

Fishery Data Series No. 10-34

**Abundance, Age, Sex and Size Statistics for Pacific
Herring in Togiak District of Bristol Bay, 2008**

by

Gregory B. Buck

May 2010

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Measures (fisheries)	
centimeter	cm	Alaska Administrative Code	AAC	fork length	FL
deciliter	dL			mid-eye to fork	MEF
gram	g	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	mid-eye to tail fork	METF
hectare	ha			standard length	SL
kilogram	kg	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	total length	TL
kilometer	km				
liter	L	at	@	Mathematics, statistics	
meter	m	compass directions:		<i>all standard mathematical signs, symbols and abbreviations</i>	
milliliter	mL	east	E	alternate hypothesis	H _A
millimeter	mm	north	N	base of natural logarithm	<i>e</i>
		south	S	catch per unit effort	CPUE
Weights and measures (English)		west	W	coefficient of variation	CV
cubic feet per second	ft ³ /s	copyright	©	common test statistics	(F, t, χ^2 , etc.)
foot	ft	corporate suffixes:		confidence interval	CI
gallon	gal	Company	Co.	correlation coefficient (multiple)	R
inch	in	Corporation	Corp.	correlation coefficient (simple)	r
mile	mi	Incorporated	Inc.	covariance	cov
nautical mile	nmi	Limited	Ltd.	degree (angular)	°
ounce	oz	District of Columbia	D.C.	degrees of freedom	df
pound	lb	et alii (and others)	et al.	expected value	<i>E</i>
quart	qt	et cetera (and so forth)	etc.	greater than	>
yard	yd	exempli gratia (for example)	e.g.	greater than or equal to	≥
		Federal Information Code	FIC	harvest per unit effort	HPUE
Time and temperature		id est (that is)	i.e.	less than	<
day	d	latitude or longitude	lat. or long.	less than or equal to	≤
degrees Celsius	°C	monetary symbols (U.S.)	\$, ¢	logarithm (natural)	ln
degrees Fahrenheit	°F	months (tables and figures): first three letters	Jan, ..., Dec	logarithm (base 10)	log
degrees kelvin	K	registered trademark	®	logarithm (specify base)	log ₂ , etc.
hour	h	trademark	™	minute (angular)	'
hour	h	United States (adjective)	U.S.	not significant	NS
minute	min	United States of America (noun)	USA	null hypothesis	H ₀
second	s	U.S.C.	United States Code	percent	%
		U.S. state	use two-letter abbreviations (e.g., AK, WA)	probability	P
Physics and chemistry				probability of a type I error (rejection of the null hypothesis when true)	α
all atomic symbols				probability of a type II error (acceptance of the null hypothesis when false)	β
alternating current	AC			second (angular)	"
ampere	A			standard deviation	SD
calorie	cal			standard error	SE
direct current	DC			variance	
hertz	Hz			population	Var
horsepower	hp			sample	var
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

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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 2008. Abundance was estimated from aerial surveys with chartered aircraft. Commercial harvest was measured through landing reports filed by the processors to the Alaska Department of Fish and Game. Samples were collected from commercial purse seine and gillnet harvests at the processors. The estimated 2008 total run biomass was 136,495 short tons. Total commercial harvest was 20,365 tons; 15,533 tons were harvested by the purse seine fishery and 4,832 tons by the gillnet fishery. Final exploitation rate was estimated at 16.2%. A total of 5,120 herring were sampled for age, sex, length, weight and sexual maturity information between 19 May and 29 May 2008. The 2008 inshore herring were aged from 3 to 17 years, with purse seine caught fish dominated by age-6 (18.5%), -7 (18.0%), -10 (10.3%) and -11 (12.7%) while gillnet caught fish were dominated by age-9 (15.3%), -10 (21.8%) and -11 (19.7%). Mean length and weight from the purse seine fishery samples were 343 mm and 285 grams, while fish sampled from the gillnet fishery averaged 407 mm and 304 grams.

Key words: Pacific herring, *Clupea pallasii*, sac roe, abundance, biomass, commercial herring fishery, Bristol Bay, Togiak District, age, length, weight, sex

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 stocks is the Bristol Bay-Alaska Peninsula stock. The Bristol Bay-Alaska Peninsula herring stock has been managed as a single spawning population with a total allowable exploitation rate of 20% established by the Bristol Bay Herring Management Plan, 5AAC 27.865.

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 (Figure 1). The herring fishery in Togiak District occurs on the largest discrete spawning biomass of Pacific herring in Alaskan waters (Figure 2). Estimates of this spawning aggregation have been conducted using aerial surveys since 1978. The largest measured was 239,022 tons¹ (216,839 tonnes²) in 1979 and has averaged 138,086 tons (125,271 tonnes) from 1998 through 2007 (Table 1).

Herring spawn within Togiak District from late April through early June. After spawning, herring continue their clockwise migration along the Alaska Peninsula to feeding areas near Unalaska Island. In August and September, these fish move north to over-wintering grounds north of the Pribilof Islands (Shaboneev 1965; Rummyantsev and Darda 1970; Weststad and Barton 1981; Funk 1990; Tojo et al. 2007, Figure 1).

The commercial fishery for herring in Togiak District occurs as the fish move inshore at or near their time of spawning. The target of this harvest is the ripened ovaries, or egg skeins, referred to as sac roe. This product is primarily marketed in Japan. Commercial harvest of herring for sac roe 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 20,375 tons (18,484 tonnes). The greatest harvest of

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.

30,315 tons (27,502 tonnes) occurred during the 1994 season (Table 1). The sac roe fishery is conducted using gillnets and purse seines.

Currently this fishery is managed under the Bristol Bay Herring Management Plan (5 AAC 27.865) (Sands 2009). This plan, originally adopted in 1980, sets a 20% exploitation rate of the available 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 another 7% for a food and bait fishery operated out of Dutch Harbor. The remaining harvest is reserved for the Togiak sac roe fishery with an allocation target of 30% reserved for the gillnet fleet and 70% for the purse seine fleet.

Harvest of herring spawn deposited on brown algae *Fucus* spp. (rockweed) is allowed within Togiak District. Wild spawn-on-kelp product has been historically harvested either by hand or by rake. This harvest, first documented in 1967, has been intermittent in recent years because of low demand, with no fishery occurring during the 1997, 1998, 2000 and 2001 seasons, as well as from 2004 to the present (Table 1).

During their post-spawning migration, herring that spawn in Togiak District are susceptible to one other directed fishery. This is a food and bait fishery which occurs during the mid-to-late summer months around Unalaska Island with boats operating out of Dutch harbor. Harvests in this fishery were first documented in 1929 and peaked at 3,006 tons (2,727 tonnes) in 1932 (Jackson 2008). The fishery declined and ended completely by 1938 because of poor market demand. This fishery was renewed in 1981 with harvests quickly peaking in 1984 at 3,578 tons (3,246 tonnes) and has since declined with the most recent 10-year average standing at 1,666 tons (1,511 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 were the first to develop 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). Concern over this additional harvest has been brought before the North Pacific Fishery Management Council and the Alaska Board of Fisheries.

Stock assessments of the Togiak herring population began in 1976 and have been conducted annually since 1978 (McBride et al. 1981; McBride and Whitmore 1981; Fried et al. 1982-1984; Lebida et al. 1985a-b; Lebida 1987; Sandone and Brannian 1988; Lebida and Sandone 1990; Rowell et al. 1991; Rowell 1995, 2002a-b; West 2002; West et al. 2003; Schwanke 2003a-b, Brazil 2007a-c and Brazil et al. 2009).

OBJECTIVES

The specific objectives of this data report were to:

1. Estimate the total run biomass of spawning Pacific herring available for harvest within Togiak District;
2. Document the commercial harvest (including dead loss 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 total run biomass, harvest (by gear type) and escapement; and
4. Estimate the inseason and final exploitation rate of herring in Togiak District.

METHODS

BIOMASS

Herring biomass within Togiak District was estimated using aerial survey procedures outlined by Lebida and Whitmore (1985). Surveys were flown daily at low tide, weather permitting. The district is divided into 13 aerial survey sections (Figure 3). Daily biomass estimates were made by summing survey section estimates. Peak inseason biomass is defined as the maximum daily estimate witnessed during the fishing season and total run biomass is defined as the sum of all daily biomass estimates judged to be composed of fish not accounted for in any other survey (Figure 4). In a typical fishing season, this will be the peak biomass estimate combined with an immediate postseason estimate.

HARVEST

Fish tickets (sales receipts) completed by buyers for each commercial delivery of herring were used as the primary source for documenting the harvest. Fish ticket information included date of harvest, gear type, biomass (tons), and location by subdistrict. 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 for the purposes of calculating exploitation rates.

AGE COMPOSITION

Effort was made to sample the commercial catch from each management subdistrict every fishing period (day) that commercial fishing was allowed. Samples were noted by gear type, processor and subdistrict and collected at the close of each commercial fishing period from processors, tenders, or individual fishing vessels. Attempts were made to collect samples from multiple vessels and/or processors to ensure samples were collected from as many schools of herring as possible. 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 as purse seines are less size-selective than gillnets.

To determine age, a scale was removed from the left side of each fish approximately 2.5 cm behind the operculum and 2.5 cm below the lateral line. If scales were absent from this preferred area, a scale was removed from the right side of the fish in the same location, or anywhere a readable scale was present. Removed scales were dipped in 10% mucilage solution, mounted sculptured side up on glass slides, and read by annuli interpretation at low (~10x) magnification using a microfiche reader. Annuli interpretation was accomplished 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.

Standard length (tip of snout to the hypural plate) was measured to the nearest millimeter. Each herring was weighed to the nearest 0.5 g. Sex and maturity was determined for each herring by visual examination of the gonads. Maturity was rated using an abbreviated version of the 8-scale guideline outlined in Barton and Steinhoff (1980). These categories were combined and summarized as green (not ready to spawn), ripe (ready to spawn) or spent (already spawned).

Sample sizes were designed to ensure that the resulting age composition estimate of the multinomial population would result in a solution whereby each age category would simultaneously fall within 5% ($\delta = 0.05$) of the true population age proportions 90% of the time (Thompson 1987). It has been determined that a sample size of 400 herring provides this level of precision and accuracy. We attempted to collect samples daily from each section where commercial purse seine and gill net fisheries occurred.

Samples of similar gear types were combined with adjacent spatial and temporal samples that were not significantly different. To achieve adequate sample sizes, gillnet and purse seine samples were aggregated into sampling groups containing samples that were similar in time, location or age composition prior to the application of these sampling groups to corresponding harvest or survey biomass estimates. Ideally, sample groups had a minimum of 400 fish. Only samples collected from the purse seine fishery were used to characterize aerial survey biomass estimates because this gear type is less size-selective than gillnet gear.

If harvest sampling is insufficient to characterize biomass within the district ADF&G can conduct test fishing with commercial purse seine gear to broaden coverage. Test fishing was not conducted during the 2008 season due to budget constraints and the belief that sampling coverage of the commercial harvest was adequate.

Once sampling groups have been matched with corresponding harvest or aerial survey biomass estimates, age composition and related information are calculated. The mean weight-at-age, \bar{W}_a , for herring was estimated for each gear-time-area stratum by:

$$\bar{W}_a = \frac{\sum_{i=1}^{n_a} W_{ai}}{n_a} \quad (1)$$

where:

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

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

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

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

where:

B_a = the biomass for age a ,

n_a = the number of herring in the sample that were age a ,

B = aerial survey or harvest biomass estimate.

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

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

Escapement (spawning) biomass, E_{tot} , was estimated as 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 :

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

An age structured analysis (ASA) model was used to forecast the 2008 herring run (Appendix C). Historical total run biomass estimates were used to weight the model, with more recent estimates given greater influence. The latest biomass estimate included in the 2008 forecast model was for 2007.

EXPLOITATION RATE

The exploitation rate, U , is estimated as:

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

where:

C = harvest and

B = biomass.

An inseason exploitation rate is estimated using the Togiak sac roe harvest and available documented biomass while the final exploitation rate is estimated using the total run biomass and including the Dutch Harbor food and bait harvest in C . Available documented biomass is the sum of daily aerial surveys that are counted towards total run biomass conducted while fishing is in progress. If total run biomass consists of peak biomass and a postseason survey, available documented biomass is equivalent to peak biomass. If total run biomass is calculated entirely from surveys conducted while fishing is in progress, it will be equivalent to available documented biomass.

RESULTS

BIOMASS

Aerial surveys in Togiak District began on 5 May (Table 2). Herring were first spotted on 15 May during a survey that estimated 1,014 tons (920 tonnes). Herring biomass increased steadily through 22 May when 70,692 tons were observed (64,131 tonnes). Togiak District experienced a severe storm beginning 23 May that precluded both surveying and fishing for several days. The peak inseason biomass of 82,557 tons (74,895 tonnes) was observed during the next survey on 28 May. This biomass was highly concentrated in the center of Togiak District (Figures 3–4). The age composition of the harvest differed significantly pre- and post-storm. It is believed that a total run biomass estimate of 136,495 tons (123,827 tonnes) calculated by combining the peak inseason biomass estimate on 28 May with the aerial survey estimate from 18 May of 53,938 tons (48,932 tonnes) was a reasonable estimate of total run biomass because the aggregation of spawning herring in the district likely would have experienced a nearly complete turn-over in the 10-day interval between these 2 surveys. This biomass estimate is 98.8% of the 10-year average and 99.2% of the 20-year average (Table 1). A postseason survey conducted on 9 June detected 724 tons (657 tonnes).

Aerial survey conditions ranged from poor to good throughout the season, with fair to good conditions during the peak inseason survey and fair to poor during the 18 May survey (Table 2). A total of 48.6 miles (78.2 km) of spawning was observed along coastlines in Togiak District in 2008, almost half of it during the peak survey date of 28 May (Table 2). This represents 89.9% of the 10-year average and 115.9% of the 20-year average (Table 3).

HARVEST

Commercial openings between 16 and 31 May produced a total harvest of 20,523 tons (18,618 tonnes) within Togiak District (Table 4). Historically, this fishery commences around 6 May however there is a fair bit of temporal variation, with fishing commencing as early as 26 April (in 2003) and as late as 19 May (in 1999) in the last 10 years (Table 5). This temporal variation is largely a function of the spring ice break-up and related water temperatures in the eastern Bering Sea. In 2008, with the area experiencing a late spring, the department forecasted the first harvest on 11 May. The actual fishing season was later still, with fish first spotted on 15 May and fishing commencing the next day. The 2008 season was also marked by a severe storm on 23–24 May that caused the fishing fleet to suspend operations. Fishing ended on 31 May, making for a relatively long 16 day fishing season. Fishing with purse seine gear before the storm was open from Right Hand Point to Anchor Point and from Togiak Reef west to Cape Newenham while gillnet gear was allowed from Right hand Point east to Egg Island (Figure 5). On 23 May, the area open for purse seine gear was changed to include the entire coastline between Cape Newenham and Anchor Point while the area open to gillnet gear was extended west of Right Hand Point approximately 12 km to the middle of Nunavachak Bay. These boundaries remained in effect throughout the remainder of the season.

The total commercial harvest in the Togiak District sac roe fishery of 20,523 tons (18,618 tonnes) represents 100.4% of the 10-year historical average and 100.7% of the 20-year average (Table 1). Catches from Nunavachak subdistrict accounted for the largest percentage (36.0%) of the total commercial harvest, followed by the Hagemeister (33.6%), Kulukak (23.5%), Pyrite Point (2.6%), Togiak (2.3%) and Cape Newenham (1.9%) subdistricts (Table 4; Figure 6).

Roe percentages ranged from 5.1% for herring harvested by purse seine in the Togiak subdistrict on 16 May to 12.4% for herring harvested by gillnet in Kulukak subdistrict on 26 May (Table 4).

Purse Seine

There were 11 commercial purse seine openings totaling 292 hours in Togiak District from 16 May to 28 May, harvesting a total of 15,691 tons (14,235 tonnes) during 2008 (Table 4). The first opening on 16 May experienced a 274 ton (249 tonnes) purse seine harvest concentrated in the Nunavachak section. Purse seine harvests peaked on 22 May with 1,948 tons (1,767 tonnes) and ended on 28 May with a harvest of 1,763 tons (1,599 tonnes). An additional 158 tons (144 tonnes) was taken in the Hagemeister section postseason during test fishing. The daily commercial purse seine harvest averaged 1,412 tons (1,281 tonnes). The purse seine catches were concentrated in the Nunavachak subdistrict early in the season with 83% of pre-storm catches reported there while 82% of post-storm catches occurred in the Hagemeister subdistrict. No dead loss was reported or observed in 2008. All fishing periods were 24 hours in length except the first, which lasted 52 hours. Excluding the initial 52 hour opening and days where harvest was precluded due to weather, the commercial purse seine fleet harvested an average of 1,726 tons (1,566 tonnes) per day (Table 4).

Roe accounted for 8.4% (by weight) of the commercial purse seine fishery. Roe percentages ranged from 5.1% in Togiak subdistrict on 16 May to 11.0% reported from the Cape Newenham subdistrict on 27 May (Table 4). The total average roe percentage (weighted) for purse seine harvested herring was approximately 1% below the 10- and 20-year average (Table 5).

Gillnet

There were 13 commercial gillnet openings totaling 312 hours held between 16 May and 31 May, harvesting a total of 4,832 tons (4,383 tonnes), all from the Kulukak subdistrict. The first commercial harvest on 16 May was 69.5 tons (63 tonnes) and harvest peaked on 20 May with a landing of 1,499 tons (1,360 tonnes) and ended on 30 May with a harvest of 40 tons (36 tonnes). A gillnet opening on the following day yielded no harvest (Table 4). Excluding days where fishing was open without harvest (e.g. the mid-season storm event), the daily gillnet harvest was 537 tons (487 tonnes).

Roe accounted for 11.4% (by weight) of the commercial gillnet fishery. Roe percentages ranged from a low of 9.7% on 30 May, to a high of 12.4% on 26 May (Table 4). The total average roe percentage (weighted) for gillnet harvested in 2008 was slightly higher than the 10-year and 20-year average (Table 5).

Spawn on Kelp

There was no commercial harvest for this fishery in 2008 and no registered buyers (Table 1). The last time this fishery occurred was in 2002.

AGE, SIZE, AND SEX COMPOSITION

A total of 4,430 samples collected from the commercial purse seine fishery (all sections) produced 3,970 readable scales (Table 6; Appendices B1–B4 and B6). A total of 1,540 samples were collected from 22, 25, 26 and 27 May in the Hagemeister Section, producing 1,396 (30.5%) of the total readable scales (Figure 7; Appendices B1 and B6). A total of 1,259 samples were collected from 19, 20, 21 and 22 May in the Nunavachak Section, producing 1,090 (23.8%) of the total readable scales (Figure 8; Appendices B2 and B6). A total of 720 samples were

collected from 20 and 21 May in the Pyrite Point Section, producing 661 (14.43%) of the total readable scales (Figure 9; Appendices B3 and B6) and a total of 910 samples were collected from catches on the 18, 21 and 22 May in Togiak Section producing 823 (18.0%) of the total readable scales (Figure 10; Appendices B4 and B6).

A total of 690 herring were sampled from the commercial gillnet fishery in openings occurring on 20, 21, 22, 26 and 27 May from the Kulukak Section (Figure 11; Table 6; Appendix B5).

Total Run

Samples used to estimate the total run biomass age composition were collected from purse seine harvests on 18 May in Togiak Section, 19 May in the Nunavachak Section and 26 and 27 May in the Hagemeister Section. The 500 fish sampled on 18 and 19 May were applied to the estimate of 53,938 tons (48,932 tonnes) observed during the 18 May aerial survey. The 662 fish sampled on 26 and 27 May were applied to the aerial survey estimate of 82,557 tons (74,895 tonnes) observed on 28 May.

The age composition of the total run was dominated by herring of age-6, -7, -10 and -11, comprising 14.6%, 15.5%, 11.3% and 17.1% (respectively) of the run by weight and 17.2%, 16.5%, 8.6% and 17.2% by number (Table 7; Figure 12; Appendix A1). The age composition of the run shifted between 18 and 28 May with the earlier portion of the run being dominated by the 2 older age classes (48.3% by weight and 44.4% by fish) while the later run was characterized by younger fish with 39.0% of biomass and 39.6% of the fish age-6 or -7 (Table 7).

A postseason aerial survey on 9 June detected 724 tons (657 tonnes). This survey was conducted 10 days after the final harvest and 13 days after final catch sampling. Due to the amount of time lapsed between the final sample(s) which might provide age composition information, and this survey, and in the absence of any postseason test fishing, no attempt was made to characterize the age composition of these fish.

Commercial Harvest

The weighted age composition of the commercial harvest was calculated by combining the weighted age composition from the commercial purse seine and gillnet fishery (Table 7; Figure 12; Appendices A2–A3). The age composition of the commercial harvest by weight was predominately age-11 (18.2%), age-10 (15.6%), and age-7 (15.9%) (Table 7; Figure 12). The gillnet harvest was markedly older than the purse seine harvest (Figures 13 and 14).

After the removal of outliers, a total of 4,571 samples were used to characterize the 2008 Togiak District sac roe harvest. The average length and weight of herring harvested in the commercial fishery was 288 mm and 352 g respectively. The sex composition of all samples collected from commercial purse seine and gillnet harvests was unbiased with regards to sex (48.4% male, 51.6% female, $p=0.04$) and varied over time (Appendices B1–B6).

Purse Seine

Herring samples were collected from commercial purse seine openings occurring during 18–22 May and 25–27 May from the Hagemeister, Nunavachak, Pyrite Point, and Togiak Sections (Appendices B1–B4 and B6).

Herring sampled from the purse seine fishery ranged from age-3 to age-17 (Table 7). Age-6, -7, -10 and -11 were the major age classes comprising 15.2%, 16.9%, 13.1% and 17.2% of the

commercial purse seine harvest by weight and 18.5%, 18.0%, 10.3%, and 12.7% by number (Table 7).

Herring sampled from the 2008 purse seine harvest had a mean length of 285 mm and mean weight of 343 g (Table 8). The purse seine harvest sampling was slightly skewed towards males (51% male and 49% female; $p=0.068$) (Appendix B6).

Gillnet

Herring sampled from the gillnet fishery ranged from age-5 to age-15 (Table 7), with age-9, -10 and -11 fish representing 15.5%, 23.3% and 21.2%, of the commercial gillnet harvest by weight and 15.3%, 21.8% and 19.7% by number (Table 7; Appendix A2; Appendix B6). Herring age-11 and older composed 28.9% of the gillnet harvest by weight and 26.4% by number. The contribution of herring age-8 and younger was 32.3% by weight and 36.5% by number (Table 6; Appendix A2).

Herring sampled from the 2008 gillnet harvest had a mean length of 304 mm and mean weight of 407 g (Table 8). The gillnet harvest sampling was skewed toward females (47.8% male and 52.2% female; $p=0.288$) (Appendix B5).

EXPLOITATION RATE

An inseason exploitation rate of 15.0% was estimated by dividing the commercial sac roe harvest of 20,562 tons (18,618 tonnes) by the available documented (total run) biomass of 136,495 tons (123,827 tonnes) (Tables 1–2). An estimated 115,972 tons (105,209 tonnes or 315.5 million herring), escaped harvest in the Togiak District fishery (Table 7). A final exploitation rate of 16.2% was estimated by dividing the combined Togiak District commercial sac roe and Dutch Harbor food and bait harvests by a total run biomass of 136,495 tons (123,827 tonnes) (Table 1).

DISCUSSION

The purpose of this report was to estimate total run biomass, spawning escapement, and age, size (weight and length) and sex composition of herring in Togiak District. The 2008 Togiak herring fishery was sampled utilizing a crew located in Dillingham processing samples received from a crew member based in Togiak who was responsible for making sampling requests of the processors and coordinating the logistics involved with gathering and shipping samples. This strategy provided managers with inseason age composition estimates in a timely and cost effective manner.

The 2008 total run biomass estimate (Objective 1) of 136,495 tons (123,827 tonnes) was 1.2% below the 10-year average and 0.8% below the 20-year average and 4.6% above the forecast of 130,516 tons (118,403 tonnes) (Table 1, Appendix C1). The estimated spawning escapement of 116,130 tons (105,352 tonnes) represents an estimated 316 million herring (Table 7). During aerial surveys in 2008, 48.6 linear miles (78.2 km) of spawning herring were observed, a value that falls between the 10- and 20-year average (Table 3). Herring spawn was first documented during the survey on 19 May at 12.9 miles (78.2 km), peaking during the 28 May survey at 22.7 miles (36.5 km; Table 2).

The total commercial harvest (Objective 2) of 20,523 tons (18,618 tonnes) was 101.5% of the most recent 10-year average and 99.2% of the 20-year average (Table 5). The commercial fishery started on 16 May, 10 days later than the starting date average over the last 20 years

(Table 5). The late start to the 2008 fishery can be attributed to a colder than normal spring. The average roe percent was 9.7% for all harvested herring (Table 4).

At 16 days, the 2008 Togiak District herring fishery was 5 days longer than the most recent 10-year average and 7 days longer than the 20-year average (Table 5), although it should be noted that fishing operations were suspended for 72 hours in 5 of the 6 subdistricts and 48 hours in all 6 during a storm that began on 23 May (Table 4). Fishing effort, defined as the peak vessel count during aerial surveys, was up slightly for both gillnet and purse seiners from historical lows in 2007 (Table 5). The continued low effort is probably the result of depressed market conditions as well as fisher/processor co-ops, which first appeared in 2001 and focus on quality over quantity of harvest. This practice allows the purse seine fishermen to inspect their catches more closely, and harvest only the most valuable fish. The long duration of the 2008 fishery was probably a function of low processing capacity with few buyers.

The commercial purse seine harvest of 15,691 tons (14,235 tonnes) of herring was 103.5% of the 20-year average and 106.1% of the 10-year average (Table 5). The average roe percentage of 8.4% was approximately 1% lower than the average for the last 10 and 20 years (Table 5). The commercial gillnet harvest of 4,832 tons (4,384 tonnes) was 85.6% of the 10-year average and 92.6% of the 20-year average (Table 5). The average roe percentage of 11.4% was 103.1% of the 10-year average and 108.6% of the 20-year average.

Sampling effort was considered adequate to characterize the Togiak District herring spawning biomass. Our sampling effort in 2008 was 177% of that in 2007, primarily because of improved logistics, coordination and the efficiencies realized through the introduction of new sampling technology. The number of readable scales (3,970) collected from the 2008 commercial purse seine fishery was more than the 2,033 readable scales collected in 2007 but slightly less than the 4,001 readable scales collected on average since 2000 (Brazil 2007a-c; Brazil et al. 2009; Schwanke 2003a-b; West et al. 2003). The number of readable scales (601) collected from the commercial gillnet fishery was more than the 344 collected in 2007 but less than the 814 readable scales collected on average since 2000 (Brazil 2007a-c; Brazil et al. 2009; Schwanke 2003a-b; West et al. 2003).

Catch sample data were applied to the total 2008 run biomass and commercial herring harvest in Togiak (Objective 3); age-6, -7, -10 and -11 herring were found to be the most prevalent, totaling 14.5%, 15.5%, 11.3% and 17.1% of the total run biomass (Table 7).

The commercial purse seine fishery in 2008 was dominated by age-6, -7, -10 and -11 herring, which accounted for 15.1%, 16.8%, 13.2% and 17.3% of the harvest biomass respectively (Table 7). When we compare the 2008 cohort of these 4 dominant age classes to the previous year we find the 2008 age at size was uniformly down by an average 6.0 mm and 24.8 g from 2007 (Table 9). Comparing the same metrics against the most recent 10-year average we find that age-6 and 7 fish in 2008 were 21.1 g and 13.3 g heavier than the historical average whereas the age-10 and -11 herring were 8.0 g and 5.0 g heavier than the historical mean.

Aged samples from the commercial gillnet fishery were dominated by age-10 and -11 herring which accounted for 23.3 % and 21.2% of the harvested biomass (Table 7).

The shift in age composition from older to younger herring that typically occurs in this fishery was again observed in 2008, with herring ages-6, -7, 10, and -11, comprising 5.3%, 11.2%,

16.4% and 31.9% of the biomass estimated on 18 May and 20.6%, 18.3%, 8.0% and 7.4% on 28 May (Table 7).

One problem with estimating the true strength of recruitment in any given year is the lack of postseason sampling that would be most likely to detect younger fish. In 2008 a lack of postseason sampling precluded an age contribution estimate for the fish observed on the 9 June aerial survey. The younger recruit age classes, age-4 and age-5 herring, generally spawn later than older fish and are typically underrepresented when postseason sampling is not conducted. Nevertheless, the larger than expected age-4 and -5 herring detected in the 2008 run may indicate that a strong recruitment event may be occurring (Table 7; Figures 13-14; Appendix C1). Togiak herring have experienced strong cyclical recruitment events every 8–10 years since the late 1970s.

The inseason and final exploitation rate of herring in Togiak District was estimated in 2008 (Objective 4). The inseason exploitation rate of 15.0% (Tables 1–2) was lower than last year's rate of 20.3% (Brazil 2008). The final exploitation rate of 16.2% (Table 1) was higher than the 13.7% in 2006 and slightly below the 20-year average of 17.1% (Table 1).

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TABLES AND FIGURES

Table 1.—Historical total run biomass and commercial harvest (tons) of Pacific herring returning to Togiak District, Bristol Bay, 1987–2008.

Year	Togiak		Spawn-on-Kelp			Dutch Harbor	
	Total Run Biomass (tons)	Sac Roe Harvest (tons)	Harvest (lbs)	Harvest (tons)	Herring Equivalent (tons)	Food and Bait Harvest (tons)	Exploitation Rate
1988	134,718	14,167	489,400	245	1,782	2,004	13.3%
1989	98,965	12,259	559,754	280	2,499	3,081	18.0%
1990	88,105	12,230	413,844	207	1,617	820	16.6%
1991	83,229	14,970	348,357	174	1,310	1,325	21.2%
1992	156,957	25,808	363,600	182	1,482	1,949	18.6%
1993	193,847	17,956	383,000	192	1,481	2,790	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	1,748	19.8%
1996	135,585 ^a	24,871	455,800	228	1,899	2,239	21.4%
1997	144,887	23,813				1,950	17.8%
1998	121,000 ^a	22,776				1,994	20.5%
1999	157,028	19,226	419,563	210	1,605	2,398	14.8%
2000	130,904 ^a	20,421				2,014	17.1%
2001	115,155	22,370				1,439	20.7%
2002	120,196 ^a	17,049	67,793	34	260	2,751	16.7%
2003	126,213 ^a	21,663				1,487	18.3%
2004	143,124 ^a	18,868				1,258	14.1%
2005	156,727	20,912				1,154	14.1%
2006	176,288	23,953				953	14.1%
2007	134,221	17,132				1,214	13.7%
2008	136,495	20,523				1,536	16.2%
<hr/>							
1998-2007							
Average	138,086	20,437	243,678	122	933	1,666	16.4%
1988-2007							
Average	137,583	20,375	371,919	186	1,460	1,896	17.1%

Note: Blank cells indicate no fishery occurred that year.

Sources: Jones et al. (2009); ADF&G fish tickets.

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

Table 2.–Aerial survey estimates (tons) of herring by index area, Togiak District, 2008.

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	CN	HAG		WAL
5 May	10:10	1.8															
8 May	10:00	3.8															
11 May	10:05	4.6															
14 May	9:50	3.1															
15 May	9:00	1.9				54				391	570						
16 May	9:00	3.8								106					8,903		
18 May	11:00	3.7								34,211	19,726						
19 May	14:30	1.5	12.9														
22 May	9:30	2.5	13	500	16,232	5,043	2,098	5,428	30,900	2,936	1,000	3,595	2,959				70,692
28 May	13:30	3.6	22.7				15,222	31,655	28,111	55	5,622	61	1,784		49		82,557 ^c
9 June	9:15	3.7					83	512	120								724
Mean	10:31	3.1															
Total			48.6												Peak Biomass		82,557

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

^b 1= Excellent, 2 = Good, 3 = Fair, 4 = Poor, 5 = Unsatisfactory.

^c The Togiak District Pacific herring biomass was estimated at 134,221 (tons). This was the sum of:

1) Peak biomass aerial survey estimate of 82,557 (tons) observed 28 May.

2) Aerial biomass estimate of 53,938 (tons) observed 16 May.

Table 3.—Aerial survey estimates of herring spawn deposition, Togiak District, 1978–2008.

Year	Spawn Estimates	
	Observations	Miles
1988	107	61.1
1989	69	52.5
1990	94	65.7
1991	90	69.5
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
1988-07 Average	84.7	54.1
1998-07 Average	76.9	41.9

Table 4.–Commercial herring harvest (tons) by fishing section and gear type, Togiak District, Bristol Bay, 2008.

Date	Duration (Hours)	Fishing Period	Kulukak		Nunavachak		Togiak		Hagemeister		Pyrite Point		Newenham		Total	
			Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %
Purse Seine																
16 May	52	1	0	0	160.2	10.4	114.1	5.1	0.0	0.0	0.0	0.0	0.0	0.0	274.3	8.2
19 May	24	2	0	0	2,819.7	8.8	0.0	0.0	121.6	8.6	0.0	0.0	0.0	0.0	2,941.3	8.8
20 May	24	3	0	0	1,374.5	9.7	146.9	9.8	320.8	9.2	0.0	0.0	0.0	0.0	1,842.2	9.6
21 May	24	4	0	0	1,288.4	9.3	15.0	9.6	123.8	8.7	20.1	10.7	0.0	0.0	1,447.3	9.3
22 May	24	5	0	0	1,379.0	9.2	113.8	7.3	355.7	8.8	99.7	8.4	0.0	0.0	1,948.2	9.0
23 May	24	6	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 May	24	7	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25 May	24	8	0	0	0.0	0.0	0.0	0.0	310.0	8.8	0.0	0.0	0.0	0.0	310.0	8.8
26 May	24	9	0	0	0.0	0.0	0.0	0.0	3,085.8	9.5	276.7	9.7	0.0	0.0	3,362.5	9.5
27 May	24	10	0	0	132.0	8.0	0.0	0.0	1,250.9	9.3	138.0	8.4	123.9	11.0	1,644.8	9.2
28 May	24	11	0	0	241.2	9.1	84.5	8.0	1,170.2	9.2	0.0	0.0	266.6	10.9	1,762.5	9.4
30 May									63.3						63.3	
31 May									95.0						95.0	
Subtotal	292		0.0	0.0	7,395.0	9.2	474.3	7.7	6,897.1	9.1	534.5	9.2	390.5	10.9	15,691.4	8.4
Gillnet																
16 May	24	1	69.5	10.5											69.5	10.5
20 May	24	2	1,498.5	11.2											1,498.5	11.2
21 May	24	3	805.5	10.8											805.5	10.8
22 May	24	4	493.8	11.3											493.8	11.3
23 May	24	5	0.0	0.0											0.0	0.0
24 May	24	6	0.0	0.0											0.0	0.0
25 May	24	7	0.0	0.0											0.0	0.0
26 May	24	8	652.5	12.4											652.5	12.4
27 May	24	9	803.3	11.9											803.3	11.9
28 May	24	10	305.3	11.8											305.3	11.8
29 May	24	11	162.9	10.9											162.9	10.9
30 May	24	12	40.4	9.7											40.4	9.7
31 May	24	13	0.0	0.0											0.0	0.0
Subtotal	312		4,831.7	11.4											4,832	11.4

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Table 4.–Page 2 of 2.

Date	Duration (Hours)	Fishing Period	Kulukak		Nunavachak		Togiak		Hagemeister		Pyrite Point		Newenham		Total	
			Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %	Tons	Roe %
Combined																
16 May			69.5	10.5	160.2	10.4	114.1	5.1	0.0	0.0	0.0	0.0	0.0	0.0	343.8	8.7
19 May			0.0	0.0	2819.7	8.8	0.0	0.0	121.6	8.6	0.0	0.0	0.0	0.0	2941.3	8.8
20 May			1498.5	11.2	1374.5	9.7	146.9	9.8	320.8	9.2	0.0	0.0	0.0	0.0	3340.7	10.3
21 May			805.5	10.8	1288.4	9.3	15.0	9.6	123.8	8.7	20.1	10.7	0.0	0.0	2252.8	9.8
22 May			493.8	11.3	1379.0	9.2	113.8	7.3	355.7	8.8	99.7	8.4	0.0	0.0	2442.0	9.4
23 May			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 May			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25 May			0.0	0.0	0.0	0.0	0.0	0.0	310.0	8.8	0.0	0.0	0.0	0.0	310.0	8.8
26 May			652.5	12.4	0.0	0.0	0.0	0.0	3085.8	9.5	276.7	9.7	0.0	0.0	4015.0	10.0
27 May			803.3	11.9	132.0	8.0	0.0	0.0	1250.9	9.3	138.0	8.4	123.9	11.0	2448.1	10.1
28 May			305.3	11.8	241.2	9.1	84.5	8.0	1170.2	9.2	0.0	0.0	266.6	10.9	2067.8	9.7
29 May			162.9	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.9	10.9
30 May			40.4	9.7	0.0	0.0	0.0	0.0	63.3	0.0	0.0	0.0	0.0	0.0	103.7	9.7
31 May			0.0	0.0	0.0	0.0	0.0	0.0	95.0	0.0	0.0	0.0	0.0	0.0	95.0	0.0
%			23.5%		36.0%		2.3%		33.6%		2.6%		1.9%			
Total			4831.7	11.4	7395.0	9.2	474.3	7.7	6897.1	9.1	534.5	9.2	390.5	10.9	20,523.1	9.7

Note: Includes test fish harvest conducted during closed commercial periods and food and bait harvest.

Table 5.–Sac roe herring industry participation, fishing effort and harvest, Togiak District, 1988–2008.

Year	Fishery Dates					Gillnet					Purse Seine					Total Harvest ^c
	Daily		Start	Close	Days	Duration			Roe %	Duration			Roe %			
	Buyers	Capacity ^a				Effort ^b	(hours)	Harvest ^c		CPUE	Effort ^b	(hours)		Harvest ^c	CPUE	
1988	22		5/17	5/17	1	300	4.0	3,695	3.1	8.3	239	0.5	10,472	87.6	10.9	14,167
1989	19		5/9	5/14	6	320	5.0	2,844	1.8	7.8	310	3.0	9,415	10.1	8.5	12,259
1990	16	3,100	5/8	5/21	14	277	66.0	3,072	0.2	9.0	221	3.0	9,158	13.8	9.7	12,230
1991	16	3,350	5/10	5/17	8	170	14.0	3,182	1.3	8.5	200	3.0	11,788	19.6	10.0	14,970
1992	18	3,700	5/20	5/27	8	274	25.5	5,030	0.7	8.8	301	0.3	20,778	230.1	9.2	25,808
1993	12	2,500	4/27	5/12	16	75	144.5	3,564	0.3	10.1	140	33.8	14,392	3.0	9.6	17,956
1994	16	3,300	5/11	5/20	10	146	76.0	7,462	0.7	12.0	240	4.6	22,853	20.7	9.4	30,315
1995	22	4,350	5/7	5/15	9	250	33.5	6,995	0.8	12.0	254	12.2	19,737	6.4	10.1	26,732
1996	19	4,850	5/5	5/8	4	461	18.0	6,863	0.8	11.1	268	2.4	18,008	27.8	9.0	24,871
1997	18	4,200	5/2	5/6	5	336	24.0	5,164	0.6	11.8	231	6.4	18,649	12.6	9.4	23,813
1998	15	2,475	4/29	5/10	12	152	46.0	5,952	0.9	12.5	123	16.5	16,824	8.3	9.6	22,776
1999	12	2,400	5/18	5/26	9	171	28.0	4,858	1.0	11.5	96	4.7	14,368	31.8	9.2	19,226
2000	12	2,100	5/6	5/14	9	227	67.0	5,464	0.4	10.6	90	15.8	14,957	10.6	10.1	20,421
2001	11	2,255	5/6	5/13	8	96	84.0	6,491	0.8	10.6	64	26.0	15,879	9.5	9.2	22,370
2002	8	1,920	5/3	5/13	11	82	102.0	5,216	0.6	10.9	37	57.5	11,833	5.6	9.3	17,049
2003	7	1,920	4/25	5/7	13	75	142.0	6,505	0.6	10.9	35	110.2	15,158	3.9	8.9	21,663
2004	6	2,150	4/29	5/9	11	54	162.0	4,980	0.6	10.4	31	78.0	13,888	5.7	9.5	18,868
2005	8	2,330	4/30	5/8	9	56	149.0	5,841	0.7	11.2	33	83.0	15,071	5.5	9.6	20,912
2006	7	2,060	5/12	5/21	10	49	143.9	7,132	1.0	10.8	28	113.0	16,821	5.3	9.2	23,953
2007	5	1,420	5/10	5/25	16	25	366.0	4,012	0.4	11.2	21	244.0	13,120	2.6	10.0	17,132
2008	7	1,950	5/16	5/31	16	27	312.0	4,832	0.6	11.4	28	292.0	15,691	1.9	8.4	20,523
1998-2007																
Average	9	2,103	5/4	5/14	11	99	129.0	5,645	0.7	11.1	56	74.9	14,792	8.9	9.5	20,437
1988-2007																
Average	13	N/A	5/6	5/15	9	180	85.0	5,216	0.9	10.5	148	40.9	15,158	26.0	9.5	20,375

Note: Blank cells indicate no data.

^a Number of tons per day based on companies registered.

^b Peak vessel count. Conducted concurrently with aerial surveys. This occurred on 5/18/2008 for the gillnet fleet and on 5/15/2008 for the purse seine fleet.

^c Harvest total includes dead loss and test fish.

Table 6.—Number of samples for which age estimations were made by gear type, Togiak District, 2008.

Gear Type	Readable	Missing & Unreadable	Total	Percent Missing & Unreadable
Commercial Purse Seine	3,970	460	4,430	10.4
Commercial Gillnet	601	89	690	12.9
Total	4,571	549	5,120	10.7

Table 7.–Herring harvest (biomass) by age and gear type for early season (18 May aerial survey), late season (28 May aerial survey), total run, and escapement from the herring sac roe fishery, Togiak District, 2008.

Purse Seine					Gillnet					Total Harvest				
Age	Biomass ST	%	Herring (x1000)	%	Age	Biomass ST	%	Herring (x1000)	%	Age	Biomass ST	%	Herring (x1000)	%
1	0	0.0	0	0.0	1	0	0.0	0	0.0	1	0	0.0	0	0.0
2	0	0.0	0	0.0	2	0	0.0	0	0.0	2	0	0.0	0	0.0
3	11	0.1	62	0.1	3	0	0.0	0	0.0	3	11	0.1	62	0.1
4	594	3.8	3,146	7.4	4	0	0.0	0	0.0	4	594	2.9	3,146	5.9
5	1,075	6.8	4,515	10.6	5	22	0.5	61	0.6	5	1,097	5.3	4,576	8.5
6	2,378	15.2	7,909	18.5	6	380	7.9	1,024	9.5	6	2,758	13.4	8,933	16.7
7	2,647	16.9	7,702	18.0	7	627	13.0	1,595	14.7	7	3,275	16.0	9,297	17.4
8	1,351	8.6	3,573	8.4	8	532	11.0	1,272	11.8	8	1,883	9.2	4,846	9.0
9	1,149	7.3	2,668	6.2	9	748	15.5	1,661	15.3	9	1,897	9.2	4,328	8.1
10	2,060	13.1	4,406	10.3	10	1,125	23.3	2,355	21.8	10	3,184	15.5	6,760	12.6
11	2,694	17.2	5,445	12.7	11	1,024	21.2	2,127	19.7	11	3,718	18.1	7,572	14.1
12	1,051	6.7	2,055	4.8	12	266	5.5	523	4.8	12	1,318	6.4	2,578	4.8
13	411	2.6	757	1.8	13	48	1.0	87	0.8	13	459	2.2	844	1.6
14	132	0.8	243	0.6	14	49	1.0	103	1.0	14	181	0.9	347	0.6
15	80	0.5	137	0.3	15	10	0.2	17	0.2	15	90	0.4	154	0.3
16	28	0.2	51	0.1	16	0	0.0	0	0.0	16	28	0.1	51	0.1
17	31	0.2	55	0.1	17	0	0.0	0	0.0	17	31	0.2	55	0.1
18	0	0.0	0	0.0	18	0	0.0	0	0.0	18	0	0.0	0	0.0
19	0	0.0	0	0.0	19	0	0.0	0	0.0	19	0	0.0	0	0.0
20	0	0.0	0	0.0	20	0	0.0	0	0.0	20	0	0.0	0	0.0
Total	15,691	100	42,725	100	Total	4,832	100	10,825	100	Total	20,523	100	53,550	100

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Table 7.-Page 2 of 3.

Early Season (18 May)					Late Season (28 May)					Total Run				
Age	Biomass		Herring		Age	Biomass		Herring		Age	Biomass		Herring	
	ST	%	(x1000)	%		ST	%	(x1000)	%		ST	%	(x1000)	%
1	0	0.0	0	0.0	1	0	0.0	0	0.0	1	0	0.0	0	0.0
2	0	0.0	0	0.0	2	0	0.0	0	0.0	2	0	0.0	0	0.0
3	0	0.0	0	0.0	3	139	0.2	770	0.3	3	139	0.1	770	0.2
4	125	0.2	457	0.4	4	8,310	10.1	40,800	16.0	4	8,434	6.2	41,257	11.2
5	1,067	2.0	3,654	3.2	5	11,231	13.6	42,725	16.8	5	12,298	9.0	46,379	12.6
6	2,838	5.3	7,993	7.0	6	16,995	20.6	55,427	21.8	6	19,833	14.5	63,420	17.2
7	6,029	11.2	15,759	13.8	7	15,080	18.3	45,034	17.7	7	21,109	15.5	60,793	16.5
8	3,349	6.2	8,222	7.2	8	7,681	9.3	19,245	7.6	8	11,031	8.1	27,467	7.4
9	3,041	5.6	6,623	5.8	9	5,658	6.9	13,087	5.1	9	8,699	6.4	19,710	5.3
10	8,848	16.4	17,586	15.4	10	6,615	8.0	14,242	5.6	10	15,463	11.3	31,827	8.6
11	17,230	31.9	33,116	29.0	11	6,105	7.4	13,857	5.4	11	23,335	17.1	46,973	12.7
12	6,905	12.8	13,018	11.4	12	3,332	4.0	6,543	2.6	12	10,238	7.5	19,561	5.3
13	2,882	5.3	5,024	4.4	13	762	0.9	1,925	0.8	13	3,644	2.7	6,949	1.9
14	929	1.7	1,599	1.4	14	409	0.5	770	0.3	14	1,338	1.0	2,369	0.6
15	553	1.0	914	0.8	15	0	0.0	0	0.0	15	553	0.4	914	0.2
16	142	0.3	228	0.2	16	0	0.0	0	0.0	16	142	0.1	228	0.1
17	0	0.0	0	0.0	17	241	0.3	385	0.2	17	241	0.2	385	0.1
18	0	0.0	0	0.0	18	0	0.0	0	0.0	18	0	0.0	0	0.0
19	0	0.0	0	0.0	19	0	0.0	0	0.0	19	0	0.0	0	0.0
20	0	0.0	0	0.0	20	0	0.0	0	0.0	20	0	0.0	0	0.0
Total	53,938	100	114,193	100	Total	82,557	100	254,810	100	Total	136,495	100	369,002	100

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Table 7.–Page 3 of 3.

Age	Escapement		Herring	
	Biomass ST	%	(x1000)	%
1	0	0.0	0	0.0
2	0	0.0	0	0.0
3	128	0.1	708	0.2
4	7,841	6.8	38,111	12.1
5	11,201	9.7	41,803	13.3
6	17,075	14.7	54,487	17.3
7	17,834	15.4	51,496	16.3
8	9,148	7.9	22,622	7.2
9	6,802	5.9	15,382	4.9
10	12,279	10.6	25,067	7.9
11	19,617	16.9	39,401	12.5
12	8,920	7.7	16,983	5.4
13	3,185	2.7	6,105	1.9
14	1,156	1.0	2,022	0.6
15	463	0.4	760	0.2
16	114	0.1	177	0.1
17	209	0.2	330	0.1
18	0	0.0	0	0.0
19	0	0.0	0	0.0
20	0	0.0	0	0.0
Total	115,972	100	315,453	100

Table 8.—Mean length (mm), weight (g), and standard deviation by age for herring of the commercial harvest by gear type, Togiak District, 2008.

Inseason Biomass						Commercial Purse Seine						Commercial Gillnet					
Age	Sample (N)	Mean Length (mm)	SD	Mean Weight (g)	SD	Age	Sample (N)	Mean Length (mm)	SD	Mean Weight (g)	SD	Age	Sample (N)	Mean Length (mm)	SD	Mean Weight (g)	SD
2	2	233	4.2	164	8.1	2	0	0	0.0	0	0.0	2	0	0	0.0	0	0.0
3	108	238	14.4	173	40.1	3	2	233	4.2	164	8.1	3	0	0	0.0	0	0.0
4	127	254	14.9	222	50.8	4	230	237	13.9	179	45.9	4	0	0	0.0	0	0.0
5	179	271	16.1	282	57.8	5	412	255	14.1	231	48.0	5	3	291	3.8	330	20.1
6	186	281	14.7	319	55.6	6	745	271	13.7	286	49.7	6	52	285	10.9	337	36.3
7	86	292	15.2	357	56.0	7	748	280	12.5	320	49.7	7	85	291	11.5	358	44.1
8	63	301	15.6	404	65.7	8	334	289	13.5	350	53.6	8	68	298	12.3	379	46.5
9	114	309	13.0	446	61.3	9	263	301	14.9	395	66.1	9	92	305	11.5	410	46.7
10	181	313	12.7	463	66.6	10	419	307	12.9	425	62.3	10	135	310	11.2	434	49.4
11	74	317	10.5	477	57.7	11	519	311	12.0	447	62.7	11	122	312	9.9	438	43.9
12	27	322	12.7	511	69.4	12	178	315	12.1	464	62.3	12	31	316	8.7	461	42.4
13	9	323	11.4	516	66.9	13	70	322	13.6	488	67.8	13	5	326	11.0	503	42.2
14	4	327	10.1	549	60.5	14	23	322	12.2	494	60.3	14	6	323	7.1	445	42.6
15	1	336	N/A	564	N/A	15	13	327	7.6	517	56.9	15	2	334	3.5	480	61.2
16	1	339	N/A	567	N/A	16	9	336	7.6	554	67.2	16	0	0	0.0	0	0.0
17	0	0	0.0	0	0.0	17	5	330	10.2	479	49.3	17	0	0	0.0	0	0.0
Average		286	29.4	348	118.5			285	26.3	343	101.4			304	14.8	407	59.2
Total	1,162						3,970						601				

Table 9.—Mean weight and length for the dominant age classes in the 2008 Togiak herring purse seine fishery in comparison to the previous 10 years.

Year	age-6		age-7		age-10		age-11	
	Length	Weight	Length	Weight	Length	Weight	Length	Weight
1998	267	245	279	285	304	370	307	384
1999	269	245	277	268	298	336	304	357
2000	265	246	282	303	301	369	306	387
2001	263	249	281	305	306	405	310	428
2002	267	259	280	306	310	430	316	447
2003	266	271	279	319	309	461	314	485
2004	274	272	282	301	314	441	319	473
2005	274	285	281	304	312	421	319	452
2006	270	281	286	345	316	472	322	509
2007	274	296	284	331	314	457	321	493
2008	271	286	280	320	307	425	311	447
1998-2007 Average	269	265	281	307	308	416	314	442
% of 1998-2007 Average	100.8%	108.0%	99.6%	104.3%	99.5%	102.1%	99.1%	101.2%
% of 2007	98.9%	96.6%	98.6%	96.7%	97.8%	93.0%	96.9%	90.7%

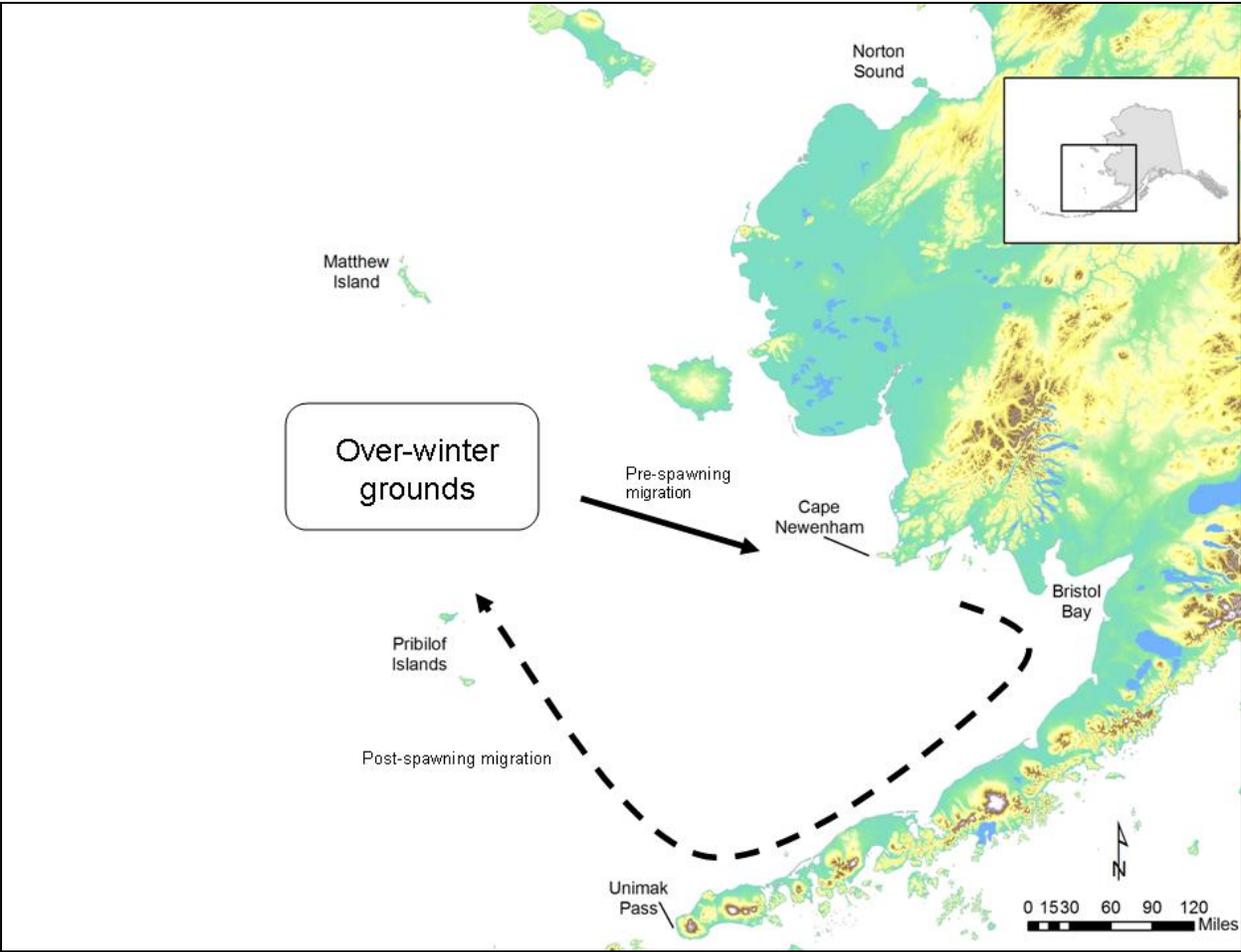


Figure 1.—Southeastern Bering Sea herring migration. Adapted from Tojo et al (2007).

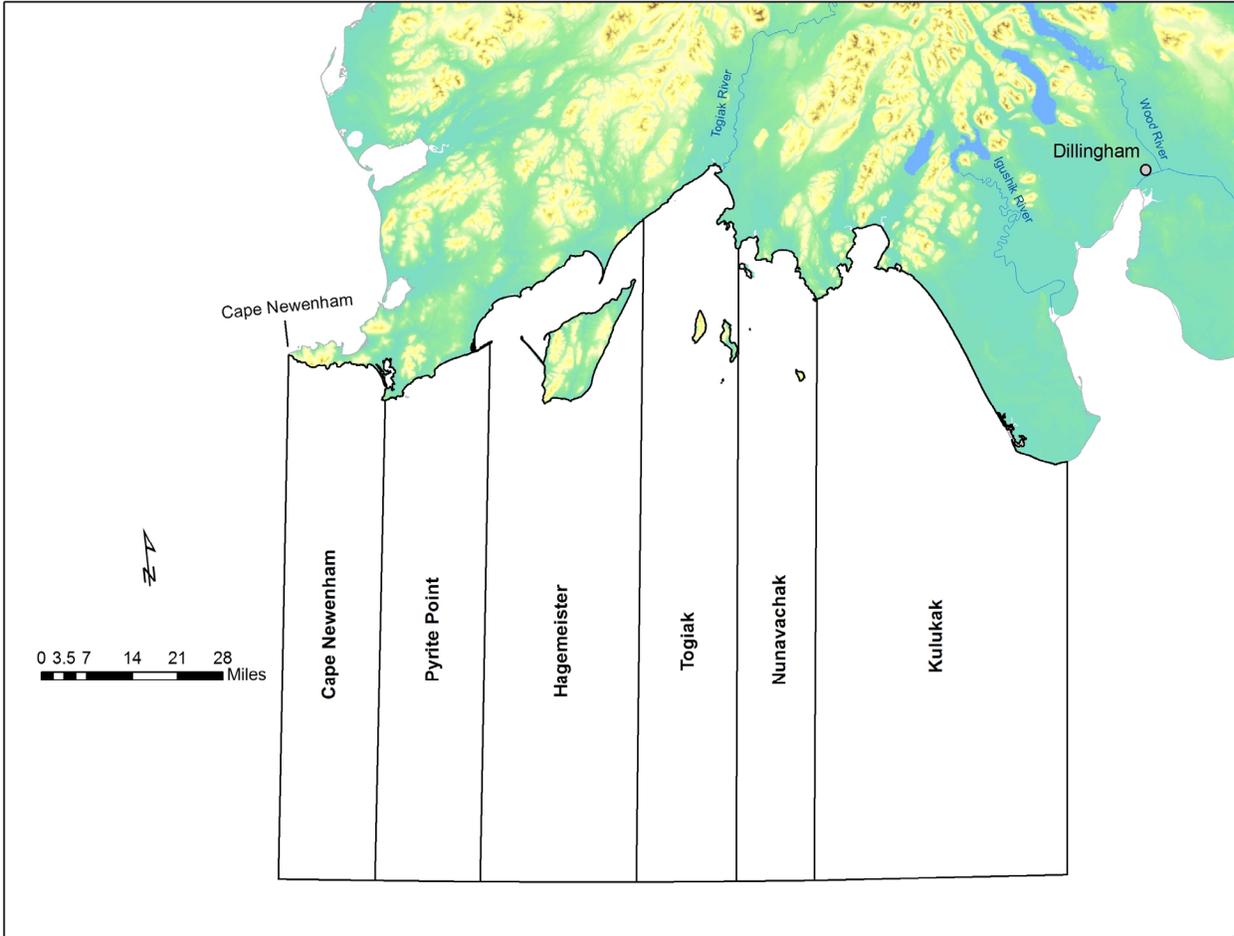
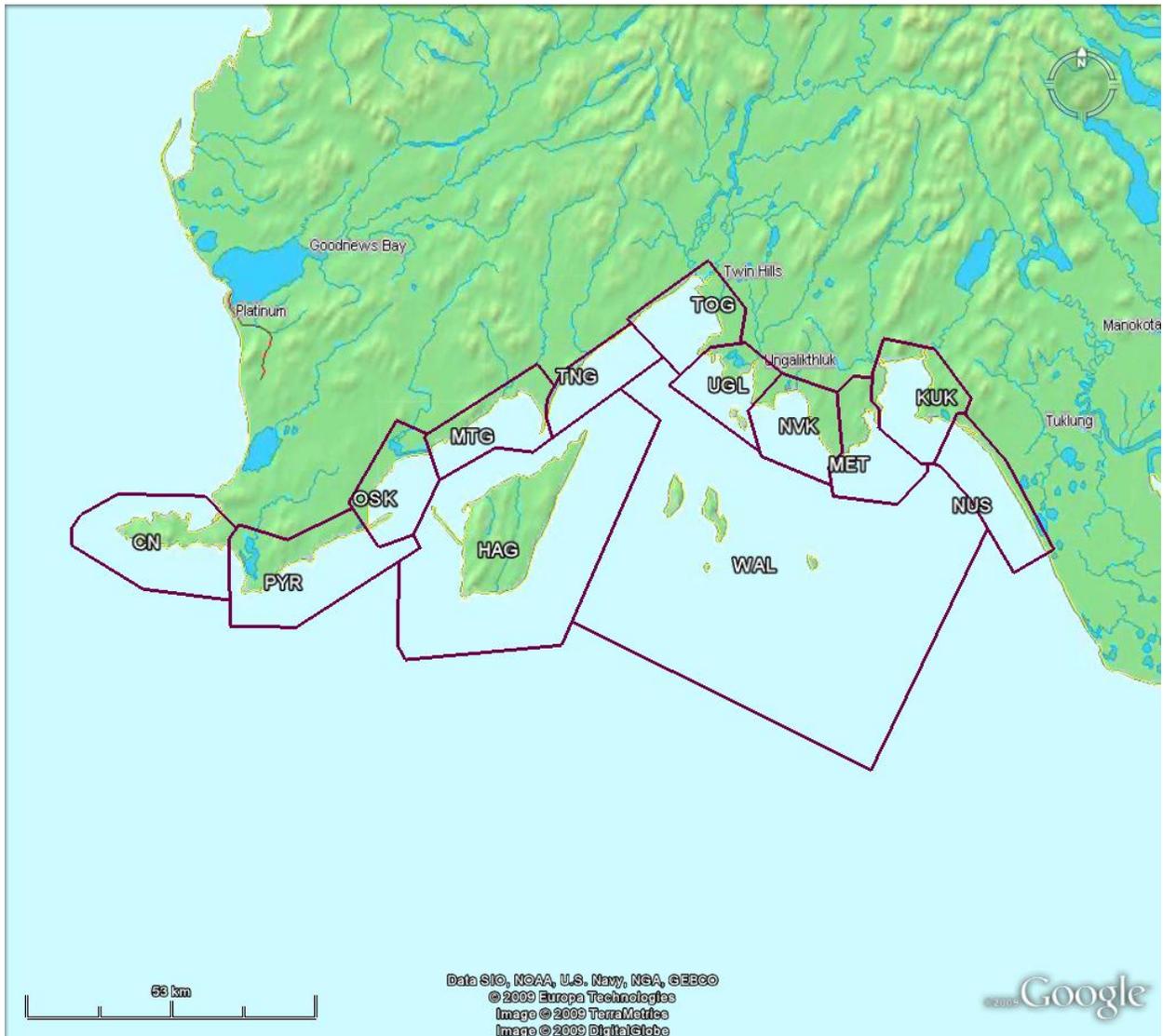


Figure 2.—Map of Togiak District and subdistrict management sections, Bristol Bay.



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

Figure 3.–Togiak herring aerial survey sections.

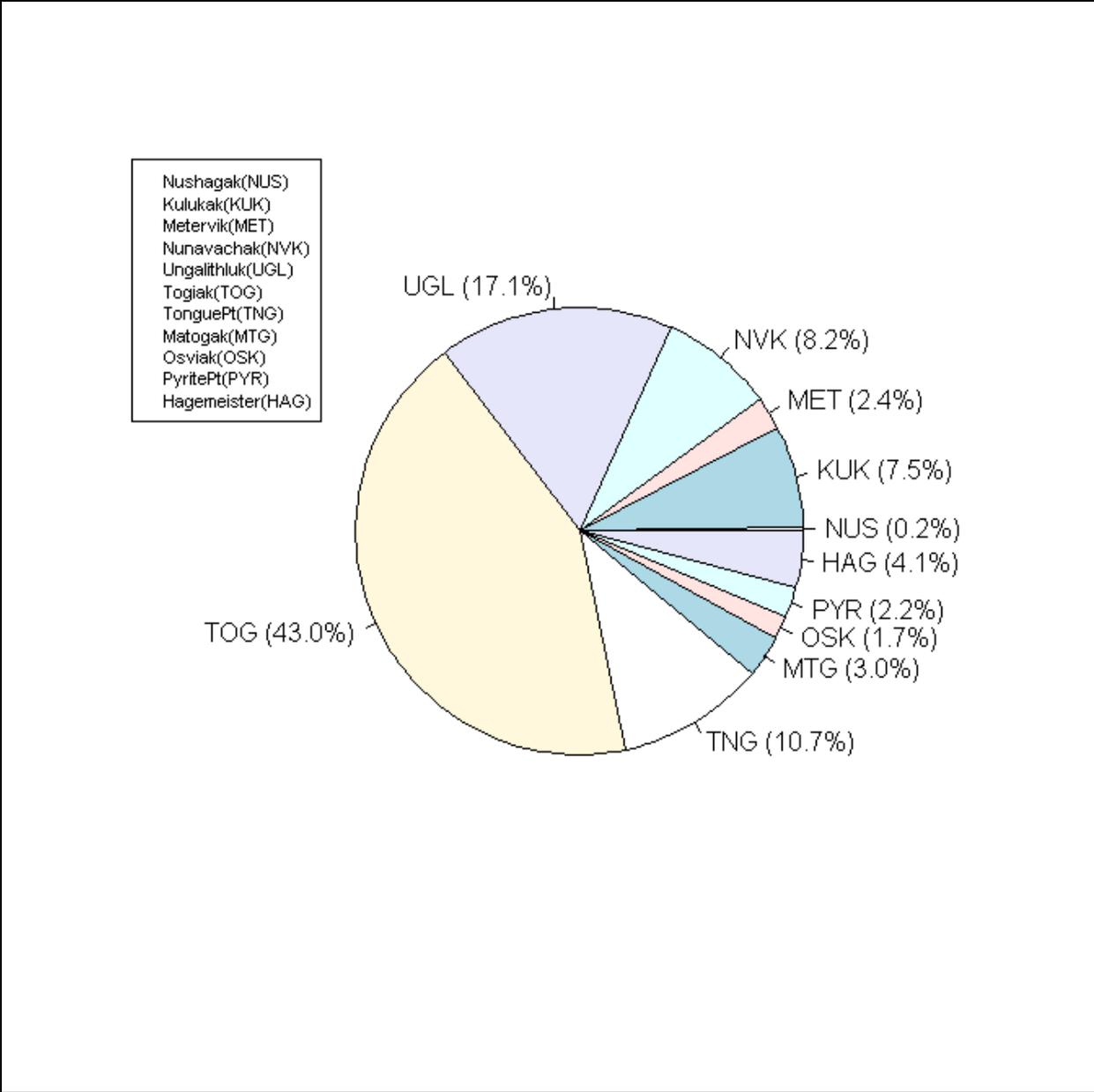


Figure 4.–Cumulative tons estimated in each aerial survey section during all aerial surveys, Togiak District, 2008.

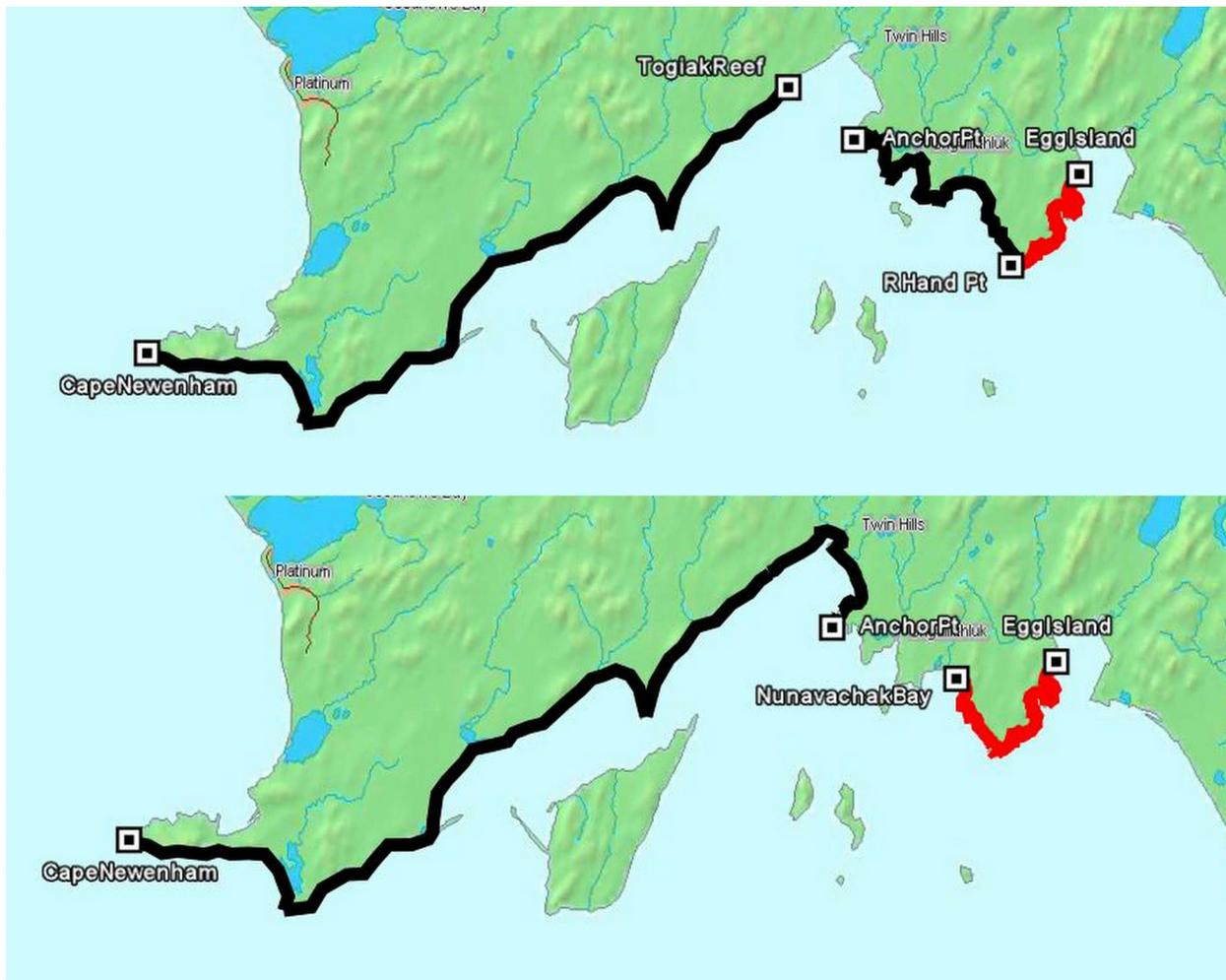


Figure 5.—Commercial harvest areas opened by gear type on 16 May (top) and 23 May (bottom), Togiak District, 2008. Area open to purse seine highlighted in black. Areas open to gillnet highlighted in red.

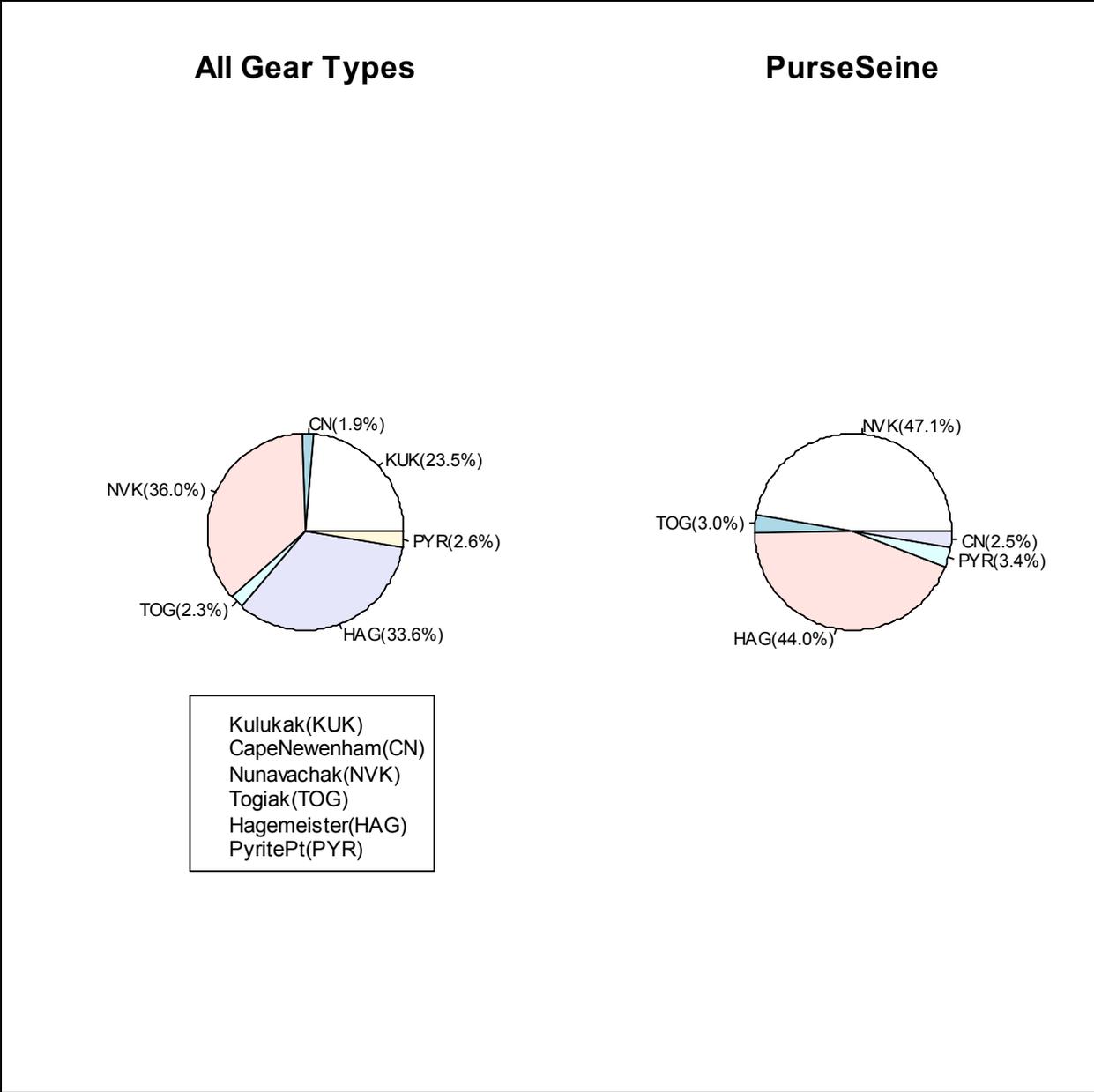


Figure 6.—Commercial harvest by reporting subdistrict for all gear types (left) and for purse seine only (right), Togiak District, 2008. All gillnet harvest occurred in the Kulukak subdistrict in 2008.

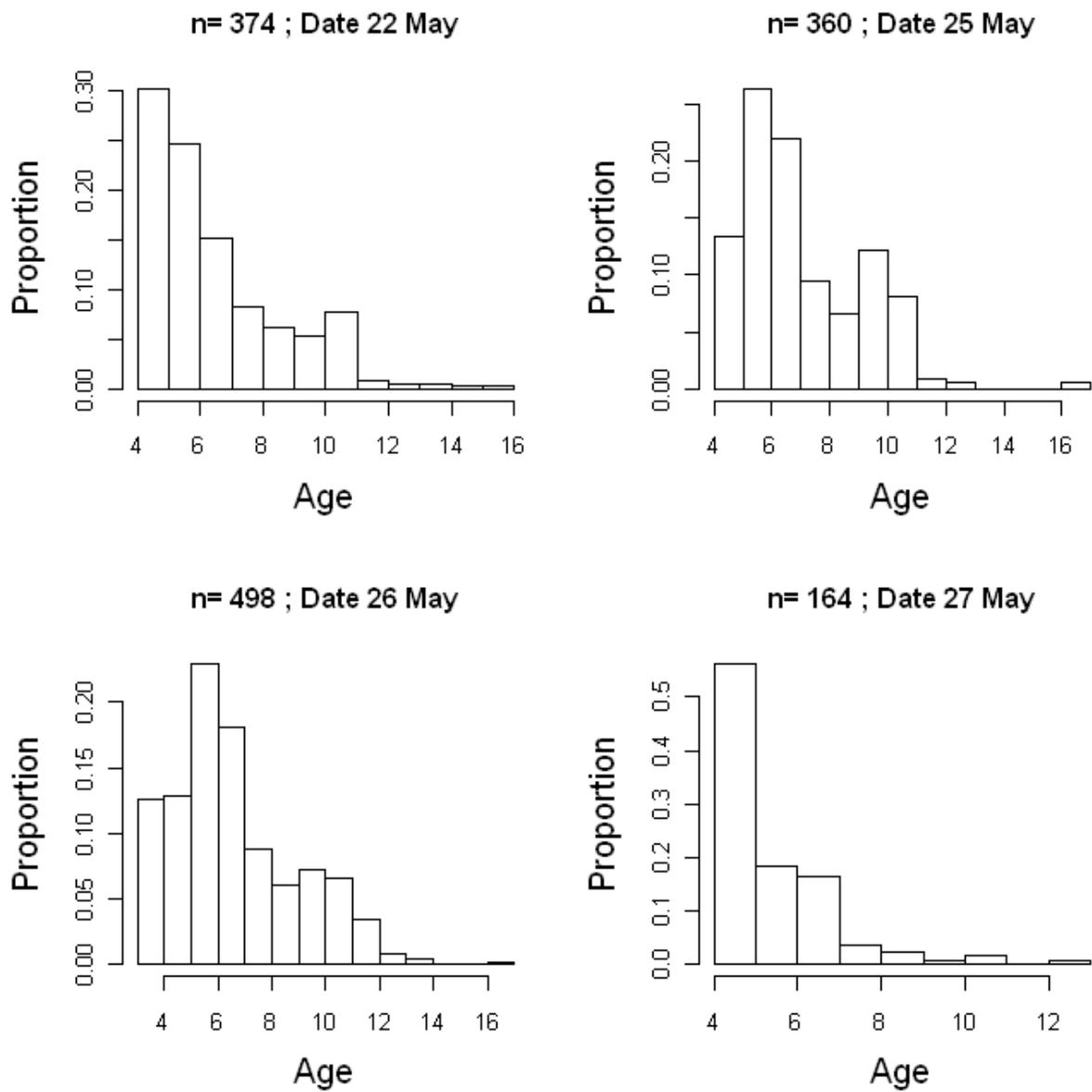


Figure 7.–Age composition of samples taken from the Hagemeister subdistrict, Togiak District, 2008.

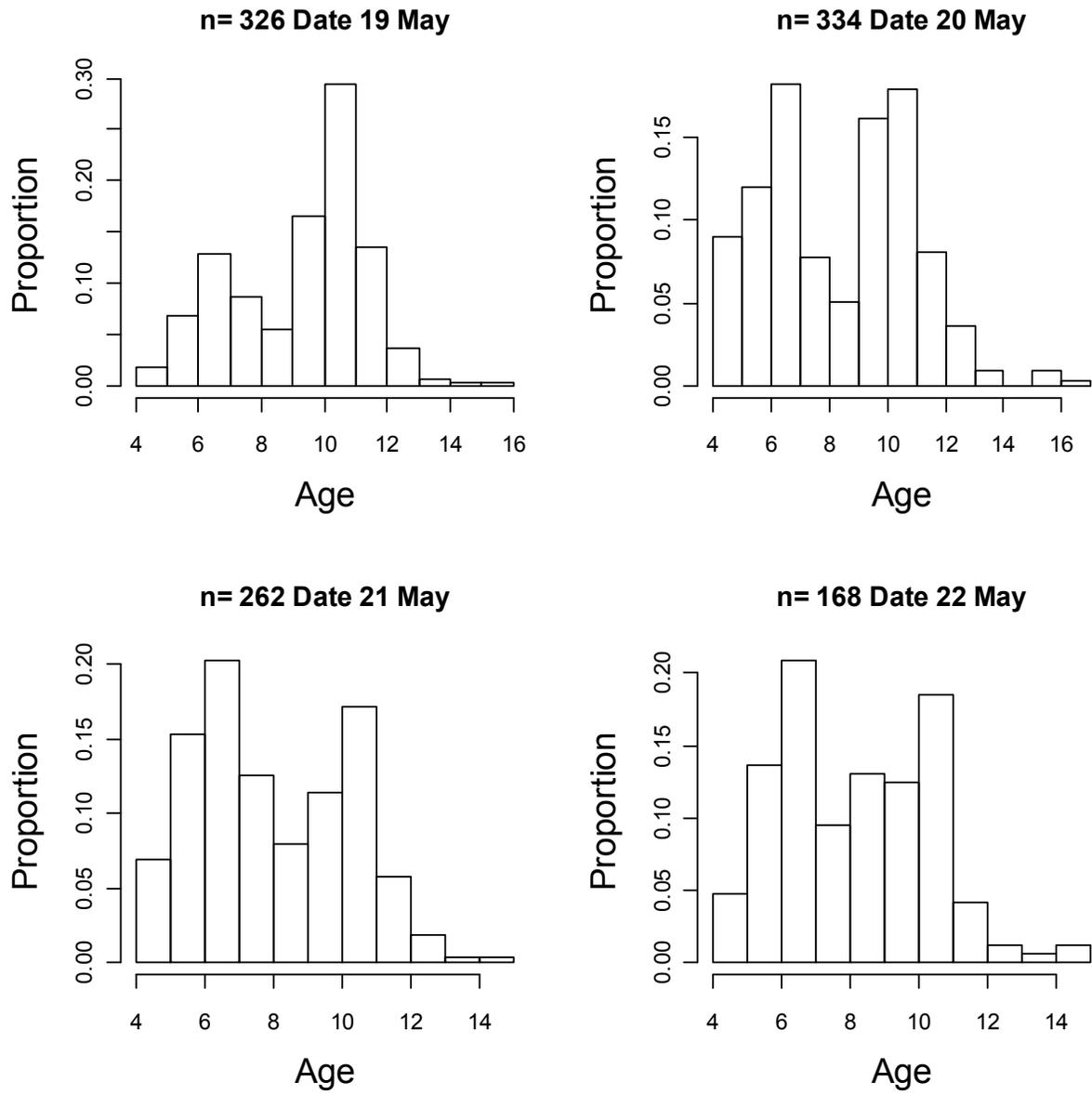


Figure 8.—Age composition of samples taken from the Nunavachak subdistrict, Togiak District, 2008.

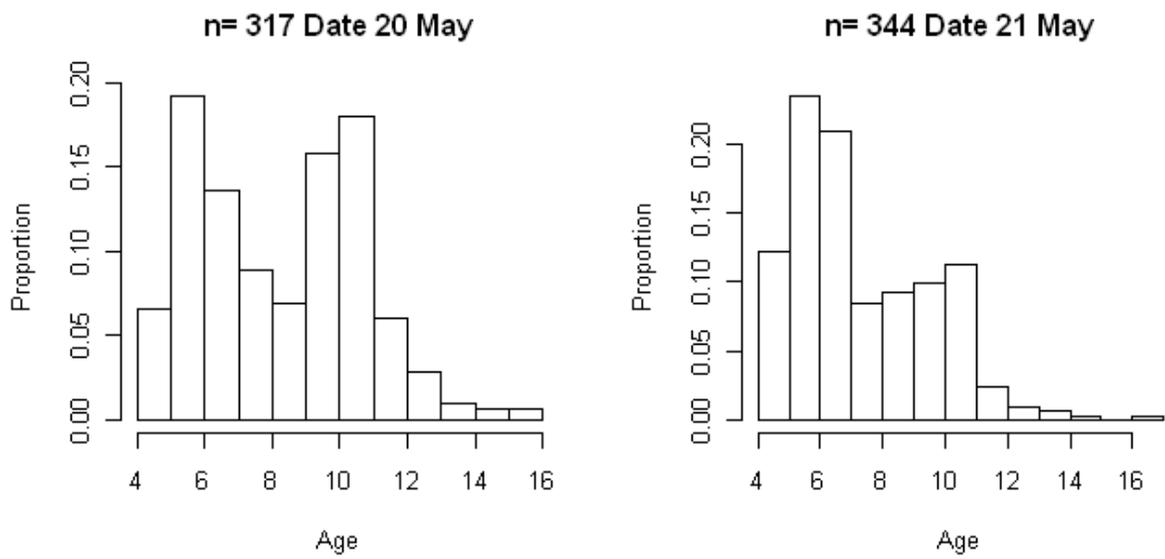


Figure 9.—Age composition of samples taken from the Pyrite Point subdistrict, Togiak District, 2008.

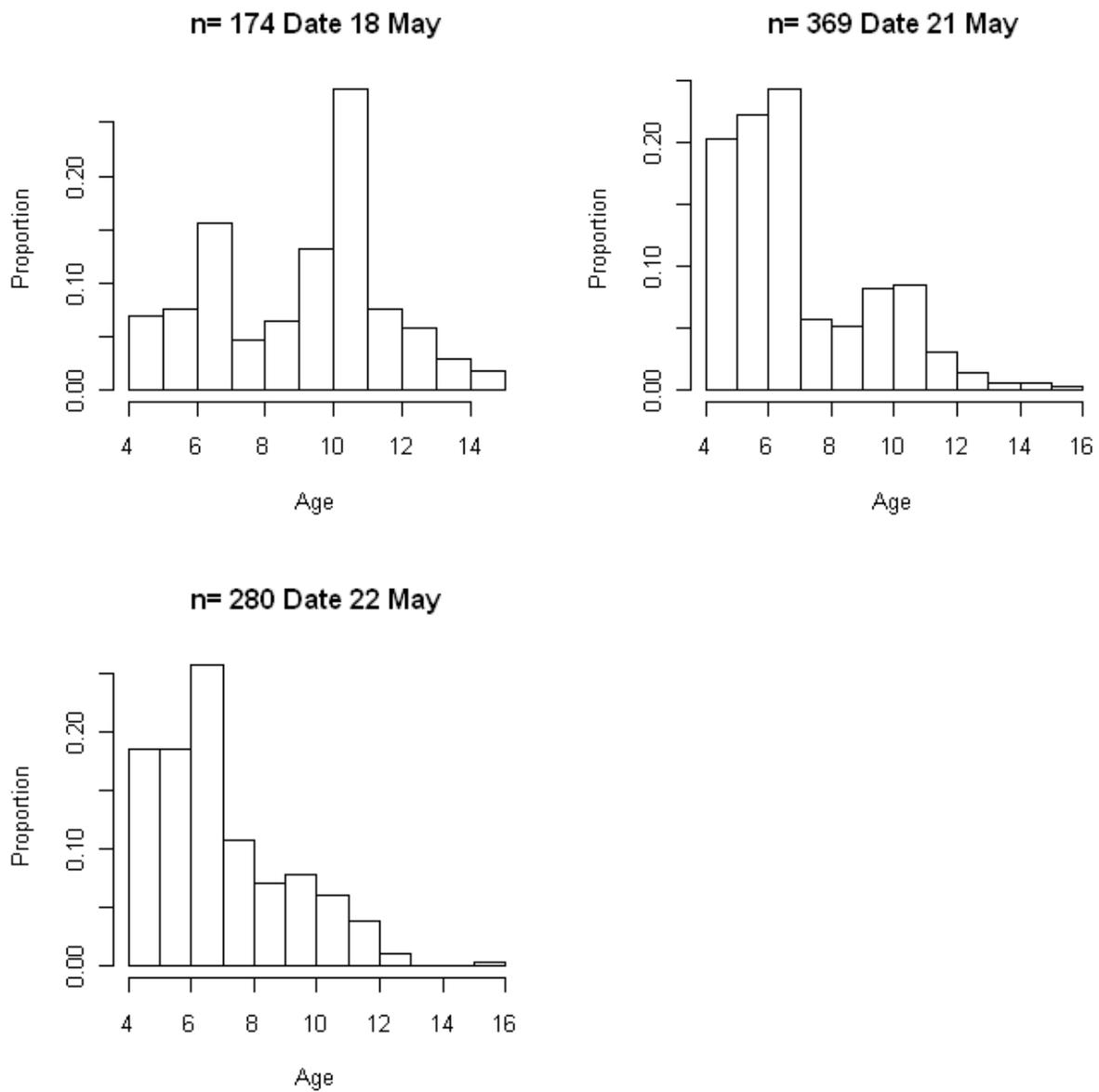


Figure 10.–Age composition of samples taken from the Togiak subdistrict, Togiak District, 2008.

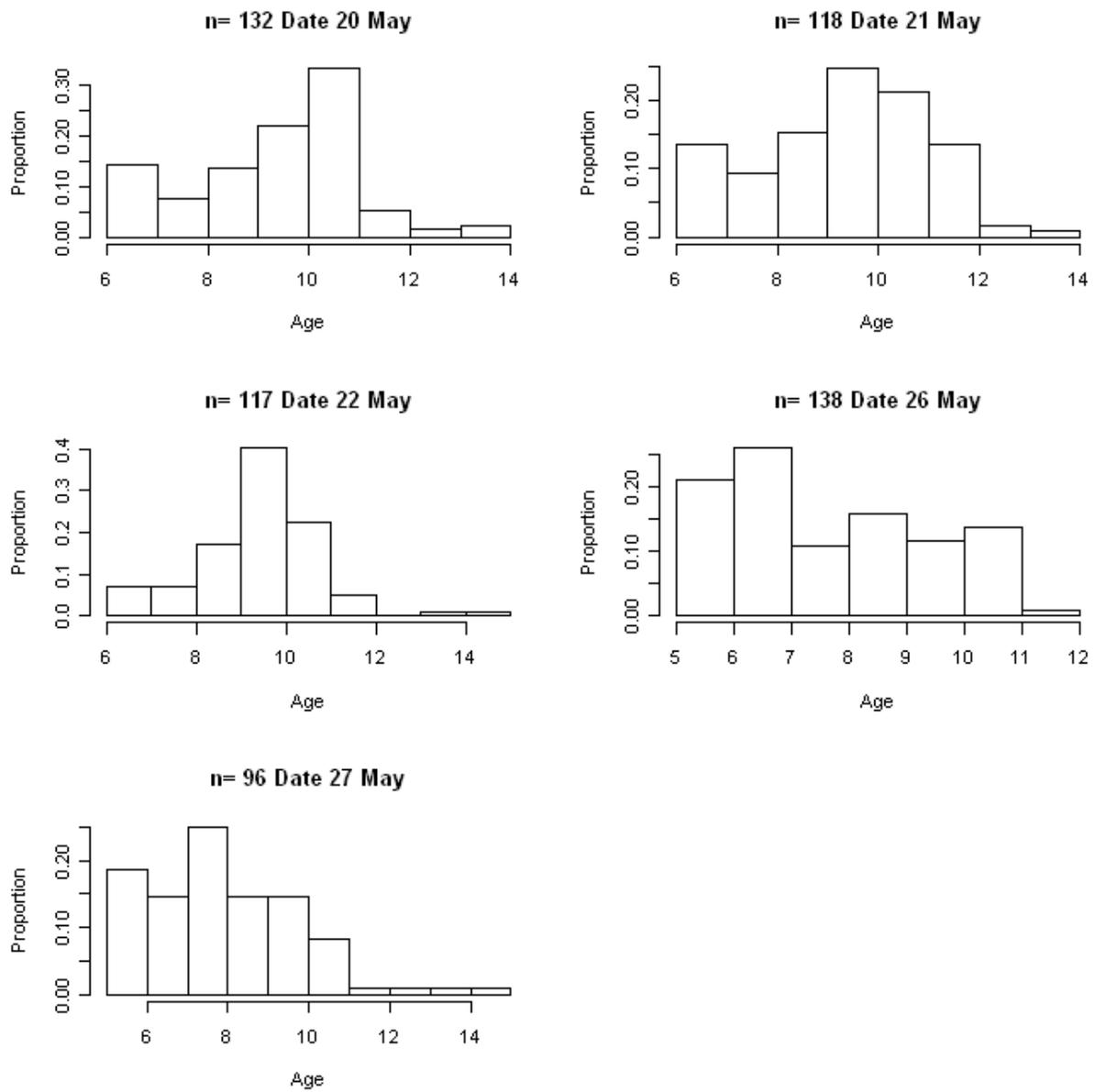


Figure 11.–Age composition of samples taken from the Kulukak subdistrict, Togiak District, 2008.

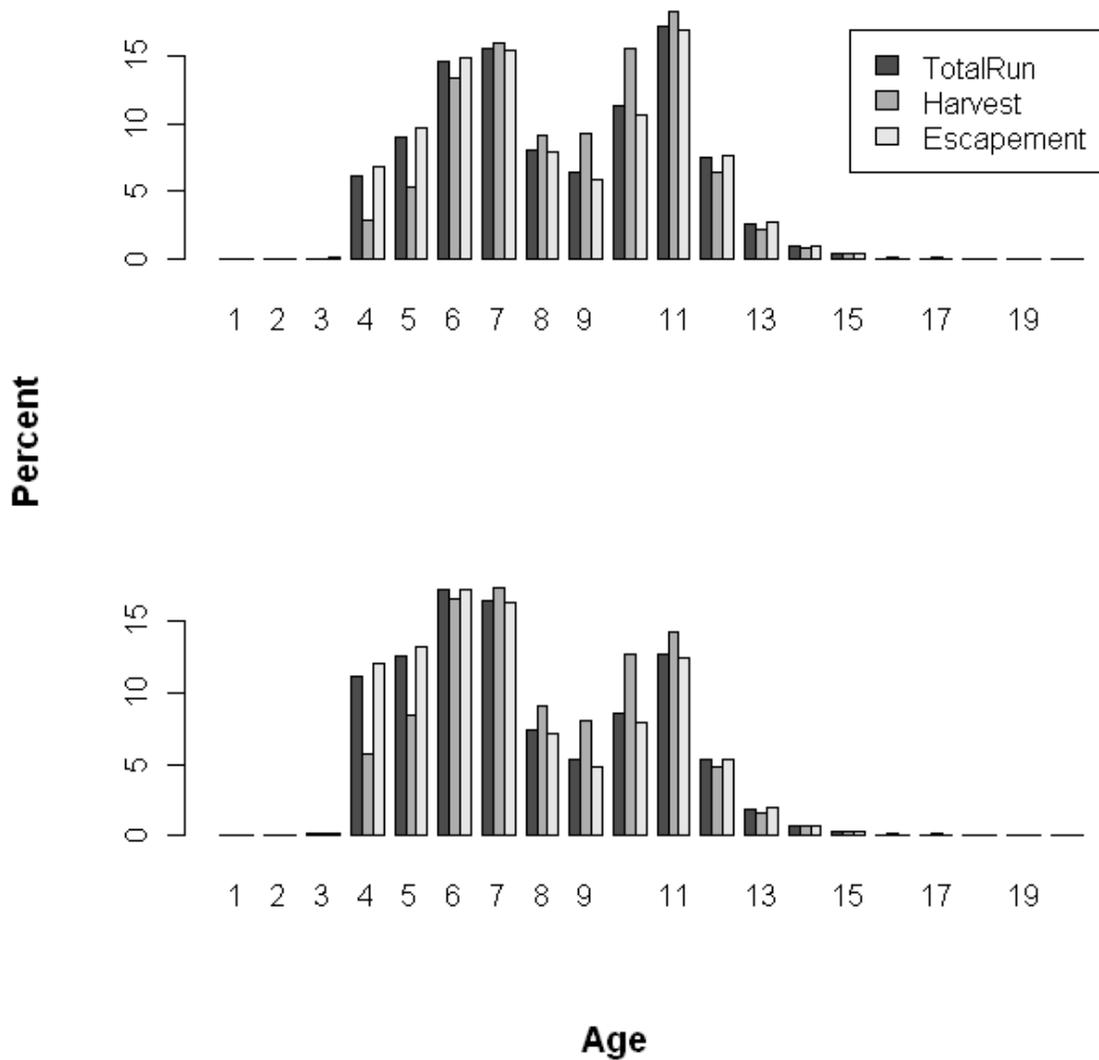


Figure 12.—Age composition of total run, harvest and escapement by biomass (top) and numbers of fish (bottom), Togiak District, 2008.

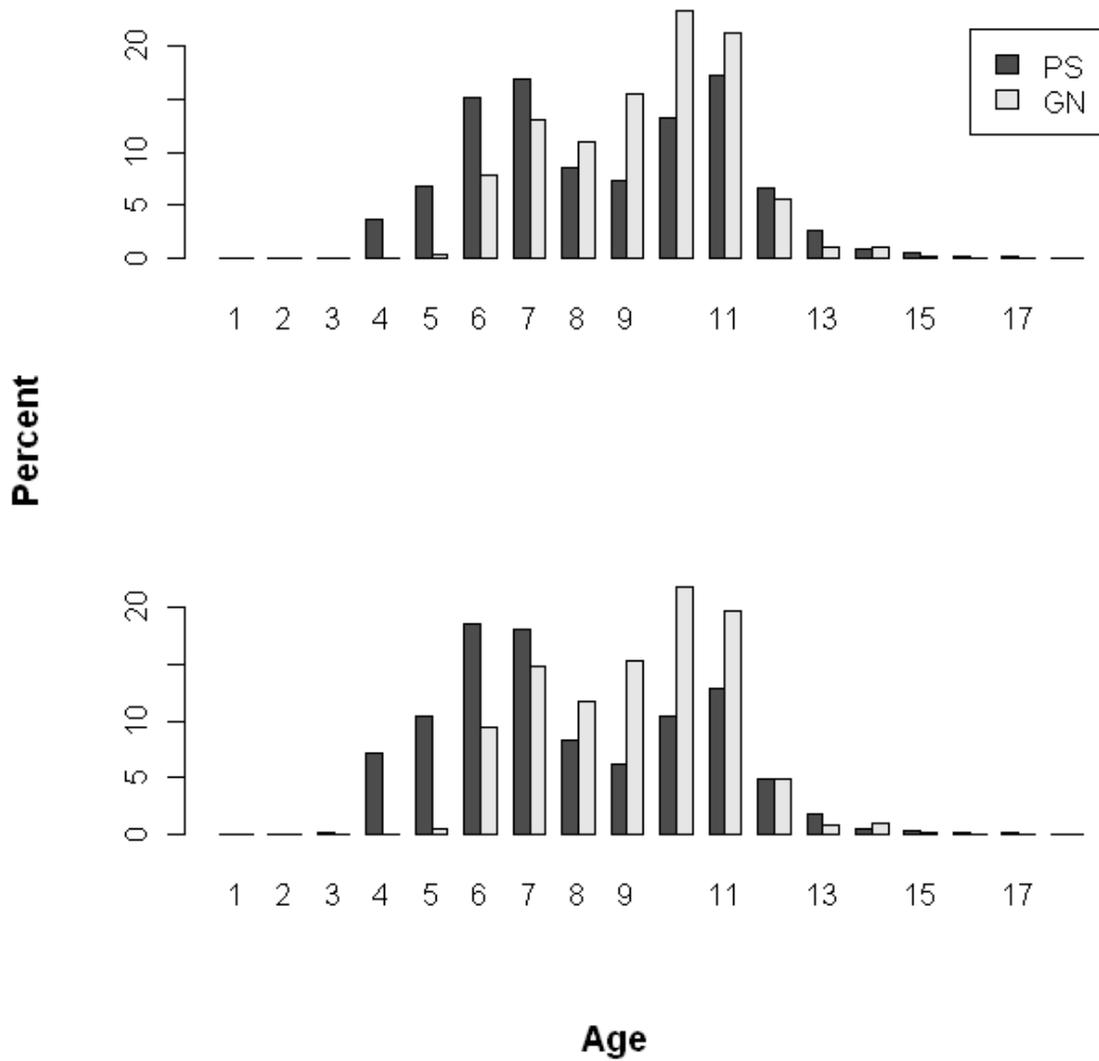


Figure 13.—Percent age composition of the commercial harvest by gear type (Purse Seine=PS, Gillnet=GN) by biomass (top) and by numbers of fish (bottom), Togiak District, 2008.

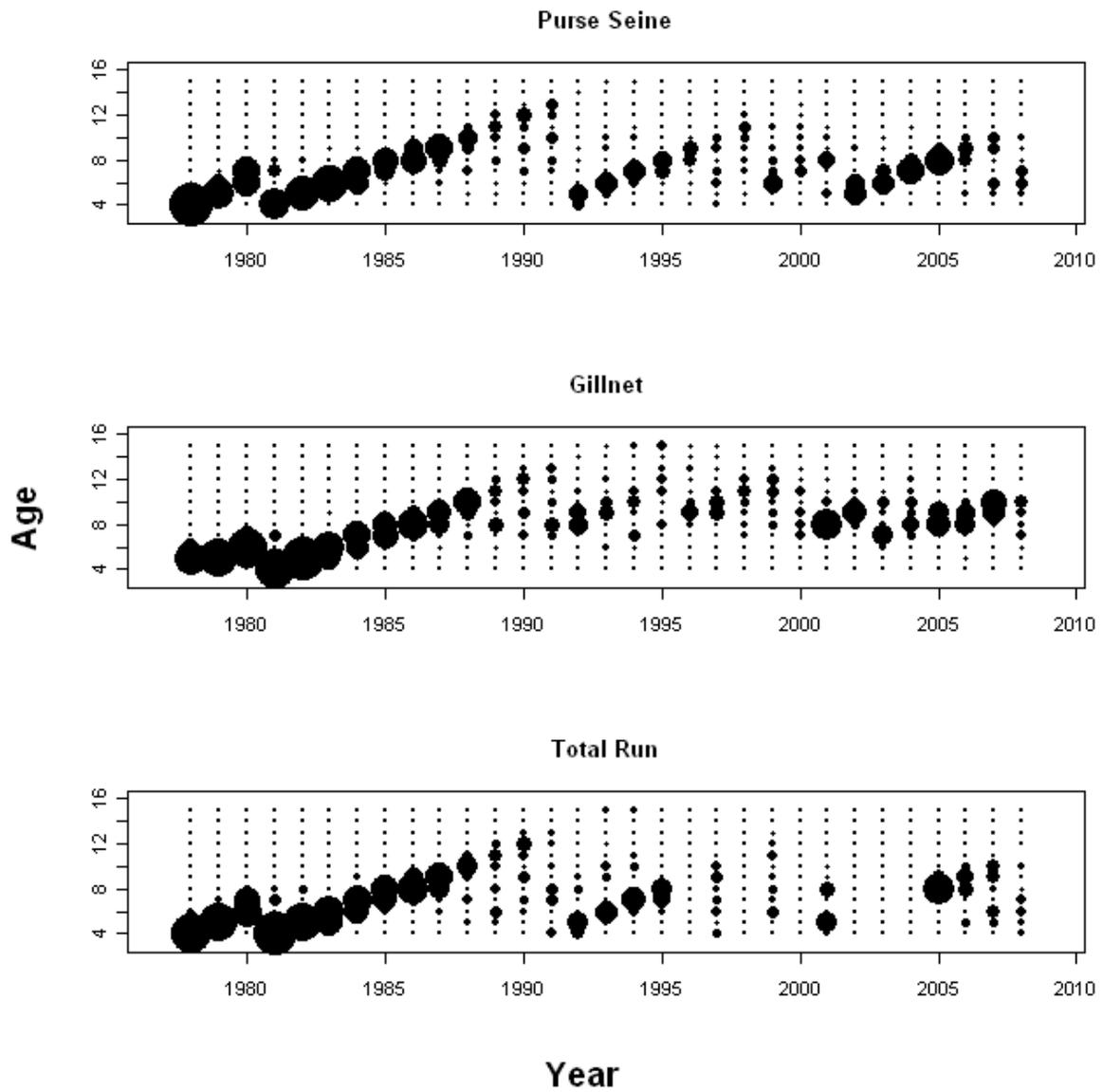


Figure 14.—Relative age class contribution to the purse seine harvest, gillnet harvest and total run, Togiak District, Bristol Bay, 1977–2008.

APPENDIX A

Appendix A1.—Estimated age composition of the total herring run, by aerial survey date, Togiak District, 2008.

Survey Date 5/18/08				Survey Date 5/28/08			
Index Section(s): TOG/TNG				Index Section(s): NUK/UGL/TOG/TNG/MTG/OSK/PYR			
Survey Biomass: 53,938				Survey Biomass: 82,557			
Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)
1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0
3	0	0.0	0	3	2	0.3	772
4	2	0.4	457	4	106	16.0	40,920
5	16	3.2	3,654	5	111	16.8	42,850
6	35	7.0	7,993	6	144	21.8	55,589
7	69	13.8	15,759	7	117	17.7	45,166
8	36	7.2	8,222	8	50	7.6	19,302
9	29	5.8	6,623	9	34	5.1	13,125
10	77	15.4	17,586	10	37	5.6	14,283
11	145	29.0	33,116	11	36	5.4	13,897
12	57	11.4	13,018	12	17	2.6	6,563
13	22	4.4	5,024	13	5	0.8	1,930
14	7	1.4	1,599	14	2	0.3	772
15	4	0.8	914	15	0	0.0	0
16	1	0.2	228	16	0	0.0	0
17	0	0.0	0	17	1	0.2	0
18	0	0.0	0	18	0	0.0	0
19	0	0.0	0	19	0	0.0	0
20	0	0.0	0	20	0	0.0	0
Total	500	100.0	114,193	Total	662	100.0	255,168
Percent Weighted by				Percent Weighted by			
Age	Weight	Weight	Biomass	Age	Weight	Weight	Biomass
1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0
3	0	0.0	0	3	328	0.2	140
4	496	0.2	125	4	19,585	10.1	8,334
5	4,239	2.0	1,067	5	26,470	13.6	11,264
6	11,272	5.3	2,838	6	40,056	20.6	17,045
7	23,949	11.2	6,029	7	35,541	18.3	15,124
8	13,304	6.2	3,349	8	18,104	9.3	7,704
9	12,078	5.6	3,041	9	13,336	6.9	5,675
10	35,148	16.4	8,848	10	15,590	8.0	6,634
11	68,442	31.9	17,230	11	14,388	7.4	6,122
12	27,430	12.8	6,905	12	7,854	4.0	3,342
13	11,446	5.3	2,882	13	1,796	0.9	764
14	3,689	1.7	929	14	964	0.5	410
15	2,196	1.0	553	15	0	0.0	0
16	564	0.3	142	16	0	0.0	0
17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0
19	0	0.0	0	19	0	0.0	0
20	0	0.0	0	20	0	0.0	0
Total	214,253	100.0	53,938	Total	194,012	100.0	82,557

Appendix A2.—Estimated age composition of the commercial purse seine harvest, by date and fishing section, Togiak District, 2008.

Sample Date(s) 16-19 May Section(s): Hag/Nun/Tog Harvest Biomass: 3,216				Sample Date(s) 20-22 May Section(s): Nun Harvest Biomass: 4,042				Sample Date(s) 20-22 May Section(s): Tog/Hag/PyPt Harvest Biomass: 1,196			
Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)
1	0	0.0	0	1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0	2	0	0.0	0
3	0	0.0	0	3	0	0.0	0	3	0	0.0	0
4	2	0.4	27	4	19	1.8	173	4	46	4.6	155
5	16	3.2	218	5	58	5.4	528	5	123	12.4	413
6	35	7.0	477	6	164	15.2	1,492	6	215	21.7	723
7	69	13.8	939	7	192	17.8	1,747	7	234	23.6	786
8	36	7.2	490	8	103	9.5	937	8	80	8.1	269
9	29	5.8	395	9	82	7.6	746	9	71	7.2	239
10	77	15.4	1,048	10	155	14.3	1,410	10	86	8.7	289
11	145	29.0	1,974	11	193	17.9	1,756	11	87	8.8	292
12	57	11.4	776	12	68	6.3	619	12	30	3.0	101
13	22	4.4	300	13	28	2.6	255	13	11	1.1	37
14	7	1.4	95	14	8	0.7	73	14	4	0.4	13
15	4	0.8	54	15	8	0.7	73	15	3	0.3	10
16	1	0.2	14	16	3	0.3	27	16	3	0.3	10
17	0	0.0	0	17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0	18	0	0.0	0
Total	500	100	6,808	Total	1081	100	9,833	Total	993	100	3,337
Percent Weighted by				Percent Weighted by				Percent Weighted by			
Age	Weight	Weight	Biomass	Age	Weight	Weight	Biomass	Age	Weight	Weight	Biomass
1	0	0.0	0	1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0	2	0	0.0	0
3	0	0.0	0	3	0	0.0	0	3	0	0.0	0
4	496	0.2	7	4	3,930	1.0	39	4	8,719	2.7	32
5	4,239	2.0	64	5	14,642	3.6	147	5	28,555	8.8	106
6	11,272	5.3	169	6	48,316	12.0	484	6	62,295	19.3	231
7	23,949	11.2	359	7	62,328	15.5	625	7	74,035	22.9	274
8	13,304	6.2	200	8	36,571	9.1	367	8	26,967	8.4	100
9	12,078	5.6	181	9	32,517	8.1	326	9	27,161	8.4	101
10	35,148	16.4	528	10	64,739	16.1	649	10	35,343	10.9	131
11	68,442	31.9	1,027	11	85,822	21.3	861	11	36,991	11.5	137
12	27,430	12.8	412	12	31,423	7.8	315	12	12,985	4.0	48
13	11,446	5.3	172	13	13,415	3.3	135	13	5,085	1.6	19
14	3,689	1.7	55	14	3,754	0.9	38	14	2,028	0.6	8
15	2,196	1.0	33	15	4,193	1.0	42	15	1,412	0.4	5
16	564	0.3	8	16	1,452	0.4	15	16	1,212	0.4	4
17	0	0.0	0	17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0	18	0	0.0	0
Total	214,253	100.0	3,216	Total	403,102	100	4,042	Total	322,786	100	1,196

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Appendix A2.–Page 2 of 2.

Sample Date(s) 25-26 May				Sample Date(s) 27-30 May			
Section(s): Hag/PyPt				Section(s): CN/Hag/Nun/PyPt/Tog			
Harvest Biomass: 3,673				Harvest Biomass: 3,566			
Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)
1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0
3	2	0.2	24	3	2	0.3	37
4	67	7.8	809	4	106	16.0	1,982
5	106	12.4	1,281	5	111	16.8	2,076
6	209	24.4	2,525	6	144	21.8	2,693
7	169	19.7	2,042	7	117	17.7	2,188
8	78	9.1	942	8	50	7.6	935
9	54	6.3	652	9	34	5.1	636
10	80	9.3	967	10	37	5.6	692
11	62	7.2	749	11	36	5.4	673
12	20	2.3	242	12	17	2.6	318
13	6	0.7	72	13	5	0.8	94
14	2	0.2	24	14	2	0.3	37
15	0	0.0	0	15	0	0.0	0
16	0	0.0	0	16	0	0.0	0
17	3	0.3	36	17	1	0.2	19
18	0	0.0	0	18	0	0.0	0
Total	858	100	10,366	Total	662	100	12,380

Age	Weight	Percent Weighted by		Age	Weight	Percent Weighted by	
		Weight	Biomass			Weight	Biomass
1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0
3	328	0.1	4	3	328	0.2	7
4	11,677	4.2	156	4	17,429	10.1	359
5	25,220	9.1	336	5	20,506	11.9	423
6	59,926	21.7	798	6	33,720	19.5	695
7	53,891	19.5	718	7	32,535	18.8	671
8	27,686	10.0	369	8	15,338	8.9	316
9	21,588	7.8	288	9	12,308	7.1	254
10	33,920	12.3	452	10	14,563	8.4	300
11	27,090	9.8	361	11	14,970	8.7	309
12	9,285	3.4	124	12	7,412	4.3	153
13	2,702	1.0	36	13	2,396	1.4	49
14	964	0.3	13	14	898	0.5	19
15	0	0.0	0	15	0	0.0	0
16	0	0.0	0	16	0	0.0	0
17	1,481	0.5	20	17	567	0.3	12
18	0	0.0	0	18	0	0.0	0
Total	275,758	100	3,673	Total	172,970	100	3,566

Appendix A3.–Estimated age composition of the commercial gillnet harvest, by date and fishing section, Togiak District, 2008.

Sample Date(s) 16-22 May				Sample Date(s) 26-30 May			
Section(s): Kul				Section(s): Kul			
Harvest Biomass: 2,867				Harvest Biomass: 1,964			
Age	No.	Percent by No.	Numbers (x1,000)	Age	No.	Percent by No.	Numbers (x1,000)
1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0
3	0	0.0	0	3	0	0.0	0
4	0	0.0	0	4	0	0.0	0
5	0	0.0	0	5	3	1.3	61
6	8	2.2	133	6	44	18.8	891
7	35	9.5	582	7	50	21.4	1,013
8	29	7.9	483	8	39	16.7	790
9	56	15.3	932	9	36	15.4	729
10	105	28.6	1,747	10	30	12.8	608
11	95	25.9	1,581	11	27	11.5	547
12	29	7.9	483	12	2	0.9	41
13	4	1.1	67	13	1	0.4	20
14	5	1.4	83	14	1	0.4	20
15	1	0.3	17	15	1	0.4	0
16	0	0.0	0	16	0	0.0	0
17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0
Total	367	100.0	6,107	Total	234	100.0	4,718
Percent Weighted by				Percent Weighted by			
Age	Weight	Weight	Biomass	Age	Weight	Weight	Biomass
1	0	0.0	0	1	0	0.0	0
2	0	0.0	0	2	0	0.0	0
3	0	0.0	0	3	0	0.0	0
4	0	0.0	0	4	0	0.0	0
5	0	0.0	0	5	990	1.1	22
6	2,860	1.8	52	6	14,683	16.7	328
7	13,072	8.4	240	7	17,370	19.7	388
8	11,184	7.2	205	8	14,622	16.6	326
9	23,436	15.0	430	9	14,250	16.2	318
10	45,872	29.3	841	10	12,686	14.4	283
11	41,965	26.8	770	11	11,400	13.0	254
12	13,244	8.5	243	12	1,055	1.2	24
13	2,008	1.3	37	13	508	0.6	11
14	2,166	1.4	40	14	437	0.5	10
15	523	0.3	10	15	0	0.0	0
16	0	0.0	0	16	0	0.0	0
17	0	0.0	0	17	0	0.0	0
18	0	0.0	0	18	0	0.0	0
Total	156,330	100.0	2,867	Total	88,001	100.0	1,964

APPENDIX B

Appendix B1.—Age, sex and size composition of Pacific herring caught by commercial purse seine, Hagemeister Section, 22, 25, 26 and 27 May, 2008.

Sample Dates	Sex (number)						Weight				Length			
	Age	Male	Female	Unknown	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	
22-May	4	28	22	1	51	13.6	1.8	172	48.3	51	233	15.6	51	
	5	26	35	1	62	16.6	1.9	218	39.3	62	250	12.8	62	
	6	53	38	1	92	24.6	2.2	267	52.9	92	265	15.4	92	
	7	28	29	0	57	15.2	1.9	310	45.2	57	278	11.7	57	
	8	13	18	0	31	8.3	1.4	344	69.4	31	287	15.3	31	
	9	17	5	1	23	6.1	1.2	391	60.8	23	301	11.2	23	
	10	8	12	0	20	5.3	1.2	430	60.4	20	309	9.2	20	
	11	13	16	0	29	7.8	1.4	428	47.9	29	308	11.6	29	
	12	1	2	0	3	0.8	0.5	504	94.8	3	321	18.6	3	
	13	2	0	0	2	0.5	0.4	467	63.3	2	316	24.7	2	
	14	0	2	0	2	0.5	0.4	467	84.5	2	318	8.5	2	
	15	1	0	0	1	0.3	0.3	517	0.0	1	331	0.0	1	
	16	0	1	0	1	0.3	0.3	631	0.0	1	350	0.0	1	
	Sample Total		190	180	4	374	100.0		293	100.5	374	271	28.3	374
	25-May	4	5	1	0	6	1.7	0.7	167	20.1	6	233	7.6	6
		5	19	23	0	42	11.7	1.7	250	41.6	42	260	12.0	42
6		36	57	2	95	26.4	2.3	296	45.5	95	273	12.4	95	
7		32	45	2	79	21.9	2.2	329	45.2	79	283	10.9	79	
8		12	19	3	34	9.4	1.5	351	43.6	34	289	11.7	34	
9		5	16	3	24	6.7	1.3	407	59.3	24	305	12.8	24	
10		13	29	2	44	12.2	1.7	424	57.1	44	309	11.4	44	
11		14	11	4	29	8.1	1.4	438	50.2	29	312	9.8	29	
12		1	2	0	3	0.8	0.5	477	38.8	3	312	5.0	3	
13		1	1	0	2	0.6	0.4	453	51.3	2	335	8.5	2	
17	1	0	1	2	0.6	0.4	457	5.3	2	336	1.4	2		
Sample Total		139	204	17	360	100.0		338	80.2	360	285	22.0	360	

-continued-

Sample Dates	Age	Sex (number)				% of Total	SE	Weight			Length		
		Male	Female	Unknown	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
26 May	3	1	1	0	2	0.4	0.3	164	8.1	2	233	4.2	2
	4	36	25	0	61	12.2	1.5	175	42.1	61	237	14.3	61
	5	23	41	0	64	12.9	1.5	230	52.5	64	255	16.4	64
	6	55	58	1	114	22.9	1.9	279	54.7	114	271	16.3	114
	7	37	52	1	90	18.1	1.7	310	53.6	90	279	16.9	90
	8	25	19	0	44	8.8	1.3	358	57.4	44	294	15.2	44
	9	11	19	0	30	6.0	1.1	394	73.9	30	301	19.9	30
	10	13	23	0	36	7.2	1.2	424	68.5	36	308	16.8	36
	11	19	14	0	33	6.6	1.1	436	66.1	33	314	13.6	33
	12	7	10	0	17	3.4	0.8	462	79.5	17	318	14.0	17
	13	1	3	0	4	0.8	0.4	449	88.2	4	317	23.2	4
	14	2	0	0	2	0.4	0.3	482	96.5	2	320	25.5	2
	17	1	0	0	1	0.2	0.2	567	0.0	1	339	0.0	1
	Sample Total		194	239	2	498	100.0		309	102.2	498	278	29.0
27 May	4	24	21	0	45	27.4	3.5	165	33.2	45	237	13.7	45
	5	19	26	2	47	28.7	3.5	198	34.4	47	251	12.8	47
	6	15	15	0	30	18.3	3.0	250	55.1	30	265	17.0	30
	7	13	13	1	27	16.5	2.9	275	69.4	27	276	17.6	27
	8	3	3	0	6	3.7	1.5	283	63.6	6	277	19.9	6
	9	0	4	0	4	2.4	1.2	392	102.6	4	306	19.3	4
	10	1	0	0	1	0.6	0.6	379	0.0	1	304	0.0	1
11	2	1	0	3	1.8	1.0	326	159.7	3	283	50.6	3	
13	0	1	0	1	0.6	0.6	548	0.0	1	343	0.0	1	
Sample Total		77	84	3	164	100		225	77.9	164	258	24.2	164

Appendix B2.–Age, sex and size composition of Pacific herring caught by commercial purse seine, Nunavachak Section, 19, 20, 21 and 22 May, 2008.

Sample Dates	Age	Sex (number)					SE	Weight			Length		
		Male	Female	Unknown	Total	% of Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
19-May	4	0	1	0	1	0.3	0.3	207	0.0	1	246	0.0	1
	5	4	1	0	5	1.5	0.7	267	54.4	5	265	12.4	5
	6	9	13	0	22	6.7	1.4	315	31.5	22	276	7.6	22
	7	19	23	0	42	12.9	1.9	342	31.9	42	285	7.8	42
	8	14	14	0	28	8.6	1.6	370	44.4	28	292	13.5	28
	9	9	9	0	18	5.5	1.3	418	51.2	18	300	8.6	18
	10	23	31	0	54	16.6	2.1	449	50.2	54	308	10.8	54
	11	46	50	0	96	29.4	2.5	471	52.5	96	313	9.5	96
	12	27	17	0	44	13.5	1.9	481	49.0	44	317	9.0	44
	13	5	7	0	12	3.7	1.0	503	44.7	12	321	9.8	12
	14	1	1	0	2	0.6	0.4	537	96.5	2	331	4.9	2
15	1	0	0	1	0.3	0.3	513	0.0	1	315	0.0	1	
16	0	1	0	1	0.3	0.3	564	0.0	1	336	0.0	1	
Sample Total		158	168	0	326	100.0		428	78.7	326	304	17.6	326
20-May	4	7	3	0	10	3.0	0.9	216	99.3	10	241	7.9	10
	5	15	5	0	20	6.0	1.3	245	48.3	20	257	10.7	20
	6	21	19	0	40	12.0	1.8	301	42.1	40	275	12.3	40
	7	29	29	3	61	18.3	2.1	333	53.1	61	284	11.7	61
	8	14	12	0	26	7.8	1.5	349	46.5	26	287	10.9	26
	9	8	9	0	17	5.1	1.2	422	78.3	17	309	13.8	17
	10	28	26	0	54	16.2	2.0	426	55.3	54	307	9.5	54
	11	33	27	0	60	18.0	2.1	471	62.4	60	315	10.5	60
	12	11	16	0	27	8.1	1.5	479	72.8	27	319	12.2	27
	13	8	4	0	12	3.6	1.0	485	78.7	12	321	10.1	12
	14	2	1	0	3	0.9	0.5	484	32.3	3	326	14.5	3
16	0	2	1	3	0.9	0.5	532	84.7	3	335	8.5	3	
17	1	0	0	1	0.3	0.3	466	0.0	1	324	0.0	1	
Sample Total		177	153	4	334	100.0		387	99.9	334	296	23.7	334

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Sample Dates	Age	Sex (number)				% of Total	SE	Weight			Length			
		Male	Female	Unknown	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	
21 May	4	1	1	1	3	1.1	0.7	192	41.5	3	240	8.5	3	
	5	9	6	0	15	5.7	1.4	256	52.4	15	261	13.7	15	
	6	22	18	0	40	15.3	2.2	276	48.5	40	270	13.5	40	
	7	33	19	1	53	20.2	2.5	308	47.9	53	279	12.6	53	
	8	15	18	0	33	12.6	2.1	357	51.1	33	291	12.3	33	
	9	8	13	0	21	8.0	1.7	398	83.6	21	304	17.3	21	
	10	9	20	1	30	11.5	2.0	416	61.0	30	306	11.9	30	
	11	23	21	1	45	17.2	2.3	422	58.7	45	308	13.8	45	
	12	10	5	0	15	5.7	1.4	424	52.3	15	310	11.3	15	
	13	4	1	0	5	1.9	0.8	487	53.0	5	320	19.2	5	
	14	1	0	0	1	0.4	0.4	471	0.0	1	317	0.0	1	
	15	0	1	0	1	0.4	0.4	465	0.0	1	313	0.0	1	
	Sample Total		135	123	4	262	100.0		355	85.8	262	290	21.8	262
	22 May	4	1	1	0	2	0.0	0.1	199	4.9	2	242	16.3	2
		5	4	2	0	6	0.0	0.1	242	25.4	6	258	10.0	6
6		16	7	0	23	0.1	0.3	283	32.2	23	272	8.5	23	
7		22	13	0	35	0.2	0.4	320	43.9	35	281	11.6	35	
8		12	4	0	16	0.1	0.2	333	65.3	16	290	15.1	16	
9		11	10	1	22	0.1	0.3	372	62.8	22	297	15.6	22	
10		11	10	0	21	0.1	0.3	405	42.4	21	306	7.9	21	
11		18	13	0	31	0.2	0.3	415	47.8	31	311	9.8	31	
12		3	4	0	7	0.0	0.2	468	41.9	7	313	9.1	7	
13		2	0	0	2	0.0	0.1	366	72.8	2	306	21.2	2	
14		0	1	0	1	0.0	0.1	370	0.0	1	293	0.0	1	
15		0	2	0	2	0.0	0.1	500	9.5	2	326	3.5	2	
Sample Total			100	67	1	168	1.0		356	75.6	168	292	20.0	168

Appendix B3.—Age, sex and size composition of Pacific herring caught by commercial purse seine, Pyrite Point Section, 20 and 21 May, 2008.

Sample Dates	Sex (number)						Weight			Length				
	Age	Male	Female	Unknown	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	
20 May	4	3	1	0	4	0.0	0.1	199	19.0	4	245	5.1	4	
	5	10	7	0	17	0.1	0.1	255	24.3	17	260	6.9	17	
	6	32	29	0	61	0.2	0.2	307	31.9	61	274	8.5	61	
	7	16	24	3	43	0.1	0.2	337	41.5	43	283	10.2	43	
	8	14	14	0	28	0.1	0.2	371	44.8	28	291	9.5	28	
	9	16	6	0	22	0.1	0.1	401	82.1	22	298	19.6	22	
	10	22	28	0	50	0.2	0.2	415	74.1	50	302	17.7	50	
	11	23	33	1	57	0.2	0.2	451	47.5	57	310	10.4	57	
	12	10	9	0	19	0.1	0.1	466	53.7	19	313	8.4	19	
	13	6	3	0	9	0.0	0.1	492	41.0	9	321	14.2	9	
	14	2	1	0	3	0.0	0.1	487	32.8	3	318	8.5	3	
	15	2	0	0	2	0.0	0.0	566	17.0	2	331	5.7	2	
	16	1	1	0	2	0.0	0.0	493	32.2	2	330	0.0	2	
	Sample Total		157	156	4	317	1.0		381	86.3	317	293	21.1	317
	21 May	4	10	3	0	13	0.0	0.1	195	63.8	13	242	21.1	13
		5	12	17	0	29	0.1	0.2	235	51.6	29	256	14.3	29
6		28	50	3	81	0.2	0.3	296	38.6	81	273	10.0	81	
7		32	40	0	72	0.2	0.2	325	45.0	72	281	11.8	72	
8		13	16	0	29	0.1	0.2	356	39.1	29	290	10.2	29	
9		17	15	0	32	0.1	0.2	393	52.2	32	301	13.6	32	
10		16	18	0	34	0.1	0.2	411	55.7	34	306	12.6	34	
11		17	22	0	39	0.1	0.2	443	59.0	39	309	10.8	39	
12		5	3	0	8	0.0	0.1	451	50.6	8	316	10.0	8	
13		1	2	0	3	0.0	0.1	466	102.5	3	320	11.6	3	
14		2	0	0	2	0.0	0.0	551	42.1	2	333	0.0	2	
15	1	0	0	1	0.0	0.0	527	0.0	1	329	0.0	1		
17	1	0	0	1	0.0	0.0	451	0.0	1	315	0.0	1		
Sample Total		155	186	3	344	1.0		343	85.8	344	285	22.5	344	

Appendix B4.–Age, sex and size composition of Pacific herring caught by commercial purse seine, Togiak Section, 18, 21 and 22 May, 2008.

Sample Dates	Age	Sex (number)					SE	Weight			Length		
		Male	Female	Unknown	Total	% of Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
18 May	4	0	1	0	1	0.0	0.1	289	0.0	1	277	0.0	1
	5	9	2	0	11	0.1	0.2	264	49.1	11	263	10.3	11
	6	6	7	0	13	0.1	0.2	334	69.9	13	281	16.6	13
	7	17	10	0	27	0.2	0.3	355	36.3	27	286	7.5	27
	8	2	6	0	8	0.0	0.2	368	43.0	8	290	12.3	8
	9	6	5	0	11	0.1	0.2	414	49.2	11	302	10.4	11
	10	14	9	0	23	0.1	0.3	474	62.6	23	312	11.2	23
	11	28	21	0	49	0.3	0.4	474	72.6	49	312	11.9	49
	12	4	9	0	13	0.1	0.2	482	53.0	13	318	10.7	13
	13	3	7	0	10	0.1	0.2	541	77.0	10	324	10.0	10
	14	5	0	0	5	0.0	0.1	523	58.6	5	321	7.4	5
15	1	2	0	3	0.0	0.1	561	68.2	3	331	7.2	3	
Sample Total		95	79	0	174	1.0		430	96.9	174	303	20.4	174
21 May	4	13	11	0	24	0.1	0.1	188	25.6	24	238	7.3	24
	5	22	29	0	51	0.1	0.2	241	43.9	51	255	12.5	51
	6	34	47	1	82	0.2	0.2	285	50.8	82	270	13.8	82
	7	36	52	2	90	0.2	0.3	323	42.9	90	280	10.0	90
	8	6	15	0	21	0.1	0.1	343	46.8	21	285	12.4	21
	9	10	8	1	19	0.1	0.1	360	53.7	19	290	11.5	19
	10	17	10	3	30	0.1	0.1	413	70.7	30	306	14.1	30
	11	15	11	5	31	0.1	0.2	421	49.8	31	312	7.8	31
	12	5	5	1	11	0.0	0.1	430	67.1	11	312	15.4	11
	13	1	1	3	5	0.0	0.1	461	45.5	5	336	11.8	5
	14	2	0	0	2	0.0	0.0	463	15.9	2	334	7.1	2
15	2	0	0	2	0.0	0.0	442	63.3	2	327	9.9	2	
16	0	1	0	1	0.0	0.0	593	0.0	1	341	0.0	1	
Sample Total		163	190	16	369	1.0		320	85.5	369	279	24.9	369

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Sample Dates	Sex (number)						Weight			Length			
	Age	Male	Female	Unknown	Total	% of Total	SE	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
22 May	4	3	5	1	9	0.0	0.1	186	24.8	9	237	6.5	9
	5	20	23	0	43	0.2	0.2	219	53.1	43	250	17.1	43
	6	13	37	2	52	0.2	0.3	288	50.3	52	269	14.0	52
	7	28	43	1	72	0.3	0.3	300	51.8	72	275	12.7	72
	8	15	13	2	30	0.1	0.2	315	52.0	30	281	14.9	30
	9	12	7	1	20	0.1	0.2	387	55.9	20	299	10.4	20
	10	11	10	1	22	0.1	0.2	408	64.5	22	303	14.6	22
	11	9	6	2	17	0.1	0.1	391	74.8	17	304	18.4	17
	12	3	7	1	11	0.0	0.1	422	63.0	11	305	20.3	11
	13	2	0	1	3	0.0	0.1	461	41.3	3	321	13.1	3
16	0	1	0	1	0.0	0.0	620	0.0	1	331	0.0	1	
Sample Total		116	152	12	280	1.0		311	86.0	280	277	24.0	280

Appendix B5.–Age, sex and size composition of Pacific herring caught by commercial gillnet, Kulukak Section, 20, 21, 22, 26 and 27 May, 2008.

Sample Dates	Age	Sex (number)				% of Total	SE	Weight			Length		
		Male	Female	Unknown	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
20 May	6	1	3	0	4	0.0	0.2	351	32.5	4	286	12.0	4
	7	3	12	0	15	0.1	0.3	358	27.2	15	285	6.0	15
	8	3	7	0	10	0.1	0.2	382	44.6	10	298	12.5	10
	9	14	4	0	18	0.1	0.3	414	45.0	18	302	7.6	18
	10	13	16	0	29	0.2	0.4	439	41.1	29	310	11.2	29
	11	29	15	0	44	0.3	0.5	445	40.6	44	312	8.8	44
	12	3	4	0	7	0.1	0.2	476	35.1	7	320	5.9	7
	13	0	2	0	2	0.0	0.1	491	80.6	2	317	4.9	2
14	2	1	0	3	0.0	0.1	451	28.9	3	323	11.0	3	
Sample Total		68	64	0	132	1.0		424	52.6	132	306	13.5	132
21 May	6	1	1	0	2	0.0	0.1	334	36.8	2	286	9.2	2
	7	4	10	0	14	0.1	0.3	374	49.4	14	296	11.5	14
	8	5	6	0	11	0.1	0.3	396	49.3	11	300	14.1	11
	9	12	6	0	18	0.2	0.4	418	29.1	18	307	7.2	18
	10	12	17	0	29	0.2	0.5	454	58.6	29	313	9.7	29
	11	13	11	1	25	0.2	0.4	443	48.5	25	314	11.4	25
	12	8	8	0	16	0.1	0.3	453	40.1	16	314	7.6	16
	13	0	2	0	2	0.0	0.1	513	10.3	2	328	9.9	2
14	0	1	0	1	0.0	0.1	420	0.0	1	322	0.0	1	
Sample Total		55	62	1	118	1.0		430	56.2	118	309	12.4	118
22 May	6	1	1	0	2	0.0	0.1	394	55.5	2	288	8.5	2
	7	2	4	0	6	0.1	0.2	411	65.9	6	301	22.3	6
	8	6	2	0	8	0.1	0.2	376	57.7	8	299	15.2	8
	9	10	10	0	20	0.2	0.4	423	50.9	20	309	13.1	20
	10	23	24	0	47	0.4	0.6	425	45.0	47	309	11.3	47
	11	17	9	0	26	0.2	0.4	435	40.1	26	311	8.9	26
	12	4	2	0	6	0.1	0.2	444	42.6	6	314	9.8	6
	14	1	0	0	1	0.0	0.1	393	0.0	1	324	0.0	1
15	0	1	0	1	0.0	0.1	523	0.0	1	336	0.0	1	
Sample Total		64	53	0	117	1.0		424	48.9	117	309	12.8	117

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Sample Dates	Age	Sex (number)					SE	Weight			Length		
		Male	Female	Unknown	Total	% of Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
26-May	5	0	2	0	2	0.0	0.1	321	18.7	2	292	4.9	2
	6	7	20	0	27	0.2	0.4	331	26.0	27	284	10.7	27
	7	15	21	0	36	0.3	0.4	353	41.0	36	290	10.7	36
	8	6	9	0	15	0.1	0.3	378	45.8	15	296	13.1	15
	9	12	10	0	22	0.2	0.3	397	45.2	22	303	11.4	22
	10	6	10	0	16	0.1	0.3	421	46.7	16	308	13.4	16
	11	10	9	0	19	0.1	0.3	416	48.2	19	309	11.4	19
12	1	0	0	1	0.0	0.1	535	0.0	1	337	0.0	1	
Sample Total		57	81	0	138	1.0		376	54.1	138	297	15.0	138
27-May	5	1	0	0	1	0.0	0.1	348	0.0	1	289	0.0	1
	6	3	14	0	17	0.2	0.4	338	45.8	17	286	12.2	17
	7	6	8	0	14	0.1	0.4	333	28.4	14	289	8.0	14
	8	9	15	0	24	0.3	0.5	373	44.6	24	296	10.5	24
	9	10	4	0	14	0.1	0.4	394	59.3	14	302	16.1	14
	10	10	4	0	14	0.1	0.4	425	53.5	14	311	11.2	14
	11	1	6	1	8	0.1	0.3	437	40.0	8	313	11.1	8
	12	1	0	0	1	0.0	0.1	520	0.0	1	323	0.0	1
	13	0	1	0	1	0.0	0.1	508	0.0	1	339	0.0	1
14	1	0	0	1	0.0	0.1	508	0.0	1	326	0.0	1	
15	0	0	1	1	0.0	0.1	437	0.0	1	331	0.0	1	
Sample Total		42	52	2	96	1.0		382	61.5	96	299	15.8	96

Appendix B6.—Age, sex and size composition of Pacific herring caught by commercial purse seine, all sections, 18 May to 27 May, 2008.

Sample Dates	Sex (number)						SE	Weight			Length		
	Age	Male	Female	Unknown	Total	% of Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
18-May	4	0	1	0	1	0.0	0.1	289	0.0	1	277	0.0	1
	5	9	2	0	11	0.1	0.2	264	49.1	11	263	10.3	11
	6	6	7	0	13	0.1	0.2	334	69.9	13	281	16.6	13
	7	17	10	0	27	0.2	0.3	355	36.3	27	286	7.5	27
	8	2	6	0	8	0.0	0.2	368	43.0	8	290	12.3	8
	9	6	5	0	11	0.1	0.2	414	49.2	11	302	10.4	11
	10	14	9	0	23	0.1	0.3	474	62.6	23	312	11.2	23
	11	28	21	0	49	0.3	0.4	474	72.6	49	312	11.9	49
	12	4	9	0	13	0.1	0.2	482	53.0	13	318	10.7	13
	13	3	7	0	10	0.1	0.2	541	77.0	10	324	10.0	10
	14	5	0	0	5	0.0	0.1	523	58.6	5	321	7.4	5
15	1	2	0	3	0.0	0.1	561	68.2	3	331	7.2	3	
Sample Total		95	79	0	174	1.0		430	96.9	174	303	20.4	174
19-May	4	0	1	0	1	0.0	0.0	207	0.0	1	246	0.0	1
	5	4	1	0	5	0.0	0.1	267	54.4	5	265	12.4	5
	6	9	13	0	22	0.1	0.1	315	31.5	22	276	7.6	22
	7	19	23	0	42	0.1	0.2	342	31.9	42	285	7.8	42
	8	14	14	0	28	0.1	0.2	370	44.4	28	291	13.5	28
	9	9	9	0	18	0.1	0.1	418	51.2	18	300	8.6	18
	10	23	31	0	54	0.2	0.2	449	50.2	54	308	10.8	54
	11	46	50	0	96	0.3	0.3	471	52.5	96	313	9.5	96
	12	27	17	0	44	0.1	0.2	481	49.0	44	317	9.0	44
	13	5	7	0	12	0.0	0.1	503	44.7	12	321	9.8	12
	14	1	1	0	2	0.0	0.0	537	96.5	2	331	4.9	2
15	1	0	0	1	0.0	0.0	513	0.0	1	315	0.0	1	
16	0	1	0	1	0.0	0.0	564	0.0	1	336	0.0	1	
Sample Total		158	168	0	326	1.0		428	96.9	326	304	20.4	326

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Sample Dates	Sex (number)						SE	Weight			Length			
	Age	Male	Female	Unknown	Total	% of Total		Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	
20 May	4	10	4	0	14	0.0	0.1	211	83.5	14	242	7.2	14	
	5	25	12	0	37	0.1	0.1	250	39.0	37	259	9.2	37	
	6	53	48	0	101	0.2	0.2	305	36.2	101	275	10.1	101	
	7	45	53	6	104	0.2	0.2	335	48.5	104	284	11.1	104	
	8	28	26	0	54	0.1	0.1	360	46.5	54	289	10.3	54	
	9	24	15	0	39	0.1	0.1	410	80.1	39	302	17.9	39	
	10	50	54	0	104	0.2	0.2	421	64.9	104	304	14.2	104	
	11	56	60	1	117	0.2	0.2	462	56.3	117	312	10.6	117	
	12	21	25	0	46	0.1	0.1	474	65.3	46	316	11.1	46	
	13	14	7	0	21	0.0	0.1	488	64.0	21	321	11.7	21	
	14	4	2	0	6	0.0	0.0	486	29.1	6	322	11.5	6	
	15	2	0	0	2	0.0	0.0	566	17.0	2	331	5.7	2	
	16	1	3	1	5	0.0	0.0	516	65.5	5	333	6.5	5	
	17	1	0	0	1	0.0	0.0	466	0.0	1	324	0.0	1	
	Sample Total		334	309	8	651	1.0		384	93.5	651	294	22.5	651
	21 May	4	24	15	1	40	0.0	0.1	190	41.7	40	239	13.3	40
		5	43	52	0	95	0.1	0.1	242	47.7	95	257	13.3	95
6		84	115	4	203	0.2	0.1	287	46.2	203	271	12.4	203	
7		101	111	3	215	0.2	0.2	320	45.2	215	280	11.3	215	
8		34	49	0	83	0.1	0.1	353	45.9	83	289	11.8	83	
9		35	36	1	72	0.1	0.1	386	64.2	72	299	15.1	72	
10		42	48	4	94	0.1	0.1	413	61.8	94	306	12.7	94	
11		55	54	6	115	0.1	0.1	429	57.0	115	309	11.5	115	
12		20	13	1	34	0.0	0.1	432	56.4	34	312	12.4	34	
13		6	4	3	13	0.0	0.0	472	59.5	13	326	16.0	13	
14		5	0	0	5	0.0	0.0	500	51.8	5	330	8.2	5	
15		3	1	0	4	0.0	0.0	469	54.2	4	324	9.3	4	
16		0	1	0	1	0.0	0.0	593	0.0	1	341	0.0	1	
17		1	0	0	1	0.0	0.0	451	0.0	1	315	0.0	1	
Sample Total			453	499	23	975	1.0		338	86.8	975	284	23.7	975

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Sample Dates	Age	Sex (number)				% of Total	SE	Weight			Length		
		Male	Female	Unknown	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
22 May	4	32	28	2	62	0.1	0.1	175	45.2	62	234	14.6	62
	5	50	60	1	111	0.1	0.1	220	44.6	111	250	14.5	111
	6	82	82	3	167	0.2	0.2	276	50.5	167	267	14.4	167
	7	78	85	1	164	0.2	0.2	308	48.3	164	277	12.3	164
	8	40	35	2	77	0.1	0.1	331	62.9	77	285	15.4	77
	9	40	22	3	65	0.1	0.1	383	59.7	65	299	12.5	65
	10	30	32	1	63	0.1	0.1	414	56.8	63	306	11.2	63
	11	40	35	2	77	0.1	0.1	414	55.8	77	308	12.8	77
	12	7	13	1	21	0.0	0.1	449	66.1	21	310	17.3	21
	13	6	0	1	7	0.0	0.0	436	66.2	7	315	16.7	7
	14	0	3	0	3	0.0	0.0	435	81.8	3	310	15.6	3
	15	1	2	0	3	0.0	0.0	506	12.0	3	327	4.0	3
	16	0	2	0	2	0.0	0.0	625	7.8	2	341	13.4	2
Sample Total		406	399	17	822	1.0		312	93.9	822	277	26.6	822
25 May	4	5	1	0	6	0.0	0.1	167	20.1	6	233	7.6	6
	5	19	23	0	42	0.1	0.2	250	41.6	42	260	12.0	42
	6	36	57	2	95	0.3	0.3	296	45.5	95	273	12.4	95
	7	32	45	2	79	0.2	0.2	329	45.2	79	283	10.9	79
	8	12	19	3	34	0.1	0.2	351	43.6	34	289	11.7	34
	9	5	16	3	24	0.1	0.1	407	59.3	24	305	12.8	24
	10	13	29	2	44	0.1	0.2	424	57.1	44	309	11.4	44
	11	14	11	4	29	0.1	0.1	438	50.2	29	312	9.8	29
	12	1	2	0	3	0.0	0.0	477	38.8	3	312	5.0	3
	13	1	1	0	2	0.0	0.0	453	51.3	2	335	8.5	2
17	1	0	1	2	0.0	0.0	457	5.3	2	336	1.4	2	
Sample Total		139	204	17	360	1.0		338	80.2	360	285	22.0	360

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Sample Dates	Age	Sex (number)				% of Total	SE	Weight			Length		
		Male	Female	Unknown	Total			Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
26 May	3	1	1	0	2	0.0	0.0	164	8.1	2	233	4.2	2
	4	36	25	0	61	0.1	0.2	175	42.1	61	237	14.3	61
	5	23	41	0	64	0.1	0.2	230	52.5	64	255	16.4	64
	6	55	58	1	114	0.2	0.2	279	54.7	114	271	16.3	114
	7	37	52	1	90	0.2	0.2	310	53.6	90	279	16.9	90
	8	25	19	0	44	0.1	0.1	358	57.4	44	294	15.2	44
	9	11	19	0	30	0.1	0.1	394	73.9	30	301	19.9	30
	10	13	23	0	36	0.1	0.1	424	68.5	36	308	16.8	36
	11	19	14	0	33	0.1	0.1	436	66.1	33	314	13.6	33
	12	7	10	0	17	0.0	0.1	462	79.5	17	318	14.0	17
	13	1	3	0	4	0.0	0.0	449	88.2	4	317	23.2	4
	14	2	0	0	2	0.0	0.0	482	96.5	2	320	25.5	2
	17	1	0	0	1	0.0	0.0	567	0.0	1	339	0.0	1
Sample Total		231	265	2	498	1.0		309	102.2	498	278	29.0	498
27 May	4	24	21	0	45	0.3	0.4	165	33.2	45	237	13.7	45
	5	19	26	2	47	0.3	0.4	198	34.4	47	251	12.8	47
	6	15	15	0	30	0.2	0.3	250	55.1	30	265	17.0	30
	7	13	13	1	27	0.2	0.3	275	69.4	27	276	17.6	27
	8	3	3	0	6	0.0	0.1	283	63.6	6	277	19.9	6
	9	0	4	0	4	0.0	0.1	392	102.6	4	306	19.3	4
	10	1	0	0	1	0.0	0.1	379	0.0	1	304	0.0	1
11	2	1	0	3	0.0	0.1	326	159.7	3	283	50.6	3	
13	0	1	0	1	0.0	0.1	548	0.0	1	343	0.0	1	
Sample Total		77	84	3	164	1.0		225	77.9	164	258	24.2	164

APPENDIX C

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



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Anchorage, AK 99518
Date Issued: 11/9/2007
Time: 1:00 p.m.

2008 TOGIAK HERRING FORECAST

The 2008 Togiak herring forecast and harvest allocation is listed below for the Togiak District sac roe fishery and the Dutch Harbor food and bait fishery, given a maximum 20% exploitation rate of the projected run biomass:

*Harvest Allocation of the 2008 Forecasted Pacific
Herring Run Biomass, Togiak District, Bristol Bay*

	Biomass (Short Tons)	Harvest (Short Tons)
Forecasted Biomass for 2008	130,516	
Exploitation @ maximum 20% for Total Allowable Harvest		26,103
Togiak Spawn-on-Kelp Fishery		

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(Fixed Allocation)	1,500
Remaining Allowable Harvest	24,603
Dutch Harbor Food/Bait Allocation (7.0% of the remaining allocation)	1,722
Remaining Allowable Harvest for Togiak District Sac Roe Fishery:	22,881
Purse Seine Allocation 70.0%	16,017
Gill Net Allocation 30.0%	6,864

2008 TOGIK HERRING FORECAST SUMMARY

The Pacific herring population is forecast to be 130,516 tons in the Togiak District during 2008 (Figure 1). Herring returning from the 1997 and 1998-year classes (Age-11 and -10) are expected to comprise 37.3% of the biomass (Figure 2). The remainder of the herring population is expected to be comprised of ages 4-5 (4.9%), ages 6-7 (30.9%), ages 8-9 (16.4%), and ages 12+ (10.5%) herring. The forecasted individual average weight of herring in the harvest biomass is 394 g.

We used an age-structured analysis (ASA) model to forecast the Togiak herring population using catch and age composition data and aerial survey biomass estimates. The ASA model integrated data from purse seine fishery age compositions (1978-2007), total run age compositions (1978-1995, 1997, 1999, 2001, and 2005-2007), and aerial survey biomass estimates (1981, 1983, 1992-1994, 1997, 1999-2001, and 2005-2007). The model estimates were generated and compared to observed data. Samples from non-selective gear (commercial purse seine) were used to assess the age composition of the total run biomass. Commercial purse seine catch samples ranged from age-4 to age-20. Age-4 herring weight for 2008 was predicted using the recent 4 year average. Simple linear regression models were used to forecast the weight of age-5 through age-15 herring based on their weight the previous year.

A temporal change in age composition from older to younger herring typically occurs in the fishery each year. Age-9 and -10 herring predominated in 2007, comprising 46.0% of the total commercial purse seine harvest by weight. As the season progressed, younger age-5 and -6 herring began to comprise a larger portion of the daily commercial purse seine harvest. This may signify the beginning of a recruitment event. However, assessing younger age classes of herring is difficult as they typically do not show up until the later part or after the fishery. In addition, we no longer conduct post-fishery sampling that occurred during the 1980s.

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The Togiak District herring biomass was estimated to be 134,221 tons in 2007. This was the sum of the peak biomass aerial survey estimate of 84,101 (tons) observed on 17 May, and the aerial biomass estimate of 50,120 (tons) observed on 29 May. Herring were first reported in the district on 6 May, when approximately 68 tons were documented. The peak biomass was observed on 17 May, with a majority of the estimated 84,101 tons concentrated in the Togiak section (71.3%). The biomass of the Togiak herring spawning population has been estimated with aerial surveys since the late 1970's, concurrent with the development of the sac-roe fishery. Large recruitment events have been observed approximately every 8 to ten years in the Togiak herring population with the most recent events occurring from the 1996 and 1997-year classes.

There is always uncertainty in forecasting the Togiak District herring biomass and predicting the 2008 run is no different than previous years. The performance of the ASA model has had a tendency to forecast low since its inception in 1993. However, the model accurately forecasted (134,566 tons) the total run biomass of 134,221 tons in 2007. The mean percent error (MPE) was -24.8% for years with reliable total run biomass estimates (Figure 1). The accuracy or mean absolute percent error (MAPE) of the ASA model has been 22.3%. The range for the 2008 forecasted total run biomass is from 97,887 tons to 163,145 tons based on a MAPE of ~25%. We consider the Togiak herring population to be healthy and sustainable.

Chuck Brazil, Fred West and Tim Baker

Bristol Bay Fishery Research Staff

Anchorage

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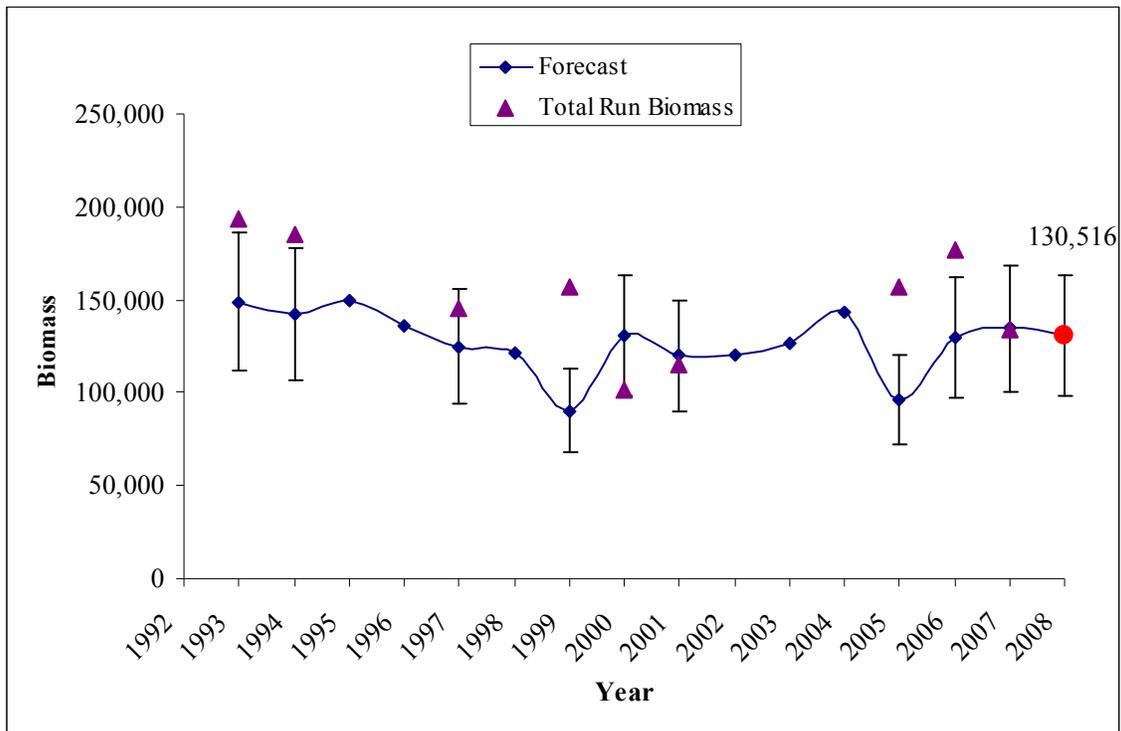


Figure 1- Observed Togiak herring total run biomass estimates and previous preseason forecasts based on the ASA model. Mean absolute percent error (MAPE) of 25% around the forecast is also shown for years with a reliable total run biomass estimate.

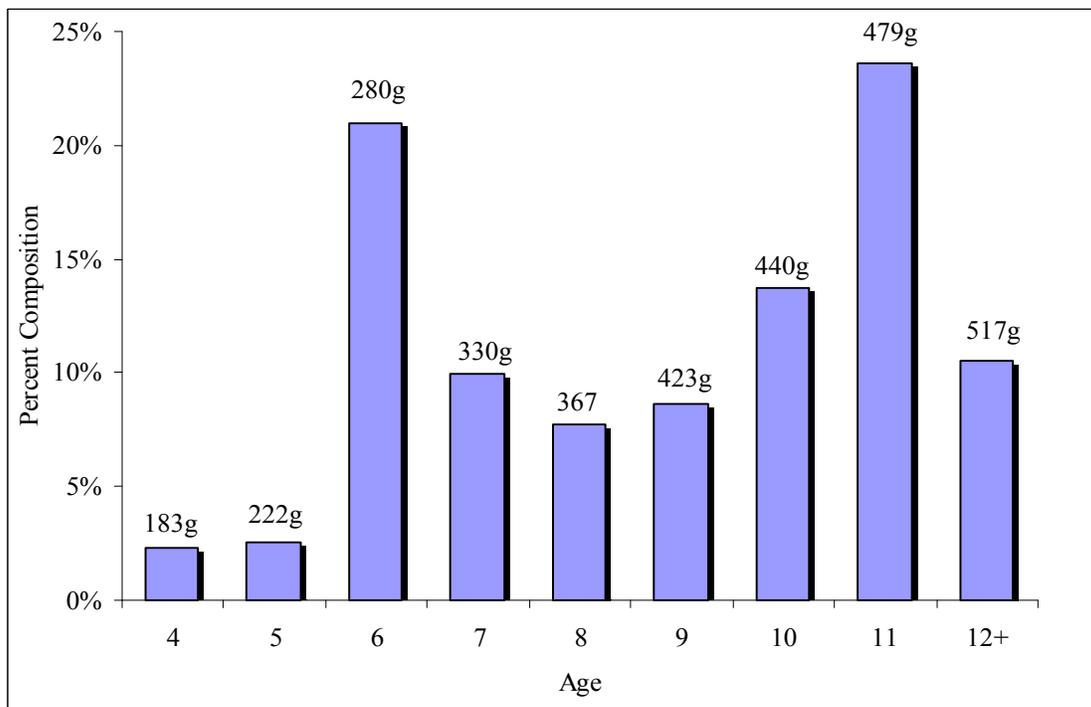


Figure 2- Forecasted age composition by weight for the 2008 Togiak herring return. Forecasted average weight (grams) by age is also presented.