6	227
12	8	0.9	79
13	7	0.8	69
14	1	0.1	10
15	2	0.2	20
16	1	0.1	10
Total	868	100	8,550
Age	Weight (total g)	Percent by Wt.	Biomass (tons)
3	0	0.0	0
4	1,737	0.7	19
5	13,987	5.3	152
6	40,307	15.2	438
7	99,290	37.4	1,078
8	51,048	19.2	554
9	23,399	8.8	254
10	17,774	6.7	193
11	8,914	3.4	97
12	3,642	1.4	40
13	3,394	1.3	37
14	581	0.2	6
15	1,007	0.4	11
16	494	0.2	5
Total	265,574	100	2,884

Sample Group			4
Sample Date(s)	5/20-5/21		
Section(s):	NUN		
Harvest Biomass:	1,518		
Age	No.	Percent by No.	Numbers (x1,000)
3	0	0.0	0
4	4	0.6	27
5	47	7.2	314
6	125	19.2	835
7	241	37.0	1,610
8	104	16.0	695
9	70	10.8	468
10	33	5.1	221
11	17	2.6	114
12	5	0.8	33
13	5	0.8	33
14	0	0.0	0
15	0	0.0	0
16	0	0.0	0
Total	651	100	4,350
Age	Weight (total g)	Percent by Wt.	Biomass (tons)
3	0	0.0	0
4	935	0.5	7
5	11,500	5.6	85
6	34,359	16.7	253
7	71,446	34.7	526
8	36,218	17.6	267
9	25,712	12.5	189
10	13,799	6.7	102
11	7,332	3.6	54
12	2,412	1.2	18
13	2,435	1.2	18
14	0	0.0	0
15	0	0.0	0
16	0	0.0	0
Total	206,148	100	1,518

-continued-

Sample Group			5
Sample Date(s)			5/23/2012
Section(s):		HAG/PYR	
Harvest Biomass:		2,201	
Age	No.	Percent by No.	Numbers (x1,000)
3	1	0.1	7
4	29	2.6	196
5	190	17.1	1,282
6	286	25.8	1,930
7	378	34.1	2,550
8	136	12.3	918
9	41	3.7	277
10	23	2.1	155
11	10	0.9	67
12	7	0.6	47
13	5	0.5	34
14	2	0.2	13
15	0	0.0	0
16	0	0.0	0
Total	1108	100	7,476
Age	Weight (total g)	Percent by Wt.	Biomass (tons)
3	185	0.1	1
4	5,539	1.9	41
5	40,858	13.8	304
6	71,486	24.2	532
7	103,508	35.0	770
8	41,050	13.9	305
9	13,836	4.7	103
10	8,806	3.0	65
11	3,976	1.3	30
12	3,181	1.1	24
13	2,378	0.8	18
14	1,059	0.4	8
15	0	0.0	0
16	0	0.0	0
Total	295,862	100	2,201

Sample Group			6
Sample Date(s)		5/24-5/26	
Section(s):		HAG	
Harvest Biomass:		2,067	
Age	No.	Percent by No.	Numbers (x1,000)
3	0	0.0	0
4	6	1.3	87
5	94	19.7	1,356
6	130	27.3	1,875
7	174	36.6	2,510
8	48	10.1	692
9	7	1.5	101
10	7	1.5	101
11	2	0.4	29
12	4	0.8	58
13	2	0.4	29
14	2	0.4	29
15	0	0.0	0
16	0	0.0	0
Total	476	100	6,867
Age	Weight (total g)	Percent by Wt.	Biomass (tons)
3	0	0.0	0
4	1,224	0.9	19
5	20,790	16.0	331
6	33,253	25.6	529
7	49,314	37.9	784
8	14,996	11.5	238
9	2,849	2.2	45
10	2,996	2.3	48
11	776	0.6	12
12	1,776	1.4	28
13	913	0.7	15
14	1,067	0.8	17
15	0	0.0	0
16	0	0.0	0
Total	129,954	100	2,067

Note: Sections refers to the following subdistricts within the Togiak District: TOG=Togiak, NUN=Nunavachak, HAG=Hagemeister, KUL=Kulukak, PYR=Pyrite Point and CPN=Cape Newenham.

Appendix A3.–Estimated age composition of herring in the commercial gillnet harvest by sample group, date and fishing section(s), Togiak District, 2012.

Sample Group			1
Sample Date(s)			5/14-5/19
Section(s):			NUN/KUL
Harvest Biomass:			743
Age	No.	Percent by No.	Numbers (x1,000)
4	1	0.3	4
5	1	0.3	4
6	13	3.5	54
7	35	9.5	144
8	104	28.2	429
9	90	24.4	371
10	57	15.4	235
11	31	8.4	128
12	24	6.5	99
13	10	2.7	41
14	2	0.5	8
15	1	0.3	4
Total	369	100.0	1,523
		Percent Weighted by	
Age	Weight	Weight	Biomass
4	304	0.2	1
5	387	0.2	2
6	4,865	3.0	22
7	14,102	8.6	64
8	44,329	27.1	202
9	39,992	24.5	182
10	26,173	16.0	119
11	14,314	8.8	65
12	12,141	7.4	55
13	5,108	3.1	23
14	1,056	0.6	5
15	590	0.4	3
Total	163,361	100.0	743

Sample Group			2
Sample Date(s)			5/20-5/21
Section(s):			NUN/KUL
Harvest Biomass:			1,212
Age	No.	Percent by No.	Numbers (x1,000)
4	0	0.0	0
5	1	0.3	7
6	7	1.9	48
7	26	7.0	176
8	98	26.2	665
9	99	26.5	672
10	66	17.6	448
11	40	10.7	271
12	21	5.6	143
13	12	3.2	81
14	4	1.1	27
15	0	0.0	0
Total	374	100.0	2,538
		Percent Weighted by	
Age	Weight	Weight	Biomass
4	0	0.0	0
5	252	0.2	2
6	2,498	1.5	19
7	10,298	6.4	77
8	39,571	24.4	296
9	42,533	26.3	318
10	29,801	18.4	223
11	19,002	11.7	142
12	10,060	6.2	75
13	5,809	3.6	43
14	2,161	1.3	16
15	0	0.0	0
Total	161,985	100.0	1,212

-continued-

Appendix A3.–Page 2 of 2.

Sample Group	3
Sample Date(s)	5/22-6/1
Section(s):	NUN/KUL
Harvest Biomass:	2,072

Age	No.	Percent by No.	Numbers (x1,000)
4	0	0.0	0
5	8	2.1	103
6	33	8.8	426
7	106	28.4	1,370
8	86	23.1	1,111
9	58	15.5	749
10	37	9.9	478
11	27	7.2	349
12	12	3.2	155
13	4	1.1	52
14	1	0.3	13
15	1	0.3	13
Total	373	100.0	4,820

		Percent Weighted by	
Age	Weight	Weight	Biomass
4	0	0.0	0
5	2,629	1.8	37
6	11,965	8.2	170
7	38,540	26.5	549
8	32,658	22.4	465
9	23,637	16.2	337
10	15,672	10.8	223
11	11,904	8.2	170
12	5,481	3.8	78
13	1,911	1.3	27
14	556	0.4	8
15	532	0.4	8
Total	145,485	100.0	2,072

Note: Sections refers to the following subdistricts within the Togiak District: NUN=Nunavachak, KUL=Kulukak.

APPENDIX B: AGE, SEX AND SIZE COMPOSITION CAUGHT BY COMMERCIAL PURSE SEINE

Appendix B1.–Age, sex and size composition of herring caught by commercial purse seine, Hagemeister Section.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/17	4	1	0	0	1	0.1	0.1	238	NA	1	270	NA	1
	5	25	18	0	43	4.6	0.7	242	48.8	43	275	18.0	43
	6	81	52	0	133	14.1	1.1	289	60.0	133	289	15.2	133
	7	171	155	3	329	34.8	1.6	314	64.1	329	294	16.2	329
	8	97	85	1	183	19.4	1.3	355	71.5	183	305	18.7	183
	9	69	42	0	111	11.7	1.0	407	79.7	111	317	18.8	111
	10	34	31	0	65	6.9	0.8	444	91.5	65	321	21.8	65
	11	21	15	1	37	3.9	0.6	431	98.4	37	322	22.3	37
	12	12	7	0	19	2.0	0.5	470	84.1	19	327	23.9	19
	13	3	9	1	13	1.4	0.4	561	57.2	13	336	22.1	13
	14	6	1	0	7	0.7	0.3	535	77.5	7	343	13.5	7
	15	2	1	0	3	0.3	0.2	444	199.2	3	326	34.4	3
	16	0	1	0	1	0.1	0.1	596	NA	1	356	NA	1
Sample Total		522	417	6	945	100.0		348	95.0	945	302	22.7	945
5/19	4	1	1	0	2	0.6	0.4	202	38.2	2	268	17.0	2
	5	10	8	0	18	5.6	1.3	255	53.1	18	285	16.2	18
	6	35	23	0	58	18.1	2.2	273	50.1	58	292	14.0	58
	7	59	57	1	117	36.4	2.7	287	43.2	117	296	12.8	117
	8	28	31	0	59	18.4	2.2	346	57.1	59	309	17.0	59
	9	10	18	0	28	8.7	1.6	374	62.7	28	318	13.7	28
	10	10	9	0	19	5.9	1.3	415	71.0	19	327	19.1	19
	11	5	3	0	8	2.5	0.9	430	72.6	8	332	15.3	8
	12	2	3	0	5	1.6	0.7	460	89.2	5	335	21.0	5
	13	1	4	0	5	1.6	0.7	493	40.8	5	346	15.7	5
	14	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	15	0	1	0	1	0.3	0.3	613	NA	1	354	NA	1
	16	1	0	0	1	0.3	0.3	494	NA	1	344	NA	1
Sample Total		162	158	1	321	100.0		319	78.7	321	303	20.4	321

-continued-

Appendix B1.–Page 2 of 4.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/20	4	3	2	0	5	0.5	0.2	267	36.6	5	288	6.3	5
	5	24	16	0	40	4.2	0.7	235	29.5	40	277	11.8	40
	6	51	39	0	90	9.5	1.0	272	48.9	90	289	13.8	90
	7	103	125	1	229	24.2	1.4	287	46.1	229	292	13.5	229
	8	44	50	1	95	10.1	1.0	323	67.2	95	300	17.4	95
	9	16	23	0	39	4.1	0.6	331	63.5	39	300	15.6	39
	10	12	15	0	27	2.9	0.5	366	90.6	27	311	23.0	27
	11	9	6	0	15	1.6	0.4	365	102.9	15	312	28.5	15
	12	3	0	0	3	0.3	0.2	448	8.3	3	334	8.1	3
	13	0	2	0	2	0.2	0.1	464	20.5	2	326	19.8	2
	14	1	0	0	1	0.1	0.1	581	NA	1	354	NA	1
	15	0	1	0	1	0.1	0.1	394	NA	1	310	NA	1
Sample Total		266	279	2	547	57.9		298	66.8	547	294	17.6	547
5/21	4	2	1	0	3	0.9	0.5	198	48.1	3	272	17.0	3
	5	16	12	0	28	8.7	1.6	233	52.4	28	283	14.0	28
	6	54	25	0	79	24.6	2.4	256	34.5	79	289	11.9	79
	7	97	44	0	141	43.9	2.8	271	53.4	141	292	13.7	141
	8	46	17	0	63	19.6	2.2	293	60.3	63	301	16.1	63
	9	13	6	0	19	5.9	1.3	356	60.6	19	319	16.2	19
	10	8	3	0	11	3.4	1.0	374	69.6	11	317	22.1	11
	11	3	1	0	4	1.2	0.6	370	95.2	4	316	25.9	4
	12	1	0	0	1	0.3	0.3	287	NA	1	294	NA	1
	13	0	1	0	1	0.3	0.3	475	NA	1	340	NA	1
	14	0	2	0	2	0.6	0.4	530	24.7	2	344	1.4	2
Sample Total		240	112	0	352	109.7		279	65.1	352	295	17.5	352

-continued-

Appendix B1.–Page 3 of 4.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/23	4	6	3	0	9	1.0	0.3	207	23.7	9	269	10.4	9
	5	45	29	0	74	7.8	0.9	221	44.6	74	273	17.1	74
	6	52	45	0	97	10.3	1.0	254	46.8	97	284	15.4	97
	7	58	61	0	119	12.6	1.1	277	44.4	119	291	13.1	119
	8	19	15	0	34	3.6	0.6	310	58.3	34	300	17.6	34
	9	7	5	0	12	1.3	0.4	317	65.2	12	305	17.1	12
	10	8	2	0	10	1.1	0.3	410	62.7	10	330	14.5	10
	11	3	1	0	4	0.4	0.2	390	61.0	4	326	17.7	4
	12	2	1	0	3	0.3	0.2	460	25.7	3	344	25.5	3
	13	0	1	0	1	0.1	0.1	450	NA	1	345	NA	1
Sample Total		200	163	0	363	38.4		269	64.7	363	288	20.3	363
5/24	4	1	3	0	4	1.2	0.6	194	51.2	4	263	20.4	4
	5	35	30	0	65	20.2	2.2	220	33.9	65	272	12.4	65
	6	43	37	0	80	24.9	2.4	254	33.9	80	284	12.3	80
	7	62	50	0	112	34.9	2.7	287	39.6	112	292	12.1	112
	8	18	15	0	33	10.3	1.7	313	41.6	33	300	11.4	33
	9	1	3	0	4	1.2	0.6	443	30.3	4	322	3.6	4
	10	2	2	0	4	1.2	0.6	454	112.4	4	328	22.1	4
	11	1	0	0	1	0.3	0.3	356	NA	1	323	NA	1
	12	2	0	0	2	0.6	0.4	479	7.1	2	356	17.0	2
	13	0	1	0	1	0.3	0.3	460	NA	1	347	NA	1
	14	1	1	0	2	0.6	0.4	534	51.6	2	344	8.5	2
Sample Total		166	142	0	308	96.0		273	64.2	308	288	18.3	308

-continued-

Appendix B1.–Page 4 of 4.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/25	4	0	2	0	2	0.2	0.1	225	48.8	2	269	9.9	2
	5	15	14	0	29	3.1	0.6	224	34.7	29	278	11.9	29
	6	23	26	1	50	5.3	0.7	259	37.3	50	289	10.0	50
	7	36	26	0	62	6.6	0.8	278	40.8	62	294	12.4	62
	8	10	5	0	15	1.6	0.4	311	51.2	15	301	12.7	15
	9	0	3	0	3	0.3	0.2	360	78.7	3	308	12.4	3
	10	1	2	0	3	0.3	0.2	394	41.2	3	338	5.8	3
	11	1	0	0	1	0.1	0.1	420	NA	1	351	NA	1
	12	2	0	0	2	0.2	0.1	409	32.5	2	346	3.5	2
	13	1	0	0	1	0.1	0.1	453	NA	1	339	NA	1
	14	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	15	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	16	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
Sample Total		89	78	1	168	17.8		272	60.0	168	292	17.0	168
Samples Combined		1,645	1,349	10	3,004					3,004			3,004

Appendix B2.–Age, sex and size composition of herring caught by commercial purse seine, Nunavachak Section.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/16	4	1	0	0	1	0.2	0.2	254	NA	1	259	NA	1
	5	13	10	0	23	3.8	0.8	285	57.2	23	289	18.8	23
	6	57	45	0	102	16.8	1.5	303	52.4	102	292	17.0	102
	7	110	141	0	251	41.3	2.0	311	55.1	251	297	15.1	251
	8	39	70	1	110	18.1	1.6	364	76.8	110	308	23.8	110
	9	37	26	0	63	10.4	1.2	387	90.5	63	314	20.1	63
	10	9	17	0	26	4.3	0.8	454	101.6	26	326	23.3	26
	11	8	8	0	16	2.6	0.6	478	79.9	16	327	18.9	16
	12	5	4	0	9	1.5	0.5	456	94.2	9	331	21.1	9
	13	4	1	0	5	0.8	0.4	526	43.0	5	348	17.1	5
	14	0	2	0	2	0.3	0.2	559	21.9	2	346	16.3	2
Sample Total		283	324	1	608	100.0		341	84.6	608	303	21.7	608
5/20	5	9	7	0	16	4.4	1.1	245	42.3	16	287	15.0	16
	6	29	22	0	51	14.0	1.8	280	47.7	51	297	13.6	51
	7	63	68	1	132	36.4	2.5	300	47.5	132	301	11.9	132
	8	40	34	0	74	20.4	2.1	349	70.3	74	312	14.6	74
	9	28	23	0	51	14.0	1.8	367	56.1	51	319	15.3	51
	10	14	7	0	21	5.8	1.2	390	61.1	21	329	17.3	21
	11	4	6	0	10	2.8	0.9	429	66.6	10	329	17.6	10
	12	2	2	0	4	1.1	0.5	445	87.0	4	330	11.8	4
	13	2	2	0	4	1.1	0.5	491	51.1	4	332	18.5	4
Sample Total		191	171	1	363	100.0		327	72.2	363	308	17.7	363

-continued-

Appendix B2.–Page 2 of 2.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/21	4	2	2	0	4	0.7	0.3	234	57.7	4	273	20.4	4
	5	17	14	0	31	5.1	0.9	245	45.2	31	279	15.1	31
	6	37	37	0	74	12.2	1.3	271	41.7	74	289	13.6	74
	7	59	50	0	109	17.9	1.6	293	53.0	109	294	15.0	109
	8	14	16	0	30	4.9	0.9	345	56.9	30	308	14.7	30
	9	6	13	0	19	3.1	0.7	369	89.7	19	313	20.9	19
	10	3	9	0	12	2.0	0.6	467	75.6	12	340	18.5	12
	11	3	4	0	7	1.2	0.4	435	119.3	7	324	25.9	7
	12	0	1	0	1	0.2	0.2	631	NA	1	357	NA	1
	13	0	1	0	1	0.2	0.2	472	NA	1	350	NA	1
Sample Total		141	147	0	288	47.4		304	79.6	288	297	21.2	288
Samples Combined		615	642	2	1,259					1,259			1,259

Appendix B3.–Age, sex and size composition of herring caught by commercial purse seine, Togiak Section.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/10	4	1	0	0	1	0.3	0.3	177	NA	1	272	NA	1
	5	2	4	0	6	1.8	0.7	265	47.0	6	271	15.6	6
	6	29	29	0	58	17.2	2.1	273	56.7	58	274	17.0	58
	7	43	48	0	91	27.0	2.4	337	62.8	91	287	13.3	91
	8	30	38	0	68	20.2	2.2	388	51.6	68	299	11.8	68
	9	28	31	0	59	17.5	2.1	438	61.4	59	308	12.3	59
	10	11	15	0	26	7.7	1.5	467	91.8	26	315	16.3	26
	11	7	2	0	9	2.7	0.9	476	40.7	9	321	9.0	9
	12	6	5	0	11	3.3	1.0	521	51.6	11	327	9.0	11
	13	3	5	0	8	2.4	0.8	528	101.9	8	328	9.1	8
Sample Total		160	177	0	337	100.0		376	96.0	337	296	20.6	337

Appendix B4.–Age, sex and size composition of herring caught by commercial purse seine, all sections.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/16	4	1	0	0	1	0.2	0.2	254	NA	1	259	NA	1
	5	13	10	0	23	3.8	0.8	285	57.2	23	289	18.8	23
	6	57	45	0	102	16.8	1.5	303	52.4	102	292	17.0	102
	7	110	141	0	251	41.3	2.0	311	55.1	251	297	15.1	251
	8	39	70	1	110	18.1	1.6	364	76.8	110	308	23.8	110
	9	37	26	0	63	10.4	1.2	387	90.5	63	314	20.1	63
	10	9	17	0	26	4.3	0.8	454	101.6	26	326	23.3	26
	11	8	8	0	16	2.6	0.6	478	79.9	16	327	18.9	16
	12	5	4	0	9	1.5	0.5	456	94.2	9	331	21.1	9
	13	4	1	0	5	0.8	0.4	526	43.0	5	348	17.1	5
	14	0	2	0	2	0.3	0.2	559	21.9	2	346	16.3	2
Sample Total		283	324	1	608	100.0		341		608	303		584
5/17	4	1	0	0	1	0.1	0.1	238	NA	1	270	NA	1
	5	25	18	0	43	4.6	0.7	242	48.8	43	275	18.0	43
	6	81	52	0	133	14.1	1.1	289	60.0	133	289	15.2	133
	7	171	155	3	329	34.8	1.6	314	64.1	329	294	16.2	329
	8	97	85	1	183	19.4	1.3	355	71.5	183	305	18.7	183
	9	69	42	0	111	11.7	1.0	407	79.7	111	317	18.8	111
	10	34	31	0	65	6.9	0.8	444	91.5	65	321	21.8	65
	11	21	15	1	37	3.9	0.6	431	98.4	37	322	22.3	37
	12	12	7	0	19	2.0	0.5	470	84.1	19	327	23.9	19
	13	3	9	1	13	1.4	0.4	561	57.2	13	336	22.1	13
	14	6	1	0	7	0.7	0.3	535	77.5	7	343	13.5	7
	15	2	1	0	3	0.3	0.2	444	199.2	3	326	34.4	3
	16	0	1	0	1	0.1	0.1	596	NA	1	356	NA	1
Sample Total		522	417	6	945	100.0		348		945	302		901

-continued-

Appendix B4.–Page 2 of 4.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/19	4	1	1	0	2	0.3	0.2	202	38.2	2	268	17.0	2
	5	10	8	0	18	3.0	0.7	255	53.1	18	285	16.2	18
	6	35	23	0	58	9.5	1.2	273	50.1	58	292	14.0	58
	7	59	57	1	117	19.2	1.6	287	43.2	117	296	12.8	117
	8	28	31	0	59	9.7	1.2	346	57.1	59	309	17.0	59
	9	10	18	0	28	4.6	0.9	374	62.7	28	318	13.7	28
	10	10	9	0	19	3.1	0.7	415	71.0	19	327	19.1	19
	11	5	3	0	8	1.3	0.5	430	72.6	8	332	15.3	8
	12	2	3	0	5	0.8	0.4	460	89.2	5	335	21.0	5
	13	1	4	0	5	0.8	0.4	493	40.8	5	346	15.7	5
	14	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	15	0	1	0	1	0.2	0.2	613	NA	1	354	NA	1
	16	1	0	0	1	0.2	0.2	494	NA	1	344	NA	1
Sample Total		162	158	1	321	52.8		319		321	303		301
5/20	4	3	2	0	5	0.5	0.2	267	36.6	5	288	6.3	5
	5	33	23	0	56	5.9	0.8	238	33.6	56	280	13.4	56
	6	80	61	0	141	14.9	1.2	275	48.4	141	292	14.1	141
	7	166	193	2	361	38.2	1.6	292	46.9	361	296	13.6	361
	8	84	84	1	169	17.9	1.2	334	69.7	169	305	17.3	169
	9	44	46	0	90	9.5	1.0	351	61.6	90	311	17.9	90
	10	26	22	0	48	5.1	0.7	377	79.2	48	319	22.3	48
	11	13	12	0	25	2.6	0.5	391	94.1	25	319	25.8	25
	12	5	2	0	7	0.7	0.3	446	61.7	7	331	9.8	7
	13	2	4	0	6	0.6	0.3	482	43.0	6	330	17.1	6
	14	1	0	0	1	0.1	0.1	581	NA	1	354	NA	1
	15	0	1	0	1	0.1	0.1	394	NA	1	310	NA	1
Sample Total		457	450	3	910	96.3		310		910	300		849

-continued-

Appendix B4.–Page 3 of 4.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/21	4	4	3	0	7	1.2	0.4	218	52.9	7	273	17.4	7
	5	33	26	0	59	9.7	1.2	239	48.7	59	281	14.6	59
	6	91	62	0	153	25.2	1.8	263	38.7	153	289	12.7	153
	7	156	94	0	250	41.1	2.0	281	54.2	250	293	14.3	250
	8	60	33	0	93	15.3	1.5	310	63.8	93	303	16.0	93
	9	19	19	0	38	6.3	1.0	362	75.8	38	316	18.7	38
	10	11	12	0	23	3.8	0.8	422	85.6	23	329	23.1	23
	11	6	5	0	11	1.8	0.5	411	111.0	11	321	24.9	11
	12	1	1	0	2	0.3	0.2	459	243.2	2	326	44.5	2
	13	0	2	0	2	0.3	0.2	474	2.1	2	345	7.1	2
	14	0	2	0	2	0.3	0.2	530	24.7	2	344	1.4	2
Sample Total		381	259	0	640	105.3		290		640	296		574
5/23	3	0	1	0	1	0.1	0.1	185	NA	1	262	NA	1
	4	11	15	0	26	2.8	0.5	190	23.1	26	262	8.8	26
	5	83	79	0	162	17.1	1.2	212	41.8	162	270	15.9	162
	6	103	104	0	207	21.9	1.3	248	41.6	207	283	14.3	207
	7	134	103	0	237	25.1	1.4	275	47.4	237	291	13.8	237
	8	32	41	0	73	7.7	0.9	309	54.0	73	300	16.1	73
	9	13	9	0	22	2.3	0.5	322	70.4	22	304	20.7	22
	10	9	3	0	12	1.3	0.4	391	81.2	12	327	23.7	12
	11	3	3	0	6	0.6	0.3	416	77.7	6	331	17.0	6
	12	3	3	0	6	0.6	0.3	482	81.4	6	345	21.5	6
	13	3	1	0	4	0.4	0.2	476	46.4	4	347	6.4	4
Sample Total		394	362	0	756	80.0		261		756	286		567

-continued-

Appendix B4.–Page 4 of 4.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/24	4	1	3	0	4	0.7	0.3	194	51.2	4	263	20.4	4
	5	35	30	0	65	10.7	1.3	220	33.9	65	272	12.4	65
	6	43	37	0	80	13.2	1.4	254	33.9	80	284	12.3	80
	7	62	50	0	112	18.4	1.6	287	39.6	112	292	12.1	112
	8	18	15	0	33	5.4	0.9	313	41.6	33	300	11.4	33
	9	1	3	0	4	0.7	0.3	443	30.3	4	322	3.6	4
	10	2	2	0	4	0.7	0.3	454	112.4	4	328	22.1	4
	11	1	0	0	1	0.2	0.2	356	NA	1	323	NA	1
	12	2	0	0	2	0.3	0.2	479	7.1	2	356	17.0	2
	13	0	1	0	1	0.2	0.2	460	NA	1	347	NA	1
	14	1	1	0	2	0.3	0.2	534	51.6	2	344	8.5	2
Sample Total		166	142	0	308	50.7		273		308	288		239
5/25	4	0	2	0	2	0.2	0.1	225	48.8	2	269	9.9	2
	5	15	14	0	29	3.1	0.6	224	34.7	29	278	11.9	29
	6	23	26	1	50	5.3	0.7	259	37.3	50	289	10.0	50
	7	36	26	0	62	6.6	0.8	278	40.8	62	294	12.4	62
	8	10	5	0	15	1.6	0.4	311	51.2	15	301	12.7	15
	9	0	3	0	3	0.3	0.2	360	78.7	3	308	12.4	3
	10	1	2	0	3	0.3	0.2	394	41.2	3	338	5.8	3
	11	1	0	0	1	0.1	0.1	420	NA	1	351	NA	1
	12	2	0	0	2	0.2	0.1	409	32.5	2	346	3.5	2
	13	1	0	0	1	0.1	0.1	453	NA	1	339	NA	1
Sample Total		89	78	1	168	17.8		272		168	292		137
Samples Combined		2,454	2,190	12	4,656					4,656			4,152

APPENDIX C: AGE, SEX AND SIZE COMPOSITION CAUGHT BY COMMERCIAL GILLNET

Appendix C1.–Age, sex and size composition of herring caught by commercial gillnet, Nunavachak Section.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/16	4	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	5	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	6	0	2	0	2	1.1	0.8	384	41.0	2	305	6.4	2
	7	7	10	0	17	9.1	2.1	421	53.6	17	314	14.6	17
	8	26	31	0	57	30.5	3.4	430	51.8	57	314	11.0	57
	9	21	26	0	47	25.1	3.2	452	42.1	47	321	11.1	47
	10	17	16	0	33	17.6	2.8	462	48.4	33	325	12.6	33
	11	4	9	0	13	7.0	1.9	474	39.2	13	328	13.1	13
	12	4	8	0	12	6.4	1.8	528	60.0	12	337	7.4	12
	13	3	0	0	3	1.6	0.9	531	27.7	3	340	8.4	3
	14	0	2	0	2	1.1	0.8	528	43.8	2	337	9.9	2
	15	0	1	0	1	0.5	0.5	590	NA	1	351	NA	1
Sample Total		82	105	0	187	100.0		453	56.6	187	321	60.8	187
5/19	4	1	0	0	1	0.5	0.5	304	NA	1	316	NA	1
	5	0	1	0	1	0.5	0.5	387	NA	1	327	NA	1
	6	5	6	0	11	6.0	1.8	372	31.8	11	313	7.3	11
	7	7	11	0	18	9.9	2.2	386	37.9	18	319	14.6	18
	8	17	30	0	47	25.8	3.3	421	52.6	47	322	11.6	47
	9	18	25	0	43	23.6	3.2	436	44.7	43	328	11.6	43
	10	13	11	0	24	13.2	2.5	456	63.8	24	333	13.9	24
	11	9	9	0	18	9.9	2.2	453	71.3	18	330	15.7	18
	12	6	5	1	12	6.6	1.8	484	56.1	12	338	13.7	12
	13	3	4	0	7	3.8	1.4	502	56.3	7	340	16.1	7
	14	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	15	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
Sample Total		79	102	1	182	100.0		432	13.7	182	327	14.3	182
Samples Combined		161	207	1	369			443	59.5	369	324	14.3	369

Appendix C2.–Age, sex and size composition of herring caught by commercial gillnet, Kulukak Section.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/20	6	0	3	0	3	1.7	1.0	357	72.4	3	311	12.1	3
	7	12	2	0	14	7.8	2.0	388	47.4	14	318	7.6	14
	8	18	27	1	46	25.7	3.3	408	42.4	46	321	12.7	46
	9	21	24	0	45	25.1	3.3	428	59.6	45	326	12.9	45
	10	15	16	1	32	17.9	2.9	442	60.9	32	332	16.3	32
	11	3	16	1	20	11.2	2.4	481	61.7	20	336	11.3	20
	12	6	4	0	10	5.6	1.7	479	69.4	10	341	10.4	10
	13	3	2	0	5	2.8	1.2	467	44.0	5	344	10.2	5
	14	2	2	0	4	2.2	1.1	540	68.9	4	353	9.0	4
Sample Total		80	96	3	179	100.0		433	63.8	179	328	15.0	179
5/21	5	1	0	0	1	0.5	0.5	252	NA	1	288	NA	1
	6	3	1	0	4	2.1	1.0	357	94.9	4	314	20.2	4
	7	2	10	0	12	6.2	1.7	406	35.4	12	319	7.6	12
	8	17	35	0	52	26.7	3.2	400	36.8	52	322	11.0	52
	9	24	30	0	54	27.7	3.2	431	39.0	54	325	11.3	54
	10	16	18	0	34	17.4	2.7	461	48.5	34	334	10.2	34
	11	9	11	0	20	10.3	2.2	469	54.3	20	335	13.7	20
	12	7	4	0	11	5.6	1.7	479	50.0	11	341	13.9	11
	13	2	5	0	7	3.6	1.3	496	66.9	7	340	12.6	7
Sample Total		81	114	0	195	100.0		433	55.7	195	327	13.6	195

-continued-

Appendix C2.–Page 2 of 2.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/22	5	2	0	0	2	1.2	0.8	273	85.6	2	291	24.7	2
	6	8	2	0	10	6.1	1.8	387	77.8	10	323	15.4	10
	7	13	28	0	41	25.2	3.3	392	63.3	41	324	13.0	41
	8	14	26	0	40	24.5	3.2	391	48.3	40	325	12.0	40
	9	16	14	0	30	18.4	2.9	422	56.8	30	331	15.0	30
	10	10	9	0	19	11.7	2.4	447	52.0	19	333	10.9	19
	11	8	4	0	12	7.4	2.0	440	40.0	12	339	7.2	12
	12	2	3	0	5	3.1	1.3	459	70.9	5	344	18.5	5
	13	1	1	0	2	1.2	0.8	466	75.0	2	353	2.1	2
	14	0	1	0	1	0.6	0.6	556	NA	1	365	NA	1
	15	1	0	0	1	0.6	0.6	532	NA	1	348	NA	1
Sample Total		75	88	0	163	100.0		410	64.1	163	328	15.0	163
5/25	5	4	2	0	6	2.9	1.2	347	45.6	6	314	15.9	6
	6	14	8	1	23	11.0	2.2	352	43.7	23	313	12.5	23
	7	25	39	1	65	31.0	3.3	346	37.4	65	313	12.1	65
	8	18	28	0	46	21.9	3.0	370	48.7	46	321	12.8	46
	9	11	16	1	28	13.3	2.4	392	52.3	28	326	14.3	28
	10	10	8	0	18	8.6	2.0	399	44.8	18	332	15.6	18
	11	9	6	0	15	7.1	1.8	441	36.0	15	342	9.4	15
	12	5	2	0	7	3.3	1.3	455	26.8	7	345	12.8	7
	13	1	1	0	2	1.0	0.7	490	87.0	2	353	19.8	2
Sample Total		97	110	3	210	100.0		374	54.2	210	322	16.3	210
Samples Combined		333	408	6	747			412	64.1	747	326	15.2	747

Appendix C3.–Age, sex and size composition of herring caught by commercial gillnet, all sections.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/14	6	0	2	0	2	1.1	0.8	384	41.0	2	305	6.4	2
	7	7	10	0	17	9.1	2.1	421	53.6	17	314	14.6	17
	8	26	31	0	57	30.5	3.4	430	51.8	57	314	11.0	57
	9	21	26	0	47	25.1	3.2	452	42.1	47	321	11.1	47
	10	17	16	0	33	17.6	2.8	462	48.4	33	325	12.6	33
	11	4	9	0	13	7.0	1.9	474	39.2	13	328	13.1	13
	12	4	8	0	12	6.4	1.8	528	60.0	12	337	7.4	12
	13	3	0	0	3	1.6	0.9	531	27.7	3	340	8.4	3
	14	0	2	0	2	1.1	0.8	528	43.8	2	337	9.9	2
	15	0	1	0	1	0.5	0.5	590	NA	1	351	NA	1
Sample Total		82	105	0	187	100.0		453	56.6	187	321	13.7	187
5/19	4	1	0	0	1	0.5	0.5	304	NA	1	316	NA	1
	5	0	1	0	1	0.5	0.5	387	NA	1	327	NA	1
	6	5	6	0	11	6.0	1.8	372	31.8	11	313	7.3	11
	7	7	11	0	18	9.9	2.2	386	37.9	18	319	14.6	18
	8	17	30	0	47	25.8	3.3	421	52.6	47	322	11.6	47
	9	18	25	0	43	23.6	3.2	436	44.7	43	328	11.6	43
	10	13	11	0	24	13.2	2.5	456	63.8	24	333	13.9	24
	11	9	9	0	18	9.9	2.2	453	71.3	18	330	15.7	18
	12	6	5	1	12	6.6	1.8	484	56.1	12	338	13.7	12
	13	3	4	0	7	3.8	1.4	502	56.3	7	340	16.1	7
Sample Total		79	102	1	182	100		432	60.8	182	327	14.3	182

-continued-

Appendix C3.–Page 2 of 3.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/20	6	0	3	0	3	1.7	0.9	357	72.4	3	311	12.1	3
	7	12	2	0	14	7.8	2.0	388	47.4	14	318	7.6	14
	8	18	27	1	46	25.7	3.2	408	42.4	46	321	12.7	46
	9	21	24	0	45	25.1	3.2	428	59.6	45	326	12.9	45
	10	15	16	1	32	17.9	2.8	442	60.9	32	332	16.3	32
	11	3	16	1	20	11.2	2.3	481	61.7	20	336	11.3	20
	12	6	4	0	10	5.6	1.7	479	69.4	10	341	10.4	10
	13	3	2	0	5	2.8	1.2	467	44.0	5	344	10.2	5
	14	2	2	0	4	2.2	1.1	540	68.9	4	353	9.0	4
Sample Total		80	96	3	179	100.0		433	63.8	179	328	15.0	179
5/21	5	1	0	0	1	0.5	0.5	252	NA	1	288	NA	1
	6	3	1	0	4	2.1	1.1	357	94.9	4	314	20.2	4
	7	2	10	0	12	6.2	1.8	406	35.4	12	319	7.6	12
	8	17	35	0	52	26.7	3.3	400	36.8	52	322	11.0	52
	9	24	30	0	54	27.7	3.3	431	39.0	54	325	11.3	54
	10	16	18	0	34	17.4	2.8	461	48.5	34	334	10.2	34
	11	9	11	0	20	10.3	2.3	469	54.3	20	335	13.7	20
	12	7	4	0	11	5.6	1.7	479	50.0	11	341	13.9	11
	13	2	5	0	7	3.6	1.4	496	66.9	7	340	12.6	7
Sample Total		81	114	0	195	100.0		433	55.7	195	327	13.6	195

-continued-

Appendix C3.–Page 3 of 3.

		Sex (number)						Weight			Length		
Sample Dates	Age	Male	Female	Unk.	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
5/22	5	2	0	0	2	1.2	0.8	273	85.6	2	291	24.7	2
	6	8	2	0	10	6.1	1.8	387	77.8	10	323	15.4	10
	7	13	28	0	41	25.2	3.2	392	63.3	41	324	13.0	41
	8	14	26	0	40	24.5	3.2	391	48.3	40	325	12.0	40
	9	16	14	0	30	18.4	2.8	422	56.8	30	331	15.0	30
	10	10	9	0	19	11.7	2.4	447	52.0	19	333	10.9	19
	11	8	4	0	12	7.4	1.9	440	40.0	12	339	7.2	12
	12	2	3	0	5	3.1	1.3	459	70.9	5	344	18.5	5
	13	1	1	0	2	1.2	0.8	466	75.0	2	353	2.1	2
	14	0	1	0	1	0.6	0.6	556	NA	1	365	NA	1
	15	1	0	0	1	0.6	0.6	532	NA	1	348	NA	1
Sample Total		75	88	0	163	100.0		410	64.1	163	328	14.9	163
5/25	4	0	0	0	0	0.0	0.0	NA	NA	0	NA	NA	0
	5	4	2	0	6	2.9	1.2	347	45.6	6	314	15.9	6
	6	14	8	1	23	11.0	2.3	352	43.7	23	313	12.5	23
	7	25	39	1	65	31.0	3.4	346	37.4	65	313	12.1	65
	8	18	28	0	46	21.9	3.1	370	48.7	46	321	12.8	46
	9	11	16	1	28	13.3	2.5	392	52.3	28	326	14.3	28
	10	10	8	0	18	8.6	2.1	399	44.8	18	332	15.6	18
	11	9	6	0	15	7.1	1.9	441	36.0	15	342	9.4	15
	12	5	2	0	7	3.3	1.3	455	26.8	7	345	12.8	7
	13	1	1	0	2	1.0	0.7	490	87.0	2	353	19.8	2
Sample Total		97	110	3	210	100.0		374	54.2	210	322	16.3	210
Samples Combined		494	615	7	1,116			422	64	1,116	325	15	1,116

APPENDIX D: HERRING BIOMASS FORECAST

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES
NEWS RELEASE

Contacts:
Greg Buck & Fred West, Asst. Area Research Biologists
Tim Baker, Area Research Biologist
Phone: (907) 267-2355
Fax: (907) 267-2442

Anchorage Regional Office
333 Raspberry Road
Anchorage, AK 99518
Date Issued: 11/10/11
Time: 1:00 p.m.

2012 TOGIAK HERRING FORECAST

The 2012 Togiak herring forecast and harvest allocation are listed below for the Togiak District sac roe and spawn-on-kelp fishery, and the Dutch Harbor food and bait fishery, given a maximum 20% exploitation rate of the projected run biomass (5 AAC 27.865).

Harvest Allocation of the 2012 Forecasted Pacific Herring Run Biomass, Togiak District, Bristol Bay

	Biomass (Short Tons)	Harvest (Short Tons)
Forecasted Biomass	123,745	
Total Allowable Harvest (20% exploitation rate)		24,749
Togiak Spawn-on-Kelp Fishery (Fixed Allocation)		1,500
Remaining Allowable Harvest		23,249
Dutch Harbor Food/Bait Allocation (7.0% of the remaining allocation)		1,627
Remaining Allowable Harvest for Togiak District Sac Roe Fishery		21,622
Purse Seine Allocation 70.0%		15,135
Gillnet Allocation 30.0%		6,487

-continued-

2012 TOGIAK HERRING FORECAST SUMMARY

The 2012 Pacific herring population forecast is 123,745 tons for the Togiak District 2012 (Figure 1). Age-7 and -8 herring returning from the 2005 and 2006 year classes are expected to comprise 52.1% of the biomass in 2012 (Figure 2). The remainder of the run will be comprised of herring ages 4–6 (19.1%), ages 9–11 (23.3%) and ages 12+ (5.5%) by weight. The forecasted individual average weight of herring in the harvest biomass is 323 g.

A run biomass of 123,745 tons would be ~16% less than the recent 10-year average. A biomass of this size has the potential to produce an overall harvest of 24,749 tons in all fisheries and 21,620 tons in the Togiak sac roe fisheries (purse seine and gillnet). A harvest of this size in the Togiak sac roe fisheries would be ~20% more than the recent 10-year average harvest.

An age-structured analysis (ASA) model was used to forecast the Togiak herring population that incorporates catch and age composition data as well as total run biomass estimates. The ASA model integrates data from purse seine fishery age compositions (1978–2011), total run age compositions (1978–1995, 1997, 1999, 2001, and 2005–2010), and aerial survey biomass estimates (1981, 1983, 1992–1994, 1997, 1999–2001, and 2005–2010). Samples from nonselective gear (commercial purse seine) are used to assess age composition of the total run biomass when a total run biomass is estimated. Commercial purse seine catch samples from 2011 ranged from age 4 to age 16. The average weight of age-4 herring for 2012 is estimated as the most recent 4-year average while simple linear regression models of historical trends are used to forecast average weights of remaining age classes.

A temporal change in age composition from older to younger herring typically occurs during this fishery. However, the 2011 inshore spawning biomass age composition was fairly stable and consisted largely of age-6 and -7 herring with a few discrete pulses of older fish. These age classes accounted for 47% of the total commercial purse seine harvest and 41% of the total harvest by weight.

The biomass of the Togiak herring spawning population has been estimated with aerial surveys since the late 1970s, concurrent with development of the sac-roe fishery. Total run biomass for 2011 was not estimated because aerial survey efforts were inadequate to measure the peak inshore biomass, primarily due to poor weather. Estimating the peak inshore biomass is a necessary precondition for estimating total run biomass. Surveys were flown between 27 April and 26 May and while most of the biomass was observed in the center of Togiak Bay, smaller concentrations of herring were noted in the vicinity of Nunavachak Bay to the east and Hagemeister Island to the west (Figure 3).

Herring become visible to our sampling effort when they recruit into the fishery; a process that we believe begins around age-4. Large recruitments in this population generally occur every 8 to 10 years. The last recruitment event experienced by Togiak herring was observed as the relatively large numbers of age-4 herring present in 2008 and 2009. It should be noted that measuring contributions of age classes less than three to the spawning biomass is difficult

-continued-

because these fish are not fully recruited (vulnerability to the gear) and they often arrive on the spawning grounds after older fish when sampling has ceased, unlike the post-fishery sampling that occurred in the 1980s.

There is always uncertainty in forecasting the Togiak District herring biomass. The mean percent error (MPE) has been -20% for years with reliable total run biomass estimates (Figure 1). The accuracy or mean absolute percent error (MAPE) of the ASA model is 19%. The forecast range for 2012 is 72,859 tons to 174,631 tons based on a MAPE of 20%. We consider this population to be healthy and sustainable.

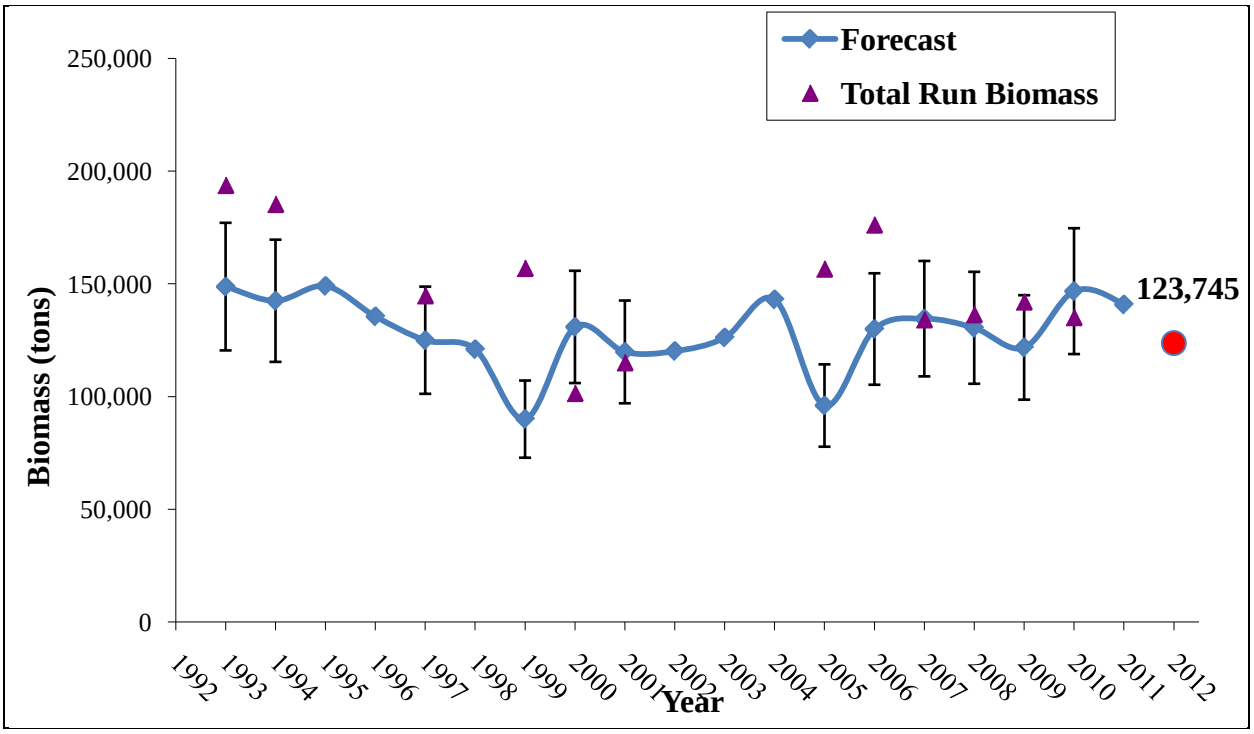


Figure 1.–Annual observed Togiak herring total run biomass estimates and preseason forecasts based on the ASA model. Mean absolute percent error (MAPE) of 25% around the forecast is also shown for years with a reliable total run biomass estimate.

-continued-

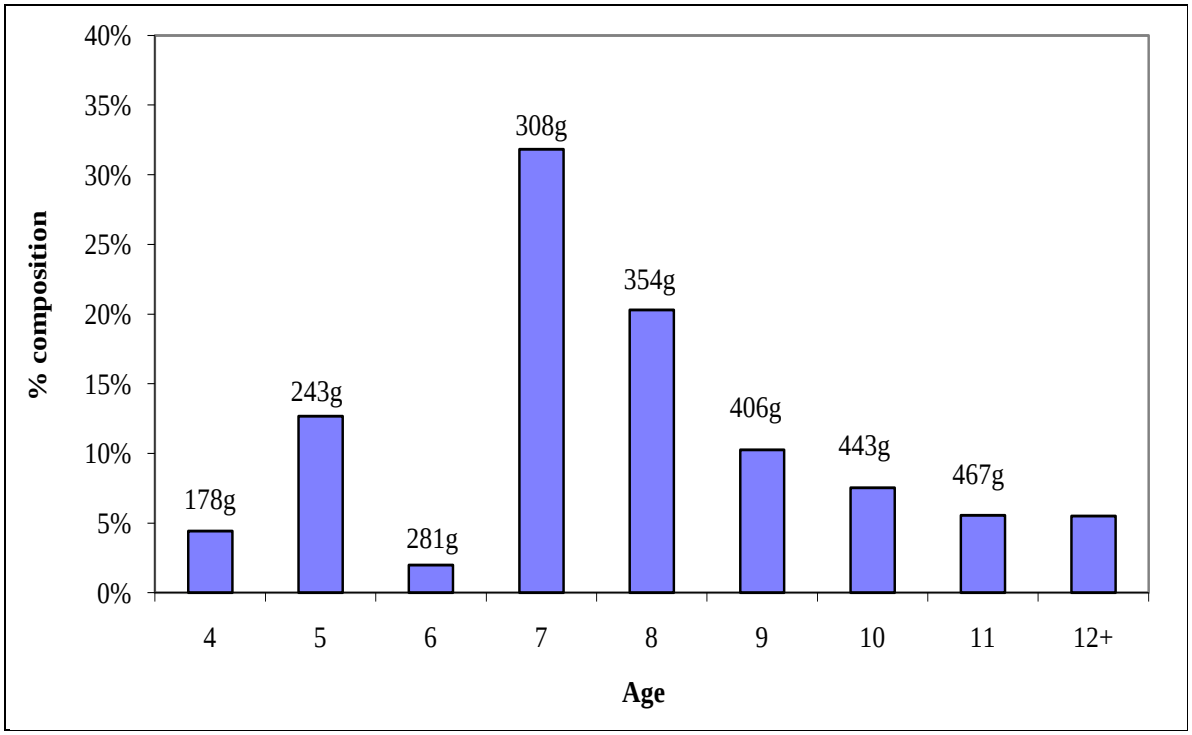


Figure 2.–Forecasted age composition by weight (grams) for the 2012 Togiak herring return. Forecasted average weight is shown for each age category.

-continued-

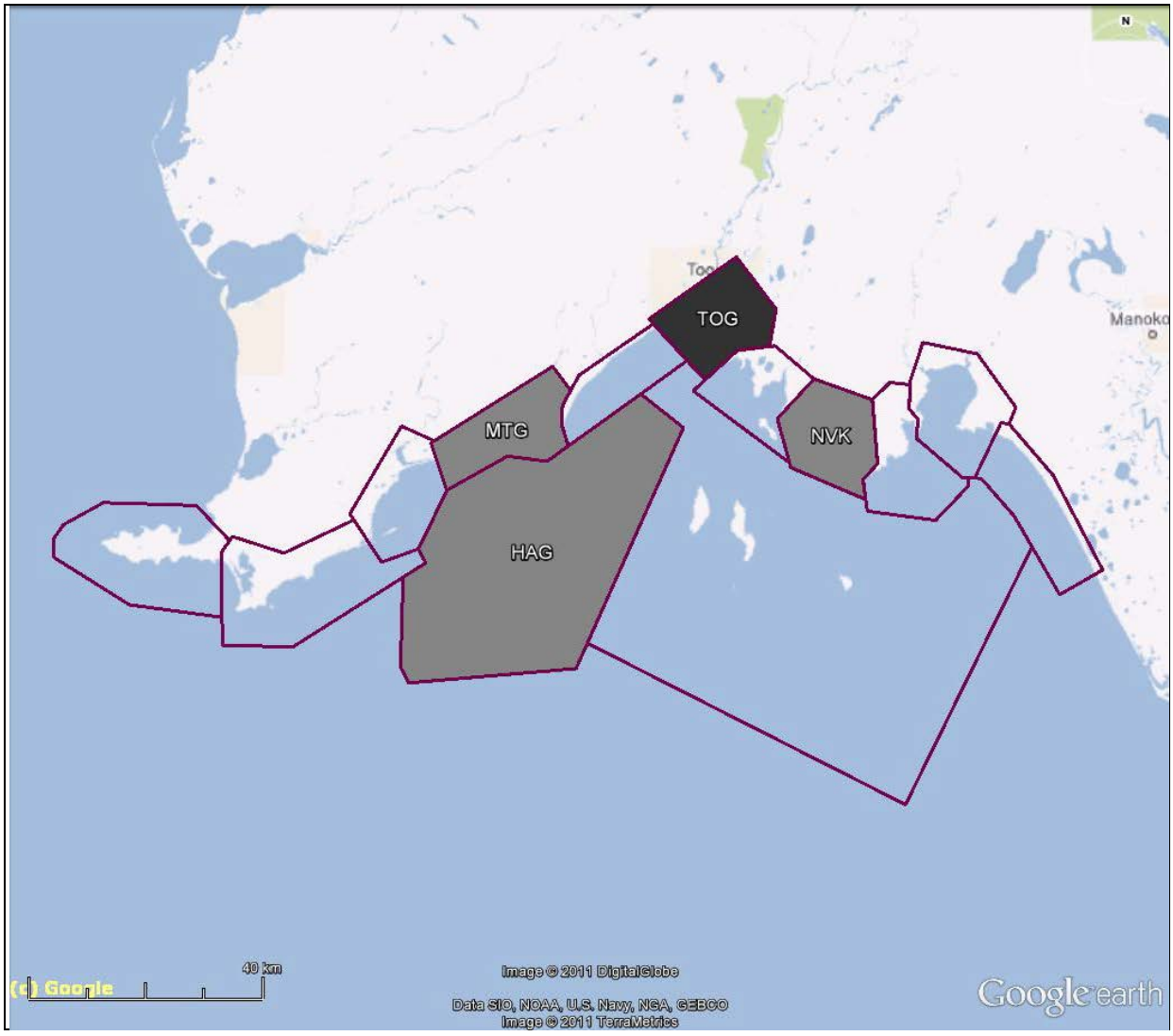


Figure 3.–Herring distribution observed during aerial surveys conducted during 2011. Survey section shaded in black (TOG=Togiak) recorded slightly more than 50% of the cumulative biomass measured across all surveys while sections with 6–12% of the cumulative recorded biomass are shaded grey (HAG=Hagemeister; MTG=Matogak; and NVK=Nunavachak). Herring were observed in all survey sections during 2011.

APPENDIX E: HERRING PATHOLOGY SURVEY

ACCESSION NO: 2011-0052

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES - FISH PATHOLOGY SECTION

333 RASPBERRY ROAD, ANCHORAGE, AK 99518-1599 - Phone (907) 267-2244/Fax 267-2194

REPORT OF LABORATORY EXAMINATION

LOT (YEAR, STOCK, SPECIES): Wild Togiak Bay Pacific herring, *Clupea pallasii*

FACILITY: ADF&G Dillingham, Alaska

CONTACT PERSON/ADDRESS: Greg Buck, 333 Raspberry Rd., Anchorage, AK 99518

SAMPLE DATE: 5/9/11 **DATE SAMPLE RECEIVED**: 5/13/11

LIFE STAGE: Adult **SPECIMEN TYPE**: Kidney/spleen/heart and blood smears

STATE: Chilled

WILD: Yes **NUMBER OF SAMPLES**: 72

HISTORY/SIGNS: NA

REASON FOR SUBMISSION: Disease history.

FINAL REPORT DATE: 7/14/11

CLINICAL FINDINGS: These fish were subsampled by purse seine from a larger sampled population, which had the following estimates: average weight of 334g, mostly age 6 or less, 47% male arid 53% females.

-continued-

ICHTHYOPHONUS:

0/72 Heart explants with growth typical of *ichthyophonus hoferi* after 14 days of incubation at 14°C.

VIROLOGY: Fish tissues processed without freezing.

0/60 Kidney/spleen pools (15 x 4 fish pools) positive for virus on EPC cells after 14 days of incubation at 14°C, and blind passaged for another 14 days incubation. Cells pre-treated with PEG to enhance viral infectivity. Minimum level of detection was 50 infectious particles per gm of pooled tissue sample.

VENV:

2/72 Peripheral blood smears were unreadable due to excessively thick smear preparations

0/70 peripheral blood smears with erythrocytic cytoplasmic inclusion bodies typical of VENV.

COMMENTS/RECOMMENDATIONS: *Ichthyophonus,* VHSV, and VENV were not detected in the samples submitted. The disease history involving the above listed pathogens for this stock has now been updated.

FISH HEALTH INVESTIGATOR: C. Bentz, J. Ferguson

TECHNICAL ASSISTANCE: I. Dickson

COPIES TO: FY2O11, Misc., Meyers, Rabung, Rozen, Davis, Brenner, Moffitt, Otis

ACCESSION NO: 2012-0067

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES - FISH PATHOLOGY SECTION

333 RASPBERRY ROAD, ANCHORAGE, AK 99518-1599 - Phone (907) 267-2244/Fax 267-2194

REPORT OF LABORATORY EXAMINATION

LOT (YEAR, STOCK, SPECIES): Wild Togiak Bay Pacific herring, *Clupea pallasii*

FACILITY: ADF&G Dillingham, Alaska

CONTACT PERSON/ADDRESS: Greg Buck, 333 Raspberry Rd., Anchorage, AK 99518

SAMPLE DATE: 5/19/12 **DATE SAMPLE RECEIVED**: 5/21/12

LIFE STAGE: Adult **SPECIMEN TYPE**: Kidney/spleen/heart and blood smears

STATE: Unlabeled bag of tissues with comingled samples for virus and *Ichthyophonus* testing; MEM-5 culture media not returned; thickened blood smears resembling tissue impression.

WILD: Yes **NUMBER OF SAMPLES**: 60

HISTORY/SIGNS: NA

REASON FOR SUBMISSION: Ongoing disease survey of Togiak Bay Pacific herring

FINAL REPORT DATE: 6/21/12

-continued-

CLINICAL FINDINGS

NECROPSY:

ICHTHYOPHONUS:

0/60 Heart explants with growth typical of *Ichthyophonus hoferi* after 14 days of incubation at 14° C.

VIROLOGY: Fish tissues processed without freezing.

0/60 Kidney/spleen pools (12 x 5 fish/pools) positive for virus on EPC cells after 14 days of incubation at 14° C, and blind passaged for another 14 days incubation. Cells pre-treated with PEG to enhance viral infectivity. Minimum level of detection was 50 infectious particles/g of pooled tissue sample.

VENV:

20/60 Peripheral blood smears were unreadable due to excessively thick preparations, completely smudged cells and an abundance of non-target tissues (e.g., sperm)

0/40 Peripheral blood smears with erythrocytic cytoplasmic inclusion bodies typical of VENV

7/40 Few Howell-Jolly bodies

COMMENTS/RECOMMENDATIONS: *Ichthyophonus*, VHSV, and VENV were not detected in the samples submitted. One third of the blood smears were not readable, please follow sampling protocol for future submissions. The disease history for this stock has now been updated.

FISH HEALTH INVESTIGATOR: Bentz, Ferguson

TECHNICAL ASSISTANCE: Dickson

COPIES TO: FY2012, Misc., Lewis, Brenner, Moffit, Rabung, Rozen, Davis, Meyers