

**Technical Paper No. 401**

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# **The Subsistence Harvest of Pacific Herring Spawn in Sitka Sound, Alaska, 2013**

by

**Lauren A. Sill**

and

**Terri Lemons**

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June 2014

Alaska Department of Fish and Game

Division of Subsistence



## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the reports by the Division of Subsistence. 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 <sup>3</sup> /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.)	\$, ¢
mnths (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	two-letter abbreviations (e.g., AK, WA)

### Measures (fisheries)

fork length	FL
mid-eye-to-fork	MEF
mid-eye-to-tail-fork	METF
standard length	SL
total length	TL

### Mathematics, statistics

<i>all standard mathematical signs, symbols and abbreviations</i>	
alternate hypothesis	H <sub>A</sub>
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics (F, t, $\chi^2$ , 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 <sub>2</sub> , etc.
minute (angular)	'
not significant	NS
null hypothesis	H <sub>O</sub>
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	$\alpha$
probability of a type II error (acceptance of the null hypothesis when false)	$\beta$
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

***TECHNICAL PAPER NO. 401***

**THE SUBSISTENCE HARVEST OF PACIFIC HERRING SPAWN IN  
SITKA SOUND, ALASKA, 2013**

by

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## ABSTRACT

The subsistence fishery for the spawn of Pacific herring *Clupea pallasii* in Sitka Sound was historically, and remains, important to Alaska residents. Alaska Department of Fish and Game (ADF&G) Division of Subsistence research on this contemporary subsistence fishery reveals that harvesting herring spawn is a specialized activity in which a relatively small number of Southeast Alaska residents harvest and distribute herring spawn widely. The giving and receiving of herring spawn products is culturally important to Alaska residents. This report presents the results of the 12th annual harvest survey conducted in Sitka and neighboring communities in 2013. The survey generated data used to calculate estimates of the subsistence harvest of herring spawn on various substrates, including hemlock branches, kelp, and other seaweed in Sitka Sound. An estimated 78,090 lb of herring spawn was harvested in 2013. More than 90% of the harvest was shared with other households within Sitka as well as other communities in the state and beyond. This report complements the Sitka Sound subsistence herring spawn harvest monitoring discussions found in *Sitka Sound Subsistence Herring Roe Fishery, 2002, 2003, and 2006*, by Mathew Brock and Michael F. Turek (Brock and Turek 2007) (ADF&G Division of Subsistence Technical Paper No. 327), *The Subsistence Harvest of Herring Spawn in Sitka, Alaska 2002–2010* by Davin Holen, Jory Stariwat, Terri Lemons, Victoria Ciccone, and Michael F. Turek (Holen et al. 2011) (ADF&G Division of Subsistence Technical Paper No. 343), and *The Subsistence Harvest of Herring Spawn in Sitka Sound, Alaska, 2011* by Lauren A. Sill and Terri Lemons (Sill and Lemons 2012) (ADF&G Division of Subsistence Technical Paper No. 369), and *The Subsistence Harvest of Herring Spawn in Sitka Sound, Alaska, 2012* by Lauren A. Sill and Terri Lemons (Sill and Lemons 2014) (ADF&G Division of Subsistence Technical Paper No. 392).

Key words: Pacific herring, *Clupea pallasii*, herring spawn, subsistence fishing, harvest estimate, subsistence, Sitka, Sitka Tribe of Alaska



# 1. INTRODUCTION

The spawn of Pacific herring *Clupea pallasii*, generally known as “herring eggs,” is a traditional food of great cultural importance for indigenous coastal communities throughout the Pacific Northwest and Southeast Alaska. Although herring spawn is consumed throughout this region, only a small number of people have the time, equipment, skills, and knowledge required to harvest it. This report presents findings of the 12th annual project designed to document subsistence harvests of herring spawn in Sitka Sound. The report covers the 2013 spring fishery (see Holen et al. 2011; Sill and Lemons 2012, 2014 for discussion of the previous study years).

Herring return annually to Sitka Sound in numbers that are not seen elsewhere in Southeast Alaska. The sheer abundance of herring and herring spawn, and the length of the spawning period, has set Sitka Sound apart from other areas in Alaska and the Pacific Northwest for this fishery (Schroeder and Kookesh 1990). Herring harvesters have taken advantage of this unique harvest opportunity during both historical and contemporary periods (Schroeder and Kookesh 1990). In the 19th century, Sitka was a center for Tlingit from all over Southeast to harvest herring and herring spawn (Pierce 1972; Emmons 1991). In the 1860s, herring were so numerous around Sitka in February and March that the water became milky from eggs and milt and it was easy to catch herring with a rake (Tikhmenev 1978). Herring spawn was traditionally exchanged for specialized foods, such as eulachon *Thaleichthys pacificus* oil and dried eulachon, berries, dried seaweed, and mountain goat *Oreamnos americanus* meat. It was also traded for raw materials and handicrafts. Recently, herring eggs from Sitka Sound have been documented being shared throughout Southeast Alaska and beyond to as far north as Barrow and Point Hope and as far south as Seattle (Sill and Lemons 2012).

The primary method of the contemporary harvest is to submerge branches of the Western hemlock *Tsuga heterophylla* in salt waters just outside the intertidal zone before spawning takes place. Herring spawn is also collected on other substrates such as *Macrocystis* kelp, hair seaweed *Desmarestia* spp., and rockweed *Fucus* spp. (Schroeder and Kookesh 1990). The herring deposit their eggs on the branches of the hemlock or other substrate that are then removed from the water. Historically, herring spawn was consumed either fresh or air-dried, or was packed in salt for later use and distribution. As freezers became more common in households in the 1940s and 1950s, freezing became the preferred method of preserving herring spawn.

At its February 1989 meeting, the Alaska Board of Fisheries (BOF) made a positive customary and traditional use determination for the harvest of herring spawn in Sitka Sound. In September 2001, the Sitka Tribe of Alaska (STA) met with representatives from the Alaska Department of Fish and Game (ADF&G) to discuss tribal members’ difficulty in meeting their subsistence needs for herring spawn in Sitka Sound during the spring 2001 season. They cited the intensive commercial harvest of herring in the sac roe fishery in the Middle, Crow, and Kasiana islands areas as affecting the subsistence users’ ability to successfully harvest herring spawn on hemlock branches.

At the January 2002 BOF meeting, STA submitted an unsuccessful proposal requesting recognition of the geographically and historically important areas used for the subsistence herring spawn harvest. During this meeting the BOF also considered, but did not adopt, a permit program for the subsistence fishery. As a consequence of these proposals, the BOF requested that the ADF&G Division of Subsistence (the Division) work with STA to develop a harvest monitoring program based on in-person harvest surveys. The BOF made a determination that the amount reasonably necessary for subsistence<sup>1</sup> (ANS) was between 105,000 and 158,000 lb of herring spawn harvested from Section 13A and that portion of Section 13B that is north of the latitude of Aspid Cape (5 AAC 01.716 (b)). This finding was based upon the best harvest estimates of ADF&G, including a 1996 household harvest survey and a 1990 harvest estimate. In

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1. Pursuant to Alaska Statute 16.05.258, the Alaska Board of Fisheries and the Alaska Board of Game are charged with identifying the fish stocks and game populations that are customarily and traditionally taken or used for subsistence, and with determining the amount of the harvestable portion that is reasonably necessary for subsistence uses.

2009, the BOF revised the ANS to 136,000–227,000 lb, based on the mean estimated harvest from 2002–2008, as determined through the annual herring spawn harvest survey conducted by the Division and STA (Holen et al. 2011). In the Sitka Sound area, state regulations allow the subsistence harvest of herring and herring spawn in sections 13A and 13B north of Aspid Cape on Baranof Island (5 AAC 01.716 (a) (7)) as well as the limited noncommercial exchange of subsistence-harvested herring spawn on kelp for customary trade (5 AAC 01.717). In 2012, STA submitted a proposal to close to commercial fishing in an area of Sitka Sound that has historically been used for the subsistence harvest of herring spawn. A compromise version of the proposal was adopted by the BOF, resulting in approximately 10 square miles of Sitka Sound being closed to the commercial herring sac roe fishery (see Appendix A).

Monitoring the subsistence harvest of herring spawn in Sitka Sound is an ongoing project. Division participation in the annual harvest monitoring program is supported by a reimbursable services agreement (RSA) from the Division of Commercial Fisheries to the Division as well as by the Division using core state general funds. The STA provides its own funding for the project, except for the harvest survey component of the research, which is supported by a cooperative agreement with ADF&G. The STA and the Division collaborate on survey design and data collection. The Division provides technical consultation and, when possible, field survey and interviewing support for the project and STA provides the Division with completed surveys.

## **PROJECT OBJECTIVES**

The primary goal of the harvest monitoring program is to document the subsistence harvest of herring spawn in Sitka Sound annually. The objectives of the project in 2013 were to:

1. Conduct in-person interviews with household members in Sitka and surrounding communities who were identified as likely harvesters of herring spawn from Sitka Sound for subsistence;
2. Produce estimates of the total pounds of herring spawn harvested on hemlock branches, giant kelp *Macrocystis pyrifera*, hair seaweed *Desmarestia spp.*, and “other” substrates; and
3. Identify locations where herring spawn were harvested.

## **METHODS**

Estimates of the subsistence herring spawn harvest in Sitka Sound have been produced for 2002–2013 by systematically identifying and surveying households that harvest herring spawn. This annual project is guided by the research principles outlined in the *Alaska Federation of Natives Guidelines for Research*<sup>2</sup> and by the National Science Foundation, Office of Polar Programs in its *Principles for the Conduct of Research in the Arctic*<sup>3</sup>, as well as the Alaska confidentiality statute (AS 16.05.815). These principles stress community approval of research designs, informed consent, anonymity of study participants, community review of draft study findings, and the provision of study findings to each study community upon completion of the research.

## **Survey Plan and Implementation**

STA and the Division met prior to the start of the 2013 subsistence herring spawn harvest to review the survey instrument, the methods for compiling the household list, and the methods for creating and validating conversion factors. The methods outlined in this section are a collaborative effort between the Division and STA. Division staff participated in the beginning of the herring spawn harvest in Sitka during April 2013 and collaborated with STA staff in updating the weight conversion factors. STA staff

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2. Alaska Federation of Natives. 2013. *Alaska Federation of Natives Guidelines for Research*. Alaska Native Knowledge Network. Accessed February 25, 2014. <http://www.ankn.uaf.edu/IKS/afnguide.html>

3. National Science Foundation Interagency Social Science Task Force. 2012. *Principles for the Conduct of Research in the Arctic*. Accessed February 25, 2014. <http://www.nsf.gov/od/opp/arctic/conduct.jsp>

conducted most of the household surveys; ADF&G staff were present in Sitka at the beginning of the survey effort and assisted in some household surveys during this time.

## **Development of the Household Survey List**

To meet Objective 1, STA updated the list of known and likely harvesters for the 2013 season. Using the 2012 household list as a starting point, new harvesters were added and non-harvesters were removed, following the methods discussed below and in more detail in (Holen et al. 2011). Outreach by STA and a chain referral method were employed to expand the list. Harvesting is a highly visible activity; therefore it was assumed that active harvesters would be aware of other harvesters. Based on the knowledge of active harvesters identified through STA outreach efforts, additional potential harvesting households were added to the household list. The household list also included households from other communities who harvested herring spawn in Sitka Sound as identified through STA outreach efforts and knowledge of the surveyors and STA staff.

For this annual survey program, once added to the household list, an identified household remains on the list unless 1 of 3 situations occurs:

1. If the household is surveyed for 3 consecutive years and has not attempted to harvest within that time, it is removed, even if the household answers in the affirmative as to whether they plan to harvest in the future; or
2. If a household is unable to be contacted for 3 consecutive years, it is removed from the list; or
3. If the household identifies that it no longer plans to harvest, it is removed from the list.

Once removed from the list, the household identification (ID) number is retired. Prior to the beginning of the 2013 herring spawn event, staff from STA and ADF&G reviewed the household master list to ensure these parameters were satisfied.

## **The Survey Instrument**

Objectives 2 and 3 were addressed through the use of a household survey. The survey instrument was designed to collect information about:

1. Whether respondents harvested, attempted to harvest, used, received, or gave away herring spawn.
2. The amount of herring spawn harvested.
3. The kind of substrate used.
4. Whether respondents harvested on their own or in collaboration with other households.
5. The amount of herring spawn respondents kept for their own use, gave away locally, or shipped out of Sitka, and the communities with which they shared the harvest.
6. The location of respondents' harvests.
7. Survey respondents' qualitative assessments of the study year's herring spawn harvest.
8. Survey respondents' qualitative descriptions of their participation in the harvest.

There were no substantive changes to the survey instrument from the 2012 survey; new questions were added concerning sharing of the harvesting effort. A copy of the 2013 instrument can be found in Appendix B.

## **Survey Implementation**

Using the 2012 household list as a base, STA created a list of 82 potential households for 2013. An interview was attempted for each household on the list; 59 households were successfully interviewed, 22 households were unable to be contacted, and 1 household was identified as deceased. Local researcher Dan Williams and STA herring biologist Jessica Gill conducted the surveys in April, May, and June 2013, directly after the herring spawn event. Soon after STA began the surveying effort, a second spawn event occurred. Surveying was suspended until after that event ceased and harvesters had brought in harvested product. Any households contacted prior to the second spawn were re-contacted afterward to ensure no changes to their survey were necessary. After the final survey effort was finished, completed surveys were sent to the Division for coding and analysis. Completed surveys were given a code (see Appendix C for code book) based on user status: 1) individual harvester, 2) non-harvester, or 3) community-harvest boat. The latter code encompasses boats, such as STA's traditional foods boat, that harvest herring for community-wide distribution in Sitka or another Southeast community. These community boats are considered a "household" for the purposes of this report, and are part of the 59 households interviewed for this report. As will be seen in the data analysis section, they are treated slightly different during analysis. For survey methodology, the skipper or owner of the boat is surveyed about the entire harvest brought in by that boat. Crew on board who take home any of the boat's harvest are not considered harvesting households but as receivers of herring spawn.

## **Update of the 2013 Conversion Factor**

Prior to beginning the household survey, conversion factors to estimate the weight of herring spawn in common storage containers were created following the methods established in 2010. In April 2013, Division staff worked with STA to process their harvest of 4,109 lb of herring spawn on hemlock branches and 149 lb of herring spawn on kelp to create conversion factors. This was the first harvest of the season for STA and was conducted using a boat owned and operated by STA. Prior to the beginning of the spawn, STA staff set hemlock branches in Sitka Sound. The locations of the sets were determined by STA staff based on active spawning conditions, their knowledge of herring spawn events, and their experience with the harvest. Five of these sets were harvested by STA and ADF&G staff and used for the conversion factor update.

Based on the plan devised by STA and the Division, the following steps were taken to measure weights in the field in 2013.

1. STA staff, accompanied by ADF&G researchers, checked all herring sets and pulled those that were ready.
2. Once the boat returned to the harbor after pulling a set, STA staff used a hanging scale connected to a hydraulic hoist attached to the dock to weigh the branches and remove them from the boat. While still on the deck of the boat, some of the branches were placed in a plastic fish tote of the type commonly used in commercial fisheries. Once full, the tote was lifted off the boat and weighed. Some branches were not placed in totes; these branches were tied up with rope, then weighed and removed from the boat.
3. STA staff recorded, by hand, the scaled gross weight (including the weight of the tote, if applicable).
4. STA staff then loaded the branches into a pickup truck for transfer to the processing site located in front of the STA Resources Protection Department office. The method of processing spawn depended on how the final product was to be stored. For storage in boxes or grocery bags, processors used pruning shears to remove the larger branches and the poorly covered branches. For storage in gallon- and quart-sized bags, the more rigid branches were discarded, leaving the softer branches and needles that would not tear the bags.

5. The processed spawn was placed in containers identified by STA as common containers used to store, move, and ship herring spawn. The container types reflected the units harvesters might be familiar with and able to report rather than having to estimate total pounds harvested for the survey. STA and Division researchers identified 25 lb and 50 lb wetlock boxes—a type of waxed cardboard box commonly used for shipping seafood—as well as plastic zip-top gallon- and quart-sized bags as the most common container types for herring spawn on hemlock branches and on kelp.
  - a. Each wetlock box from a herring set was placed in a plastic tote and weighed from a hanging scale. The gross weight of each tote was recorded by hand (weight of the plastic tote plus the weight of the wetlock box plus the weight of the spawn).
  - b. Weights were taken for each box of processed spawn in order to understand variability between boxes. An average weight of each type of box was established. The net weights of all boxes of spawn coming from the original unprocessed set were compared to understand the difference between the unprocessed and processed spawn.
  - c. During each processing event, some of the wetlock boxes did not get filled to the 100% mark. These box weights were included in the total weight calculations for the set, but not included in mean box weight calculations.
6. A few wetlock boxes from each set were taken into the STA offices and further processed for quart- and gallon-sized zip-top plastic bags. Weights of filled bags were measured by a desktop analog scale and recorded by hand.
  - a. The weights of all zip-top bags coming from one wetlock box of spawn were compared to the weight of the wetlock box to understand the effect of additional processing.
  - b. The weights of the bags were also taken independently for the purpose of developing an average weight for processed spawn for each bag size.
  - c. During the processing, some of the plastic bags did not get filled to the 100% mark. These bags were included in the total weight calculations, but not included in mean bag weight calculations.

In all, 12 sets of branches were placed by STA staff in herring spawning areas and 5 of these sets were harvested. Of the remaining sets, 3 were apparently stolen and 4 were of poor quality so the sets were not harvested. All 5 sets were weighed as they came off the boat, processed, and reweighed. For 3 of the sets, some or all of the herring spawn product was packaged into 25- and 50-pound wetlock boxes or gallon- and quart-sized containers and used for obtaining average weights of these container types. The other 2 sets were processed into grocery bags for distribution to Sitka residents. These sets were weighed pre- and post-processing to understand overall loss during processing, but were not used in the creation of conversion factors. One area near North Middle Island was used to harvest 150 lb of herring spawn on kelp, which was then processed and packaged into 25- and 50-pound wetlock boxes.

## **DATA ANALYSIS**

Division Information Management staff analyzed the data from the 2013 survey to produce estimates of the total harvest of herring spawn on all substrates. For 2013, the surveys were coded for data entry by Division staff in Douglas using the conversion factors that were determined as described above. Division staff also created codes for responses given to assessment questions (see Appendix C for 2013 code book). Responses were coded following standardized conventions used by the Division. Division

Information Management staff in Anchorage set up database structures within a Microsoft SQL Server<sup>4</sup> database. The database structures included rules, constraints, and referential integrity to ensure that data were entered completely and accurately. Data entry screens were developed in Microsoft Access and made available on a secure network. Daily incremental backups of the database occurred, and transaction logs were backed up hourly. Full backups of the database occurred twice weekly. This ensured that no more than 1 hour of data entry would be lost in the unlikely event of a catastrophic failure. All survey data were entered twice and reviewed so as to minimize data entry errors.

Once data were entered and quality-control checked using standardized procedures employed by Division Information Management staff, the information was processed using the Statistical Package for the Social Sciences (SPSS), Version 21. Initial processing included performing standardized logic checks of the data, which are often needed in complex datasets where rules, constraints, and referential integrity do not capture all the possible inconsistencies that may appear.

Data analysis also included review of raw data frequencies, cross tabulations, table generation, estimation of population parameters, and calculation of confidence intervals for the estimates. Missing information was dealt with in a manner appropriate to each situation, following such standardized practices as minimal value substitution or the use of an average response for similarly-characterized households (mean replacement). Typically, missing data are an uncommon, randomly-occurring phenomenon in Division household surveys. In unusual cases, where a substantial amount of survey information is missing, the household survey is treated as a “non-response” and not included in community estimates. All adjustments were documented.

The Division applied the weighted means method (Cochran 1977) to generate harvest estimates for herring spawn from an interviewed sample of households drawn from a list of households known to harvest herring spawn in Sitka during the study year. In cases where a household was known to be an active harvester during one year, but the harvest was unknown that year, the mean household harvest of that year was used as an estimate of that household’s actual harvest. Information Management staff used the following formula to generate these estimates:

$$H = N \left( \frac{\sum x}{n} \right) \quad (1)$$

Where

- $H$  = Total estimated harvest,
- $N$  = Total number of households identified,
- $n$  = Number of sampled households, and
- $x$  = household’s reported harvest.

In this approach, the mean of the estimate remains the same as the sampled mean so percentages derived from sampled households can be applied to the entire household list. The principal assumption is that the group of households from the household list of likely harvesters that were unable to be surveyed in 2013 has (on average) the same harvest and use patterns as the households that were successfully contacted. Harvest estimates were not generated for the community harvester boats as well as the STA boat. The reported harvest was used for these boats since all the community harvester boats were successfully surveyed. Since the mean is the primary statistic used to develop the estimates, Information Management staff produced a 95% confidence interval (CI), represented as a percentage, to measure the relative

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4. Product names are given because they are established standards for the State of Alaska, and for scientific completeness; they do not constitute an endorsement.

precision of the mean. The CI can also be applied to the total estimated harvest to obtain a likely upper and lower range for the estimate. The following formula was applied to create the CI percentage:

$$CI\% = \frac{t_{\alpha/2} \times \frac{s}{\sqrt{n}} \times \sqrt{1 - \frac{n}{N}}}{\bar{x}} \quad (2)$$

Where

$s$  = sample standard deviation,

$n$  = sampled households,

$N$  = total households identified,

$t_{\alpha/2}$  = student's  $t$  statistic for alpha level ( $\alpha = 0.05$ ) with  $n-1$  degrees of freedom, and

$\bar{x}$  = mean harvest.

A small CI percentage indicates low variance in household harvest amounts and that the actual mean is very close to the sampled mean. A larger CI percentage would indicate that there is a larger variance between household harvest amounts and an increased likelihood that the actual mean differs, possibly substantially, from the sampled harvest mean. Confidence intervals for household surveys conducted in 1987 and 1996 as well as data from the annual monitoring program are presented in Table 1. Confidence intervals are not available for the 1983 harvest estimates (Table 1).

Table 1.—Estimated subsistence harvest of herring spawn in Sitka Sound, 1983–2013.

Year	Percentages based on surveyed households					Estimated values					
	Total number of surveyed households	Percentage of households attempting to harvest	Percentage of households harvesting	Percentage of households giving away herring spawn	Percentage of households harvesting herring spawn	Estimated number of households attempting to harvest	Estimated number of households harvesting	Estimated harvest, all substrates, pounds	95% confidence interval (± %)	Range: low	Range: high
For the following 3 years, the data pertain to the entire population of Sitka, based on a random sample.											
1983	139	n/a	24%	n/a	n/a	n/a	586	42,000 <sup>a</sup>	n/a	n/a	n/a
1987	296	n/a	9%	n/a	n/a	n/a	261	20,494 <sup>a</sup>	91%	1,755	39,235
1996	150	16%	15%	n/a	20%	476	464	127,174	72%	35,131	219,217
For the following 9 years, the data pertain to only those Sitka households identified as potential participants in the subsistence herring spawn fishery.											
2002	86	n/a	71%	95%	40%	n/a	77	151,717	23%	116,701	186,734
2003	118	72%	71%	88%	30%	117	116	278,799	19%	225,704	331,895
2004	144	61%	60%	93%	17%	120	118	381,226	18%	312,224	450,229
2005	159	61%	52%	82%	13%	111	95	79,064	9%	72,272	85,856
2006	127	58%	55%	91%	27%	93	88	219,356	20%	176,484	262,228
2007	126	55%	48%	89%	43%	92	81	87,211	22%	67,702	106,720
2008	128	45%	41%	73%	52%	59	54	71,936	6%	67,764	76,108
2009	150	48%	48%	89%	79%	91	91	213,712	9%	193,623	233,801
2010	132	30%	30%	85%	13%	40	40	154,620	10%	139,872	169,367
2011	109	39%	35%	94%	35%	57	53	83,443	5%	79,719	87,166
2012	75	45%	43%	84%	88%	50	47	115,799	12%	102,332	129,265
2013	59	64%	63%	86%	28%	52	50	78,090	10%	70,075	86,106

Sources CSIS; Brock and Turek (2007); Sitka Tribe of Alaska household surveys, as summarized in Gmelch and Gmelch (1985).

Note “n/a” indicates data were not collected during the study year.

a. Harvest estimates for 1983 and 1987 are likely low due to the small size of the random sample, which might have failed to include high harvesting households that specialize in harvesting herring spawn.

## 2. 2013 RESULTS

All 3 project objectives were satisfied in 2013. Fifty-nine of 82 households identified as potential harvesters of herring spawn were successfully interviewed, including the STA boat, a boat sponsored by the Southeast Herring Conservation Alliance (SEHCA), and 3 other community harvester boats. As reported in Table 1, an estimated 52 households attempted to harvest herring spawn, and 50 of those households were successful. This represents a slight increase over the number of estimated households that attempted to harvest in 2012.

The second objective of the project was to estimate the total subsistence harvest of herring spawn in Sitka Sound during 2013. Table 2 presents the total estimated harvest (78,090 lb) of herring spawn by harvester type and substrate for all of Sitka Sound. As has been seen in prior years of study, the vast majority of harvesters were Sitka residents, but the majority of the spawn was harvested by 4 community harvester boats. These are boats that come to Sitka Sound and harvest large quantities of spawn for general distribution within Sitka or the boats' home communities. In 2013, these boats came from Hoonah, Hydaburg, and Metlakatla; one was sponsored by SEHCA. Regardless of who harvested the spawn, by far the most commonly used substrate for the harvest was hemlock branches (Figure 1). Ninety-four percent (73,302 lb) of estimated harvests occurred on hemlock branches, while 6% was herring spawn-on-kelp or spawn harvested on other substrate (4,788 lb). The 2013 spawn-on-kelp harvest amount was similar to what has been documented in years past. For the first time on this survey, respondents were also asked if their harvest was the same as, less than, or more than their harvest in recent years. A similar question was also added asking specifically about the harvest of herring eggs, not just the use of them. In general, households reported using and harvesting either the same as recent years or less than recent years; few households reported their 2013 harvest or use as being more than it has been in recent years (Figure 2).

The majority of the 2013 harvest was shared with the community of Sitka and beyond; this is a documented characteristic of the harvest common to every year of the project. Of the surveyed households, including the community harvester boats, that harvested herring spawn in 2013, 86% shared at least some of their harvest (Table 1). Because this survey only attempted to interview harvesters of herring spawn, it is not possible to obtain data for overall community use and sharing of herring spawn. However, even some survey respondents who did not harvest any eggs still shared the eggs they received from others. Of the total estimated amount of herring spawn that was harvested, only 10% was kept for use by the harvesting household; the remainder was given away (Figure 3; Table 3). Of the more than 90% of the harvest that was shared with others, approximately 41% remained within Sitka while almost half (50%) was shipped outside of Sitka (Figure 3). Spawn on hemlock branches composed most of the harvest, by weight (66%), kept for the harvester's personal use, but that is largely because of the overall higher harvest amounts of spawn harvested on branches. The majority of the spawn-on-branches harvest was shared, with only about 7% kept for personal use (Table 3). In contrast, 49% of all the spawn on kelp harvested was kept for personal use; the rest was shared (Table 3). In 2013, herring spawn from Sitka Sound was shared with residents of the following communities in addition to Sitka: Anchorage, Angoon, Hoonah, Hydaburg, Juneau, Kake, Ketchikan, Klawock, Metlakatla, Yakutat, and Seattle. In addition, as noted above, boats from Hoonah, Hydaburg, and Metlakatla traveled to Sitka Sound to harvest herring spawn for those communities' residents.

Not all potential harvesters contacted for this survey attempted to harvest herring spawn in 2013. The most common reason given for not attempting to harvest in 2013 was that the respondent was "working during the harvest." Conflicts with a work schedule have been one of the most common reasons given for not participating in the harvest in 2012 and 2011. Other reasons given were "lack of transportation/boat," "personal/health reasons," "no interest in harvesting," and "received from friends or family" (Figure 4). Interestingly, in 2012, "resource availability" was one of the more common reasons given for not harvesting, while in 2013 that reason was not given by any respondent. When asked for a qualitative assessment of the harvest in 2013, of the 24 households who answered this question 42% shared that they

felt the resource availability was different (either more or less) this year than in years past. Additionally, 38% of the respondents commented that the spawn was fast and/or they were not ready for the harvest. The frequency of other comments offered on the survey is shown in Figure 5.

Table 2.—Subsistence harvest and use of herring spawn by community of residence, Sitka area, 2013.

Resource	Percentage of households					Estimated pounds harvested	Confidence interval		
	Used	Attempted	Harvested	Gave	Received	Total	CI %	Low	High
<b>Sitka households (n=54)</b>									
Herring spawn on hemlock branches	48.1%	46.3%	44.4%	40.7%	11.1%	23,541.0	10.7%	21,011.8	26,070.3
Herring spawn on kelp	37.0%	29.6%	31.5%	14.8%	11.1%	2,123.9	8.7%	1,939.0	2,308.9
Herring spawn, unspecified	25.9%	24.1%	24.1%	7.4%	5.6%	2,314.4	14.2%	1,986.5	2,642.2
<i>Subtotal, herring spawn, all types</i>	<i>63.0%</i>	<i>61.1%</i>	<i>59.3%</i>	<i>51.9%</i>	<i>20.4%</i>	<i>27,979.3</i>	<i>9.2%</i>	<i>25,404.3</i>	<i>30,554.3</i>
<b>Community harvester boats (n=4)</b>									
Herring spawn on hemlock branches	n/a	n/a	100.0%	n/a	n/a	45,661.0	1.9%	44,775.5	46,546.5
Herring spawn on kelp	n/a	n/a	25.0%	n/a	n/a	200.0	7.5%	185.0	215.0
Herring spawn, unspecified	n/a	n/a	0.0%	n/a	n/a	0.0	n/a	n/a	n/a
<i>Subtotal, herring spawn, all types</i>	<i>n/a</i>	<i>n/a</i>	<i>100.0%</i>	<i>n/a</i>	<i>n/a</i>	<i>45,861.0</i>	<i>1.9%</i>	<i>44,975.0</i>	<i>46,747.0</i>
<b>Sitka Tribe of Alaska (n=1)</b>									
Herring spawn on hemlock branches	n/a	n/a	100.0%	n/a	n/a	4,100.0	0.0%	4,100.0	4,100.0
Herring spawn on kelp	n/a	n/a	100.0%	n/a	n/a	150.0	0.0%	150.0	150.0
Herring spawn, unspecified	n/a	n/a	0.0%	n/a	n/a	0.0	n/a	n/a	n/a
<i>Subtotal, herring spawn, all types</i>	<i>n/a</i>	<i>n/a</i>	<i>100.0%</i>	<i>n/a</i>	<i>n/a</i>	<i>4,250.0</i>	<i>0.0%</i>	<i>4,250.0</i>	<i>4,250.0</i>
<b>Total</b>	<b>66.1%</b>	<b>64.4%</b>	<b>62.7%</b>	<b>55.9%</b>	<b>18.6%</b>	<b>78,090.3</b>	<b>10.3%</b>	<b>70,075.0</b>	<b>86,105.7</b>

Sources Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2013.

Note “n/a” indicates not applicable.

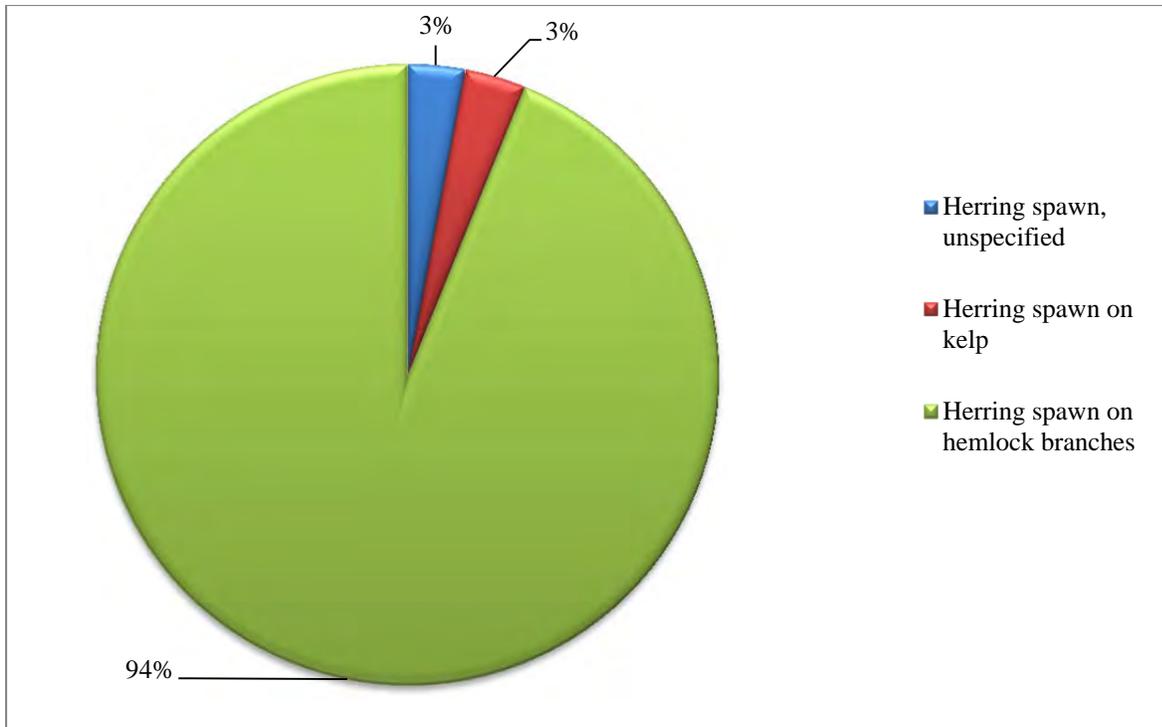


Figure 1.—Distribution of subsistence herring spawn harvest by substrate, Sitka area, 2013.

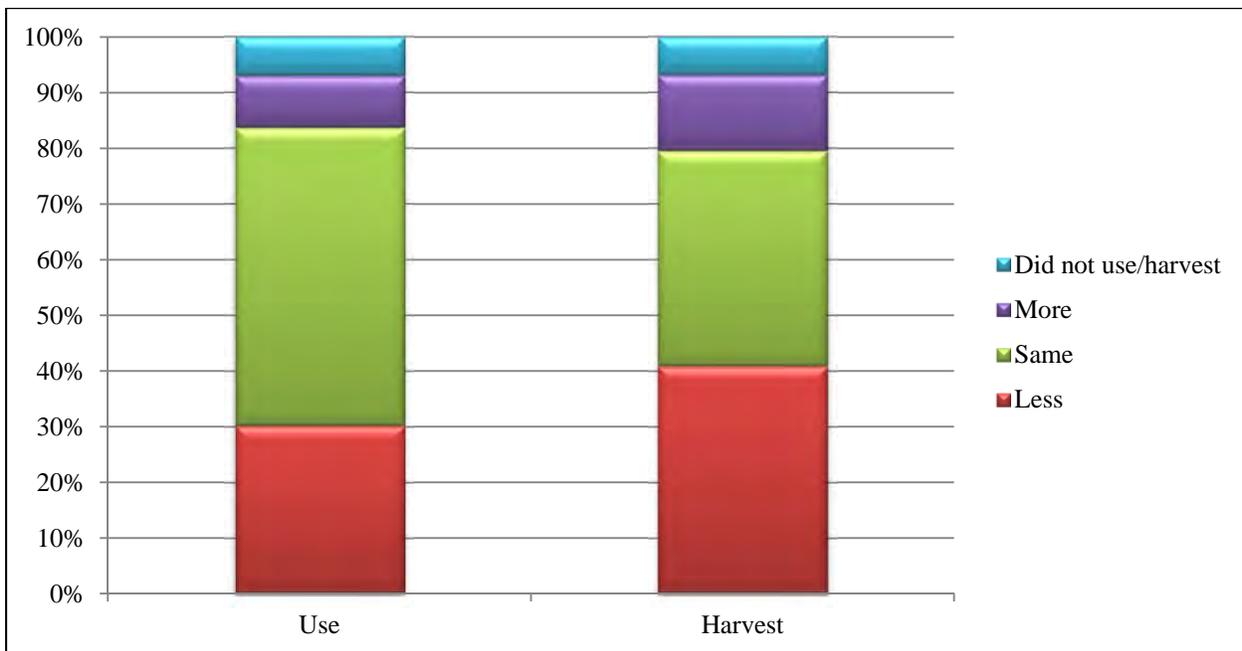


Figure 2.—Household perception of herring spawn harvest and use compared to previous years, Sitka area, 2013.

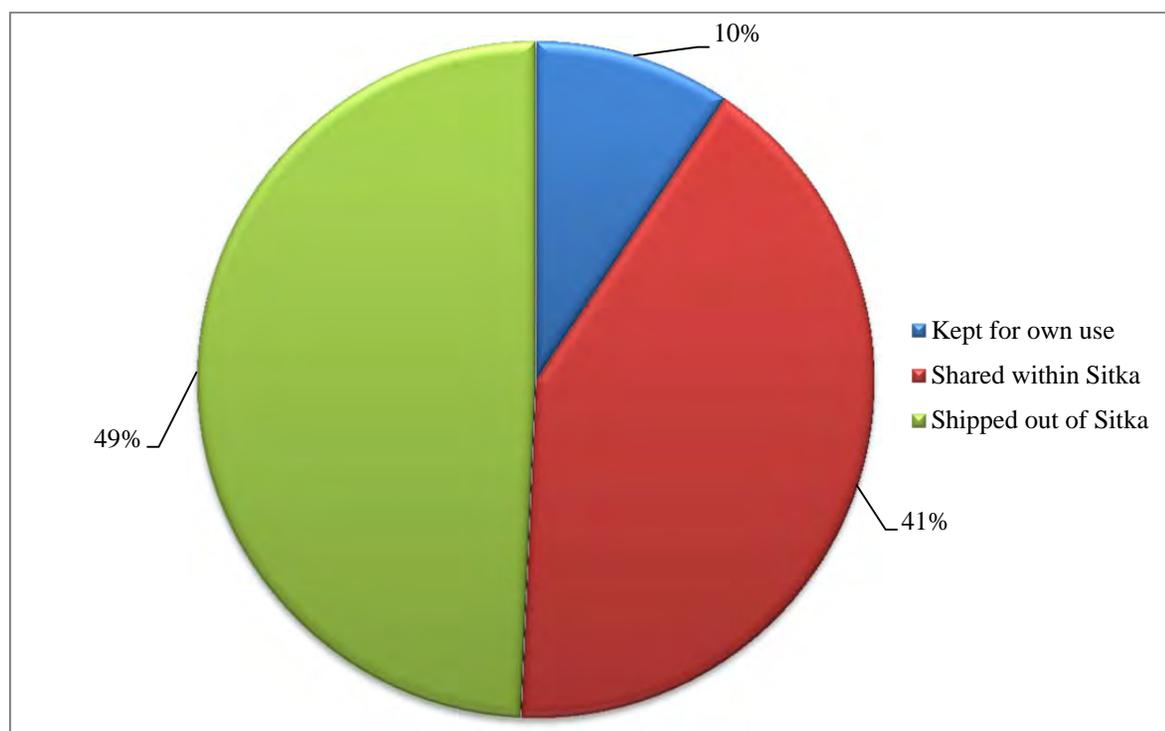


Figure 3.—Percentage of total subsistence harvested herring spawn that was shared, 2013.

Table 3.—Distribution of subsistence herring spawn harvest, Sitka area, 2013.

Resource	Estimated harvest						Total pounds
	Kept for own use		Shared within Sitka		Shipped out of Sitka		
	Pounds	Percentage of total harvest	Pounds	Percentage	Pounds	Percentage	
Herring spawn on kelp/other	1,215.9	49.2%	621.2	25.1%	636.8	25.7%	2,473.9
Herring spawn, unspecified	1,344.1	58.1%	344.7	14.9%	625.5	27.0%	2,314.4
Herring spawn on hemlock branches	4,794.7	6.5%	31,282.7	42.7%	37,224.6	50.8%	73,302.0
<b>Herring spawn, all types</b>	<b>7,354.8</b>	<b>9.4%</b>	<b>32,248.7</b>	<b>41.3%</b>	<b>38,486.9</b>	<b>49.3%</b>	<b>78,090.3</b>

Sources Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2013.

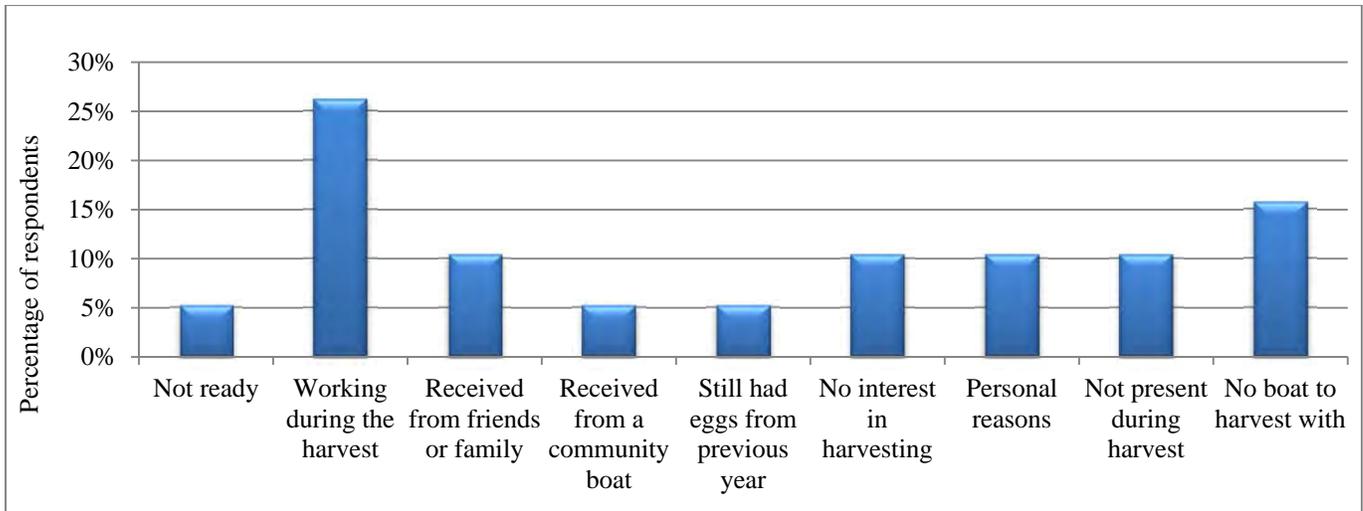


Figure 4.—Reported reasons households did not attempt to harvest herring spawn, Sitka area, 2013.

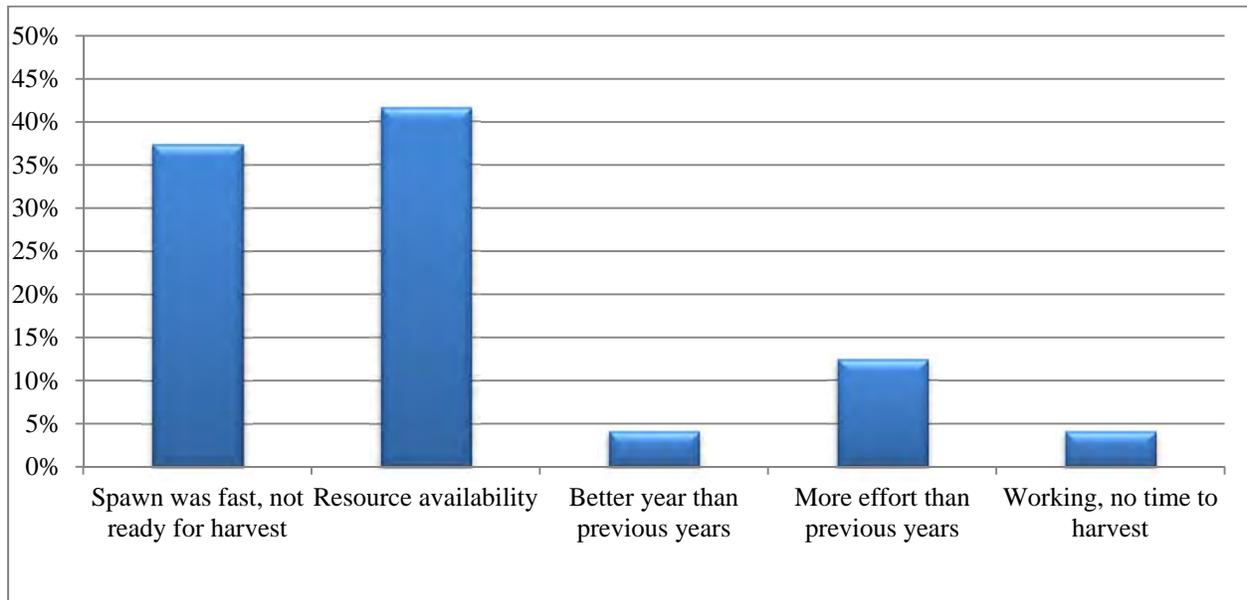


Figure 5.—Reasons given for why household harvests were different in 2013 than in recent years.

## CONVERSION FACTORS

Researchers found that there was a slight decrease in weight between primarily processed (from tote to wetlock box) and secondarily processed (from box to bag) weights due to the removal of branches during processing. There was an average of 10.5% weight lost after primary processing (to wetlock boxes) and another 1.9%, on average, loss in weight during secondary processing (from wetlock to zip-top bags). This decrease has been factored into the conversion formula for 2013 (Table 4). Conversion factors were not calculated prior to 2010.

Table 4.–Conversion factors for 2010–2013.

Container type, spawn on branches	Estimated average weight (pounds)			
	2013	2012	2011	2010
Sea Pro <sup>a</sup> large (50 lb) wetlock box	53.0 lb	59.10 lb	53.27 lb	57.78 lb
Sea-Pro <sup>a</sup> small (25 lb) wetlock box	22.8 lb	28.50 lb	24.88 lb	25.50 lb
Ziploc <sup>a</sup> gallon bag	3.94 lb	4.43 lb	3.87 lb	4.07 lb
Ziploc <sup>a</sup> quart bag	1.35 lb	1.38 lb	1.46 lb	1.42 lb
<hr/>				
Container type, spawn on kelp				
Ziploc <sup>a</sup> gallon bag	n/a	3.65 lb	n/a	n/a
5-lb bucket	n/a	23.94 lb	n/a	n/a
Sea-Pro <sup>a</sup> small (25 lb) wetlock box	16.7 lb	n/a	n/a	n/a

*Sources* Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2013; Holen et al. (2011); Sill and Lemons (2012).

*Note* “n/a” indicates conversion factors for spawn on kelp were not calculated for these years.

- a. Product names are given because they are established standards for the State of Alaska, and for scientific completeness; they do not constitute an endorsement.

## HARVEST LOCATIONS

The final project objective was to document where the herring spawn harvest took place. The aggregate locations of harvests by all survey respondents are shown in Figure 6. The majority of the harvests occurred in the core area of Sitka Sound. As can be seen more readily in Table 5, the most important location in 2013 was the Kasiana islands group (43%), followed by Crow/Gagarin islands (19%) and North Middle Island (15%). These harvest locations compare favorably to 2012, where North Middle Island, Crow/Gagarin islands, and Kasiana islands group were where the majority of harvesters made sets. The 2013 harvest was more highly concentrated in the Kasiana islands group location.

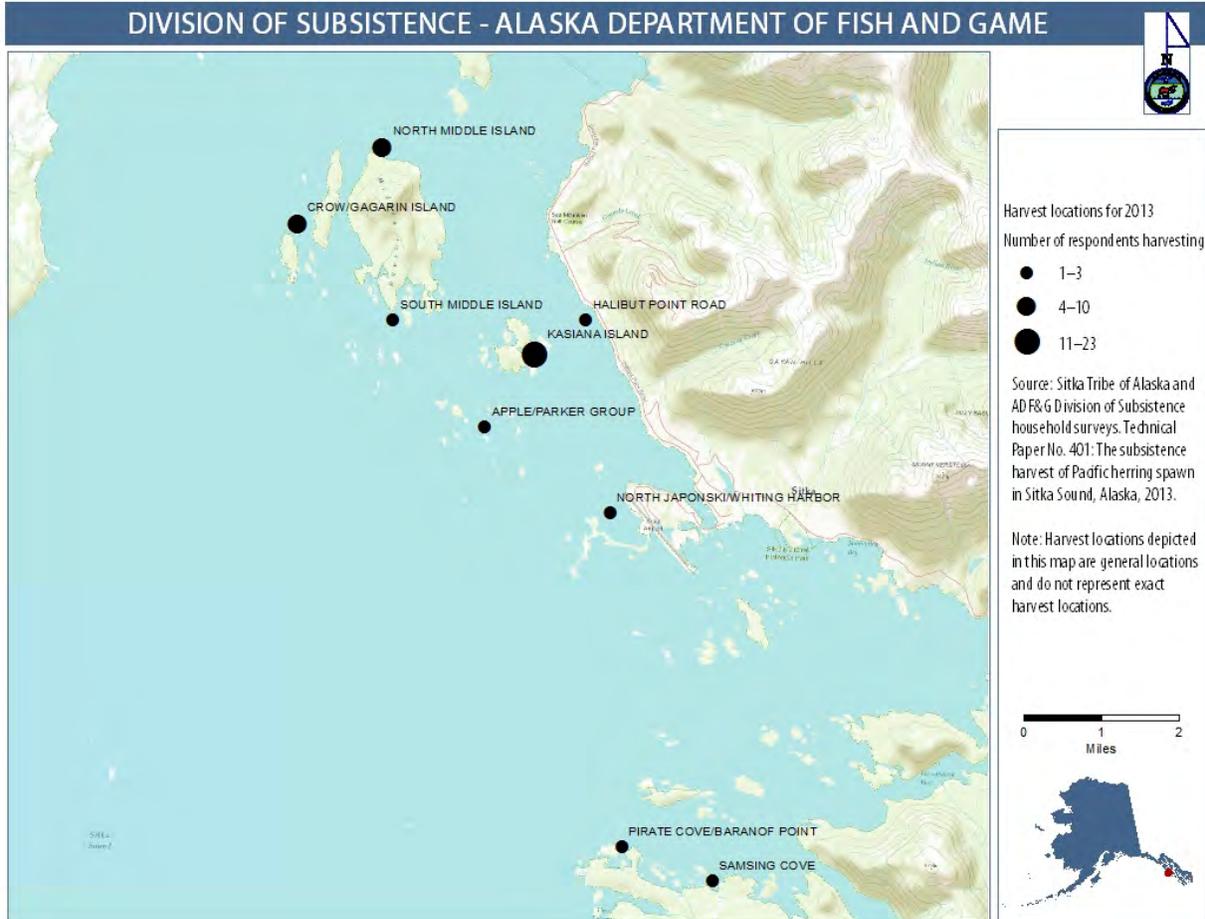


Figure 6.—Reported harvest locations, 2013.

Table 5.—Reported locations of subsistence herring spawn harvest, Sitka Sound, 2013.

Location	Number of households reporting use of location	Percentage of harvesting households using location
Kasiana islands group	23	42.6%
Crow/Gagarin islands	10	18.5%
North Middle Island	8	14.8%
Apple/Parker Group	3	5.6%
South Middle Island	3	5.6%
Pirate's Cove	2	3.7%
Samsing Cove	2	3.7%
Baranof Point	1	1.9%
North Halibut Point Road	1	1.9%
North Japonski/Whiting Harbor	1	1.9%

Sources Sitka Tribe of Alaska and ADF&G Division of Subsistence household surveys, 2013.

### 3. DISCUSSION

The 2013 herring season differed from the 2010–2012 seasons because there were low commercial harvests of herring sac roe, low subsistence harvests, and a second spawning event. For the third time in the past 5 years, the subsistence harvests of herring spawn in Sitka Sound failed to achieve the lower bound of the ANS (Figure 7). The commercial sac roe herring fishery, which usually occurs just before the subsistence harvest, also failed to harvest their guideline harvest level of 11,549 tons, instead only bringing in 5,688 tons.<sup>5</sup> According to several survey respondents and the STA biologist, the herring appeared to have changed behavior in 2013 so that they stayed in deep water until they were ready to spawn. As a result, most of the commercial fishery and the subsistence fishery overlapped temporally. In addition, about 1 week after the first spawning event ended, a second small spawn occurred. This spawn hit areas of shoreline on West Kruzof Island, Promisla and Eastern bays, Starrigavin Bay, north Middle Island, as well as in Salisbury Sound and Windy Pass. Including the second spawn, the total shoreline recorded with spawn in Sitka Sound was near the 10-year average of 61.7 nautical miles.<sup>6</sup> This second spawn was unexpected and took many harvesters by surprise; however, many attempted to take advantage of the additional opportunity. Reports received by STA and ADF&G from herring harvesters were that the second spawn did not provide much additional opportunity for subsistence harvests due to the short duration and location of the spawn.

Because project methods underwent a major revision in 2010 (Holen et al. 2011), the focus of this discussion will be on study years 2010–2013; however, the same trends have been apparent since the inception of the project. The number of households harvesting spawn trends toward fewer households over time. Year-to-year participation varies, with some years showing more participation than others, but since 2009, participation rates have remained low. However, participation is only one part of the equation when assessing the overall success of the community’s herring egg harvest. There is very little correlation seen between the number of harvesting households and the total harvest for a given year (Figure 7). Looking just at the data from 2010 on, which is when the methods of the study underwent significant revision, this lack of correlation can still be seen. Years with fewer households participating, such as 2010 (40 households) had a much higher harvest (by 85% or more) than years with higher participation, such as 2011 and 2013 (57 and 52 households, respectively). The overall success of the subsistence harvest (for these purposes this is defined by attainment of the minimum ANS) depends not only upon people making the effort to harvest herring spawn, but also on the opportunity for the harvest of quality spawn. Social, cultural, economic, and ecological factors all affect these 2 key components—participation and opportunity.

Participation in the herring spawn harvest is impacted by a harvester’s other commitments—to work, to travel, to family—as well as economic considerations such as the price of gas or maintenance of a boat or engine. Being able and choosing to participate in the harvest is not the only factor influencing subsistence harvest success. The other relevant factor to be considered can be termed “opportunity.” The opportunity to participate is influenced by both socio-cultural factors and ecological factors. The ecological side is really just looking at the spatial component of the harvest and the variation in where, when, and how spawn is deposited. In short, there needs to be herring spawn available to harvest. A consistent spawn of some duration in locations suitable to set branches is necessary. During in-depth interviews with herring harvesters, at public meetings, and in casual conversation, researchers have repeatedly heard about spawning events that lasted for weeks when the respondents were younger or during their parents’ lifetimes. Respondents have repeatedly stated that more recent spawning events in the areas most heavily

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5. Alaska Department of Fish and Game Division of Commercial Fisheries, “2014 Sitka Sound herring fishery final update,” news release, April 24, 2014. <http://www.adfg.alaska.gov/static/applications/dfnewsrelease/397298050.pdf>

6. Alaska Department of Fish and Game Division of Commercial Fisheries, “2014 Sitka Sound herring fishery final update,” news release, April 24, 2014. <http://www.adfg.alaska.gov/static/applications/dfnewsrelease/397298050.pdf>

used by subsistence harvesters have lasted a much shorter length of time, with less shoreline having multi-day deposition of spawn (see also Thornton et al. [2010]). About 3 days of spawn in an area is commonly cited by harvesters as the minimum amount necessary for quality egg deposition and a good harvest. It has been found that mean spawning days in subsistence use areas of Sitka Sound can be a reasonably good predictor of harvest success (for a further discussion of the relationship between harvest success and multi-day spawning events see both Sill and Lemons (2014) and a thesis by James Shewmake<sup>7</sup>.

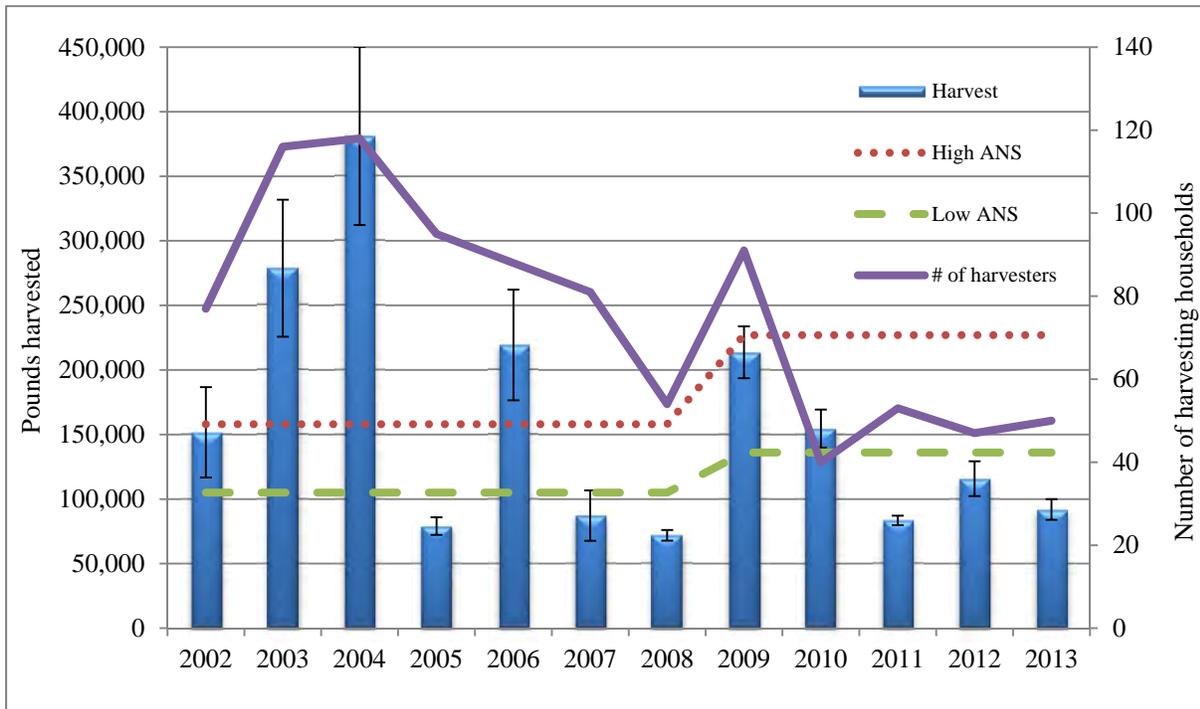


Figure 7.—Total pounds usable weight of herring harvested, number of harvesting households, and amount reasonably necessary for subsistence (ANS) of herring spawn on all substrates in Sitka Sound, 2002–2013.

The socio-cultural aspects of opportunity are separate from the ecological. Assuming there is sufficient herring spawn in locations accessible and suitable for herring egg harvest, to be a successful harvester requires, at the most basic level, that an individual can be physically present on the spawning grounds with the time available to prepare hemlock branches, set them, and, in some cases, guard them against theft. Harvesters note that branches should not soak for more than 3 days or they become soft and the needles start to disintegrate, leading to a poor deposition on the branches, so branches need to go in the water shortly before or right as the spawn is occurring. After the herring have spawned on the branches, individuals need the time and equipment to haul in their sets, process the eggs, and preserve them. In 2013, as in 2012, the most common reason given (by 26% of the responding households) for why the household did not participate in the fishery was “work.” In 2011 and 2010, this reason was also one of the top 2 given. The second most common reason given in 2013 was lack of transportation/boat. The shorter available spawning period harvesters have spoken of may be exacerbating this issue. Harvesters do not

7. James W. Shewmake II, “Spatial Resilience and the Incorporation of Traditional Ecological Knowledge in Mapping Sitka Herring” (master’s thesis, University of Alaska Fairbanks, 2013). Hereafter referred to as Shewmake (2013).

necessarily have the ability to take time off of work with little notice in order to capitalize on the spawn event. When the spawn lasts less than a week, the harvester does not have the flexibility to accommodate work schedules and other commitments. During the last 30 years, the spawn has begun as early as March 19 and as late as April 28. Some harvesters can predict fairly accurately when the spawn is going to happen as the time gets closer, but there is no real predictability to allow for much prior planning. Successful harvests often require a lot of time spent on the water, watching the herring for signs that spawning is imminent. The second most common comment, a lack of transportation or boat, is a clear physical barrier to harvesting.

Bringing the 2 factors together, participation and opportunity, Shewmake (2013) investigated harvest success in terms of participation and opportunity. By graphing the relationship between household days in subsistence areas<sup>8</sup> (defined as the number of participating households multiplied by mean spawn days) and the total pounds of eggs harvested, he found that the relationship explained much of the variability in the total harvest at a statistically significant level ( $p < 0.001$ ). Declining participation is a factor, but declining opportunity is an equally valid factor when looking at overall harvest success in a season. The contemporary subsistence herring roe on substrate fishery is not a particularly resilient system in that its capacity to buffer perturbations (such as changes in where there is herring spawn deposition) is relatively low. . There are relatively few locations within Sitka Sound that are suitable for the harvest of herring eggs. As the deposition of herring eggs in Sitka Sound varies over time, in terms of length of deposition and area of deposition, this contributes to the variable success of the harvesters.

Looking at respondents' assessment of their harvest and use in 2013 as compared to recent years provides an interesting window on the 2013 harvest year. A few responding households said they used or harvested more herring spawn in 2013 than in recent years, but most responded that both use and harvest were the same as or less than previous years. A larger proportion of households said they used the same amount of herring spawn than responded similarly for the harvest, meaning that regardless of how much spawn a household harvested, they were likely to meet their own needs first, and then share what was left over. This highlights uncertainty in the qualitative analysis as to whether households got enough herring spawn for the study year. Many respondents will be able to answer whether they got enough for their own household, but often do not know how much additional demand there may be from them to supply eggs to other households. When asked this question, surveyors have received the response that respondents are not able to know so soon after the harvest whether they have enough herring spawn for the year to provide for others.

Turning to the sharing of the 2013 harvest, there were aspects similar to and different from the sharing patterns that have emerged over the past few years. Regardless of how good or poor a harvest, 80–90% of harvesting households share their harvest; in 2013 86% of such households shared (Table 1). Also, similarly to previous years, much of the herring spawn-on-kelp harvest was retained for personal use while the herring eggs harvested on hemlock branches were most often shared within or outside of Sitka. A slight difference in 2013 was seen in where herring eggs were shared. In 2011 and 2012, more than one-half (51% and 71%, respectively) of the total harvest on any substrate was shared within the community of Sitka. In 2013 almost one-half (49%) of the harvest was shipped out of Sitka while only 41% was shared within the community (Figure 3). About one-half of the amount shipped out of Sitka came from 2 boats that were harvesting for other communities. These community boats may have been more successful in 2013 than in previous years, or may have attempted to harvest more in 2013 to meet needs in their communities. Another reason for this difference could be that with more harvesters in Sitka participating in 2013, there may have been less perceived demand within Sitka, allowing more people to share their harvest with their extended networks outside of Sitka.

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8. Shewmake (2013) defined subsistence areas through a participant mapping exercise. Areas that had historically been used for herring spawn harvests by key informants were identified and digitized. Additionally, the 19 areas identified on the annual harvest survey were included in the areas designated "subsistence areas."

Wherever herring spawn is shared, within or beyond the boundaries of Sitka, and although the total pounds harvested and shared change from year to year, the overall harvest and sharing patterns have not changed much since 2010. These statistics, in part, speak to the skill and knowledge necessary to successfully harvest herring spawn. The pattern of a small number of households harvesting a unique resource and then distributing the resource is common in Alaska's subsistence economies (Wolfe et al. 2010). These "super-households" have the time, ability, knowledge, and equipment necessary to successfully harvest subsistence resources that are then shared throughout the community. If ecological changes have occurred in the herring fishery, such as shorter spawn events or less predictable herring behavior<sup>9</sup>, these skills and knowledge become even more important because there is little time and limited resources for experimentation and adaptation.

## **CHANGES IN USE OF HERRING SPAWN**

One of the limitations of this research project is that only herring egg harvesters are targeted. While that methodology allows for the collection of much useful information, it does not allow for analysis of the wider use of herring eggs. The study had been able to document a decrease in the participation of the subsistence herring egg harvest, but there are no data available to speak to changes in overall use of the resource, either within Sitka or in other Southeast communities, or overall participation in the processing of herring eggs. While the survey tracks participation in the harvest of herring eggs, there is currently no information to show how many households are involved in the processing, distribution, or receipt of herring eggs. The survey has shown that herring eggs continue to be widely shared and used throughout the state, but a broader survey looking specifically at the use and receipt of herring eggs from the general populace would be necessary to fully discuss changes in the use of herring eggs over time.

## **CONVERSION FACTORS**

Creating annual conversion factors is useful for 2 reasons.

1. Annual conversion factor summaries give researchers a more accurate estimate of herring egg harvests because individuals often report their harvest in number of boxes/bags, rather than total pounds harvested. With an average weight determined for storage containers for that year, researchers can convert the entire reported harvest into pounds with some accuracy.
2. The other aspect of conversion factors is their potential insight into the effect of egg density on the success of the overall harvest. This is a relatively new avenue of investigation that researchers are exploring. From Shewmake's (2013) work, it can be seen that the number of consecutive spawning days is important to overall success. More spawning days should lead to thicker egg deposition and heavier branches. One way the project can potentially investigate egg density is through the creation of annual conversion factors.

Assuming that the herring spawn processors are relatively consistent in how they process branches for packing containers during the conversion factor updates, the average weight of a wetlock box should vary annually with spawn density—less in years with low density and more in high-density years. However, other factors such as sea water content of the set may also be affecting the weights of the processed spawn. Until more work is done to identify other factors potentially affecting the weight of wetlock boxes of processed spawn, year-to-year variations in conversion factors cannot be taken as an accurate indicator of herring spawn densities.

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9. While subsistence harvesters have shared with researchers that the length of the herring spawn has decreased in their lifetimes or their parents', the spawn records kept by ADF&G over the past 50 years do not support this conclusion. Shewmake (2013) illustrates that the length of spawn deposition since 2000 can be highly variable, especially when looking at the deposition of all of Sitka Sound versus just subsistence use areas or the preferred subsistence use areas. The discrepancies between ADF&G data and respondents' recollections may be due to the different geographical scales at which information is processed.

## **LOCATION OF HARVESTS**

The final aspect of the subsistence herring harvest that the project attempts to understand is the location of harvests. While the question concerning harvest locations has not been on the survey every year, from the years when this information was sought it is clear that there is a core area most harvesters use, but there is also year-to-year variability in all the locations used for the harvest. There are a number of reasons for this pattern. Within limits, harvesters will go where the herring are spawning. Herring do not have site fidelity like salmon; therefore, where they spawn each year can change. Harvesters look for areas they feel are most likely to produce high-quality spawn based on factors such as geography, substrate, and protection from wind and waves. Some harvesters do not have access to a boat, so they need to harvest in locations accessible by the road system, regardless of where the herring are spawning. Skiffs and other small boats are commonly used by herring harvesters and wind and rough seas can make harvesting dangerous; therefore, protected areas are sought. Protected areas are also favored for their likelihood of high-quality spawn since ocean surge can stir up sand on the seafloor, thus degrading the quality of the herring spawn. As Sitka has developed, and concerns for water quality have grown, harvesters have also tried to ensure that the area they harvest from is not negatively impacted by development. ADF&G documents the nautical miles of herring spawn observed in all of Sitka Sound each year. Because of the limitations in where quality subsistence harvests can occur, looking at the overall nautical miles of herring spawn in Sitka Sound does not give an accurate picture of the opportunity available to harvesters. A harvester's assessment of the length of the spawn and quality of the season is localized to areas that are accessible to that harvester and therefore may not be the same as the documented duration or total coverage of the spawn.

## **SPAWN-ON-KELP FISHERY**

In addition to further investigating the role of spawn deposition on weight conversion measurements, another aspect of the herring spawn fishery that researchers will continue to explore is the spawn-on-kelp fishery. While surveys are attempted with all harvesters of herring spawn, regardless of the substrate, herring spawn on branches accounts for the majority of the harvest and has therefore received the most attention. Often, the amounts of spawn on kelp documented by the survey have been less than that recorded on the permits (a permit is necessary to harvest spawn-on-kelp in Sitka Sound). Beginning in 2012 and continuing through 2013, researchers concentrated additional effort on identifying and contacting spawn-on-kelp harvesters. The harvest survey estimated 2,474 lb of spawn-on-kelp harvested (Table 3), while the permit data documented 2,075 lb. In part, the discrepancy in total could be explained through the expansion of survey data, whereas permit data are unexpanded. However, there may be other sources of difference between the 2 estimates, such as different participation rates in the survey process versus permit reporting compliance, that will be explored in future studies.

## **4. CONCLUSION**

Although participation in the subsistence harvest of herring spawn from Sitka Sound has dropped since the early 2000s, the harvest remains an important cultural activity for Southeast Alaska residents. Overall harvest amounts are influenced by the number of harvesters participating, but also by the opportunity for quality spawn in accessible locations. The herring spawn harvest continues to be shared extensively throughout Sitka, Southeast Alaska, and beyond. Concern for the resource over the changes experienced with the harvest is a consistent theme heard from harvesters. Future years of this project will continue to investigate the spawn-on-kelp harvest and comparisons with permit data for that fishery. In addition, the variations in spawn density and identifying accurate ways to track and correlate density with the harvest will be explored. Finally, a broader effort to look at overall use of herring eggs, not just the harvest effort, and changes over time, is needed but is beyond the scope of this project.

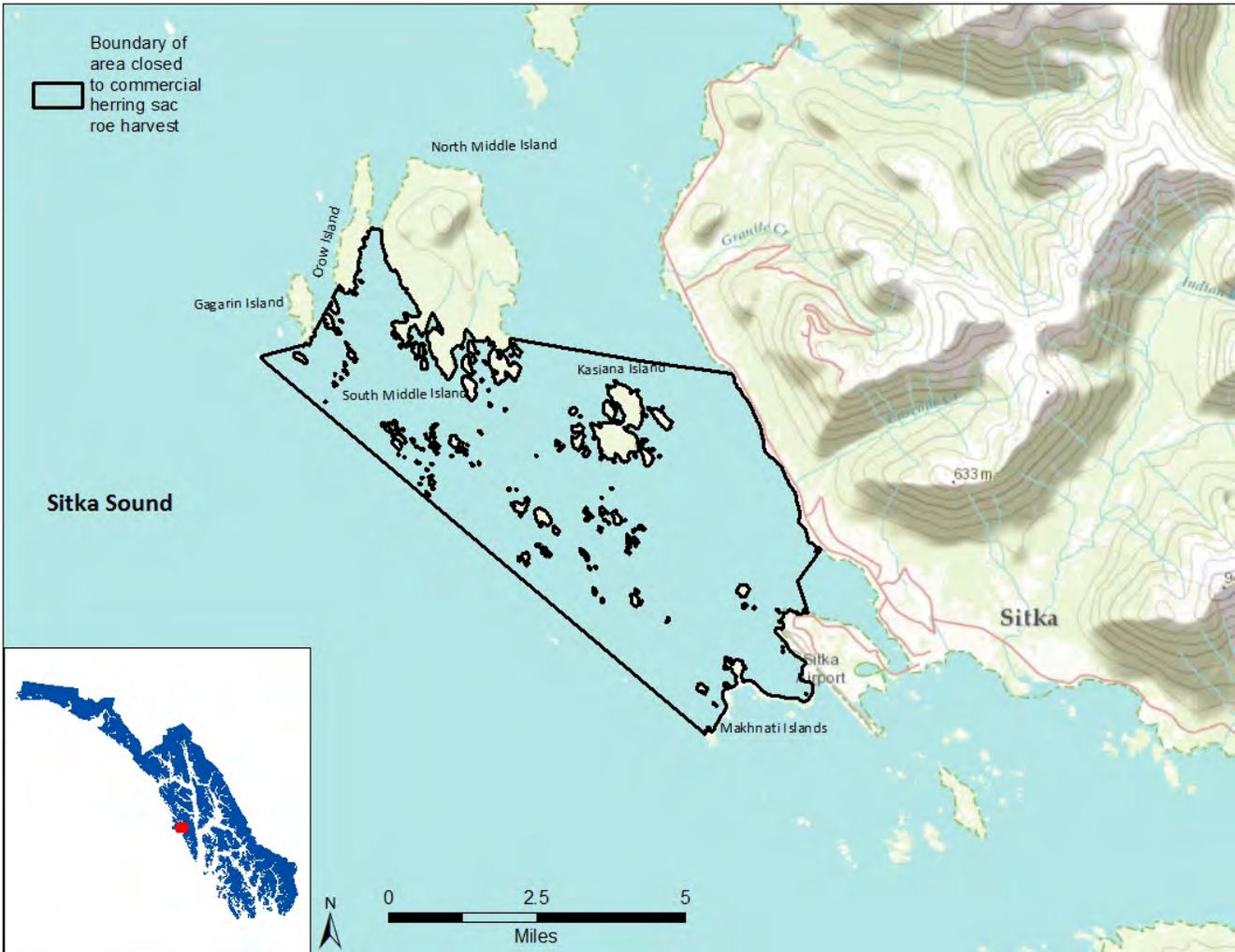
## **ACKNOWLEDGEMENTS**

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**APPENDIX A: MAP OF AREA OF SITKA SOUND CLOSED TO  
COMMERCIAL HERRING SAC ROE FISHING**



**APPENDIX B: SITKA SOUND SUBSISTENCE HERRING EGG  
HARVEST SURVEY, 2013**

# HERRING EGG SUBSISTENCE SURVEY

SITKA, ALASKA

2013

This survey is used to estimate subsistence harvests of herring eggs from Sitka Sound and to describe community subsistence economies. We will publish a summary report which will be available to all households in your community. We share this information with the Sitka Tribe of Alaska, the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service and the National Park Service. We work with the Federal Regional Advisory Councils and with local Fish and Game Advisory Committees to better manage subsistence, and to implement federal and state subsistence priorities.

This project is guided by the research principles adopted by the Alaska Federation of Natives in 1993.

We will NOT identify your household. We will NOT use this information for enforcement. Participation in this survey is voluntary. Even if you agree to be surveyed, you may stop at any time.

HOUSEHOLD ID:		
COMMUNITY ID:	Sitka	313
INTERVIEWER:		
INTERVIEW DATE:		
DATA CODED BY:		
DATA ENTERED BY:		
SUPERVISOR:		



## COOPERATING ORGANIZATIONS

RESOURCE PROTECTION DEPARTMENT  
SITKA TRIBE OF ALASKA  
429 KATLIAN STREET  
SITKA, AK 99835

907-747-2669

DIVISION OF SUBSISTENCE  
ALASKA DEPT OF FISH & GAME  
1255 W. 8TH STREET  
JUNEAU, AK 99801

907-465-3617



**HARVESTS: HERRING EGGS**

HOUSEHOLD ID

How many people lived in your household in 2013?.....

Is anyone in the household enrolled in a tribe?..... Y N

If YES, which one?.....

Do members of your household USUALLY harvest HERRING EGGS for subsistence?..... Y N

In 2013...

...Did members of your household TRY TO HARVEST herring eggs?..... Y N

If NO... why not?

*If the household tried to harvest herring eggs in 2013 fill out the rest of this page. Otherwise go to 'Assessment' section on the next page.*

Please estimate how many herring eggs ALL MEMBERS OF YOUR HOUSEHOLD HARVESTED for subsistence use this year. INCLUDE herring eggs you gave away, ate fresh, lost to spoilage, or got by helping others. If fishing with others, report ONLY YOUR SHARE of the catch.

	IN 2013 DID MEMBERS OF YOUR HH...				IN 2013, HOW MANY ( _____ ) DID YOUR HOUSEHOLD HARVEST...?		
	...USE _____?	...RECEIVE _____	...GIVE _____	...TRY TO HARVEST _____?	...FOR PERSONAL USE	...TO GIVE AWAY IN SITKA	...TO SHIP OUT OF SITKA
	<i>(circle)</i>				<i>(amount used for each purpose)</i>		
Herring Roe on Hemlock Branches	Y N	Y N	Y N	Y N			
120310000							
Herring Spawn on Kelp	Y N	Y N	Y N	Y N			
120306000							
Herring Roe/Unspecified	Y N	Y N	Y N	Y N			
120302000							

*These columns should include all the herring eggs harvested by members of this household in*

If you shared with others, how many households did you share with?

NUMBER OF HOUSEHOLDS

COMMUNITY	

What size vessel(s) did you use to harvest herring eggs in 2013?.....

**HARVESTS: HERRING EGGS**

HOUSEHOLD ID

**ASSESSMENT: HERRING EGGS**

In 2013...

Did your household use LESS, the SAME, or MORE herring eggs than in recent years?..... X L S M

If LESS or MORE, why was there a change?

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Did your household get enough herring eggs?.....Y N

How do you feel your 2013 HARVEST was compared to other years?..... X L S M

If LESS or MORE, why was your harvest different?

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If you HARVESTED LESS herring eggs in 2013, what was the last year you remember having a good harvest? \_\_\_\_\_

Do you harvest with other families?.....Y N

**COMMENTS**

DO YOU HAVE ANY QUESTIONS, COMMENTS, OR CONCERNS ABOUT THE 2013 SUBSISTENCE HERRING EGG HARVEST?

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**HARVESTS:**

HOUSEHOLD ID

Where did you harvest your herring eggs in 2013 - set branches, harvest seaweed, macrocystis kelp?

31

	Location	Date	# of sets out	# of sets harvested	Quality	Soak time	Comments
1	Kasiana Islands Group						
2	North Middle Island						
3	South Middle Island						
4	Crow/Gagarin islands						
5	Big/Little Gavanski islands						
6	Signaka Islands						
7	North Japonski/Whiting Harbor						
8	South Japonski/Mermaid Cove						
9	Causeway Islands						
10	South Halibut Point Road						
11	North Halibut Point Road						
12	Eastern/Promisla Bay						
13	Magoons/Hayward						
14	Katlian Bay						
15	Apple/Parker Group						
16	Crescent/Jamestown Bay						
17	Other:						

## **APPENDIX C: 2013 CODE BOOK**

Subsistence Herring Egg Harvest Survey 2013

Herring Spawn User Status	Code
Individual Harvester	1
Non-Harvester	2
Community boat	3

Page 1: Harvests

If enrolled in a tribe, which one?	
Sitka Tribe of Alaska	1
Organized Village of Kake	2
Metlakatla Indian Community	3
Hoonah Indian Association	4
Hydaburg Cooperative Association	5

If household did not try to harvest herring eggs in 2013, why not?	Code
Harvester - no response necessary	Blank
Refused	-7
Missing (blank, but should not be & the reason is not clear)	-8
Unknown to respondent	-9
Not ready	1
Working during the harvest/no time	2
Received from friends/family	3
Received from a community boat	4
Had eggs from last year	5
No interest	6
Personal or health issues	7
Not present during the harvest	8
Transportation/no boat	9

What size vessel did you use to harvest herring eggs?	Code
less than 20 feet	1
20-24 feet	2
over 24 foot pleasure cruiser	3
commercial vessel	4
other	5

Page 2: Assessments

If less or more USE, why?	Code
Non-harvester - no response necessary	Blank
Refused	-7
Missing (blank, but should not be & the reason is not clear)	-8
Unknown to respondent	-9
Resource availability	1
Poor quality	2
No time to harvest	3
Better than last year	4
Needed less	5
Less effort	6
Equipment	7

Personal reasons	8
Used kelp instead	9
If less or more HARVEST, why?	
Non-harvester - no response necessary	Blank
Refused	-7
Missing (blank, but should not be & the reason is not clear)	-8
Unknown to respondent	-9
Fast spawn/not ready	1
Resource availability	2
Spawn was spotty	3
Better year	4
More effort	5
No time/work	6
5. Do you have any additional comments about the 2013 subsistence herring egg harvest?	Code
Refused	-7
Missing (blank, but should not be & the reason is not clear)	-8
Unknown to respondent	-9
Spawn was short/poor abundance	1
Concerned about the future of the resource	2
Concerned about the effect of the commercial fishery on the resource	3
Spawn is less predictable in timing and location	4
Eggs of mediocre quality	5
Good quality eggs	6
Theft of branches an issue	7
Used kelp instead	8
Good spawn in small area	9
Not good deposition	10
Second spawn is unusual	11