Technical Paper No. 435

The Subsistence Harvest of Pacific Herring Spawn in Sitka Sound, Alaska, 2016

by

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and

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December 2017

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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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. Annual subsistence harvest monitoring surveys began in 2002 in response to concerns from subsistence harvesters that the commercial sac roe herring fishery was negatively affecting subsistence harvesting success. This report presents the results of the 15th annual harvest survey conducted in Sitka and neighboring communities in 2016. 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 total of 84,554 lb of herring spawn was harvested in 2016. Approximately 97% of the harvest was shared with other households within Sitka as well as other communities in the state and beyond.

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 (Moss 2016). 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 15th annual harvest assessment, which occurred in the spring of 2016, designed to document subsistence harvests of herring spawn in Sitka Sound (see Holen et al. [2011] and Sill and Lemons [2012, 2014a–b, 2015, 2017] for discussion of the previous study years).

Pacific herring return annually to spawn in locations throughout Alaska and the Pacific Northwest, but the abundance of herring and herring spawn, and the length of the spawning period, has set Sitka Sound apart from these other areas (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 Alaska to harvest herring and herring spawn (Emmons 1991; Pierce 1972). 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 as being shared throughout Southeast Alaska and beyond to as far north as Utqiaġvik (formerly 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 work with STA to develop a harvest monitoring program based on in-person harvest surveys. This method of data collection provides a way to increase community buy-in and participation, build capacity within the community and STA, and provide consistent data. The BOF also made a determination that the amount

reasonably necessary for subsistence[1] (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 results from a 1996 household harvest survey and a 1989 harvest estimate. At its 2009 meeting, 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 ADF&G 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 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). In 2015, the Federal Subsistence Board approved a proposal submitted by STA that closed approximately 2 square miles of federal waters around Makhnati Island (see Appendix A).

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

PROJECT OBJECTIVES

The goal of the harvest monitoring program is to annually document the subsistence harvest of herring spawn through household surveys with all harvesters who participate in the fishery in Sitka Sound. The objectives of the project in 2016 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 2002–2016 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*[2] and by the National Science Foundation, Office of Polar Programs in its *Principles for the Conduct of Research in the Arctic*[3], as well as the Alaska confidentiality statute (AS 16.05.815). These principles

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.
2. Alaska Federation of Natives. 2013. *Alaska Federation of Natives Guidelines for Research*. Alaska Native Knowledge Network. http://www.ankn.uaf.edu/IKS/afnguide.html (accessed January 5, 2017).
3. National Science Foundation Interagency Social Science Task Force. 2012. *Principles for the Conduct of Research in the Arctic*. http://www.nsf.gov/od/opp/arctic/conduct.jsp (accessed January 5, 2017).

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 the study community upon completion of the research.

Survey Plan and Implementation

STA and ADF&G met in February and March prior to the start of the 2016 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 ADF&G and STA. Division staff participated in the herring spawn harvest in Sitka during March 2016 and collaborated with STA staff in updating the weight conversion factors. STA staff conducted the majority of the household surveys; ADF&G staff administered a few to households residing outside of Sitka.

Development of the Household Survey List

To meet Objective 1, STA updated the list of known and likely harvesters for the 2016 season. Using the 2015 household list as a starting point, new harvesters were added and non-harvesters were removed, following the methods revised in 2010, which are 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 and ADF&G 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 2016 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 minor changes made to the 2016 survey instrument in comparison to the 2015 instrument to assist other researchers and reduce survey duplication efforts in the community. For instance, the current instrument removed questions asked for 2015 regarding barter and trade of herring eggs and added a question about harvesters' observations of anything that they thought might have affected herring egg survival to accommodate other research. Overall, the 2016 survey included similar questions asked of people attempting to harvest herring eggs in previous years to produce consistent data for trend analysis, with the exception of the survey being truncated for respondents who indicated that they did not try to harvest herring eggs in 2016. The main consequence of this change is that sharing information and assessments of use among non-harvesting households on the survey list were not collected. Therefore, the percentage of use of herring spawn for all interviewed households is not available, and use percentages are not provided in this report. A copy of the 2016 instrument can be found in Appendix B. Harvest location information was collected through 2 methods. One method was for the respondent to simply pick among standard generalized locations offered on the survey (see Appendix B). The other method was using an application designed on the ArcGIS Runtime SDK for iOS platform; basically a mapping data collection application for the Apple iPad.[4] The harvest area, defined as a point, was drawn on a U.S. Geological Survey topographic relief map downloaded on the iPad. The iPad allowed the user to zoom in and out to the appropriate scale and to document harvesting activities wherever they occurred. Once a feature was accepted, an attribute box was filled out by the researcher that noted the species harvested, amount, method of access to the resource, and month of harvest. The data were uploaded via Wi-Fi to a server. Once data collection was complete the data were downloaded into an ArcGIS file geodatabase. The application was developed by HDR, Inc.

Survey Implementation

Using the 2015 household list as a base, STA created a list of 94 potential harvesting households for 2016. An interview was attempted for each household on the list; 64 households were successfully interviewed, 29 households were unable to be contacted, and 1 household declined to participate. STA Fisheries Biologist Jessica Gill conducted the surveys in April, May, and June 2016 directly after the herring spawn events. After the final survey effort was finished, completed surveys were sent to ADF&G 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 or the Southeast Alaska Herring Conservation Alliance-sponsored vessel, that harvest herring for community-wide distribution in Sitka or another Southeast Alaska community. These community boats are considered a "household" for the purposes of this report, and are part of the 64 households interviewed. As will be seen in the data analysis section, they are treated slightly differently during analysis. For survey methods, 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 2016 Conversion Factors

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 (Holen et al. 2011). From March 26 through March 28, 2016, division staff worked with STA staff to process 3,608 lb of their harvest of herring spawn on hemlock branches 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

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

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.

Based on the plan devised by STA and ADF&G, the following steps were taken to measure weights in the field in 2016.

1. STA staff and 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 offloaded the branches from the boat and into a pickup truck for transfer to the processing site located in front of the STA Resources Protection Department office. The hydraulic winch was not available for use in 2016, so weights were not taken during offloading as has been done in previous years. 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 (usually anything larger than approximately one-half-inch in diameter) and the poorly covered branches. For storage in gallon-sized bags, the more rigid branches were discarded, leaving only the pliable branches and needles that would not tear the bags.
3. 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, 50 lb, and 80 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.
4. A few wetlock boxes from each set were taken into the STA offices and further processed for gallon- and quart-sized zip-top plastic bags. Weights of filled bags were measured by a desktop digital scale and recorded by hand.
    a. The weights of all zip-top bags coming from 1 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 of a bag filled with processed spawn.
    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, 33 sets of branches were placed by STA staff in herring spawning areas and 5 of these sets were harvested; the other sets did not receive sufficient spawn to make harvesting worthwhile. Four of these sets were weighed (a total of 3,608 lb) and processed for the conversion factor.

DATA ANALYSIS

ADF&G Information Management staff analyzed the data from the 2016 survey to produce estimates of the total harvest of herring spawn on all substrates. For 2016, the surveys were coded for data entry by ADF&G staff in Douglas using the conversion factors that were determined as described above. ADF&G

staff also created codes for responses given to assessment questions (see Appendix C for 2016 code book). Responses were coded following standardized conventions used by ADF&G. ADF&G Information Management staff in Anchorage set up database structures within a Microsoft SQL Server 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 ADF&G Information Management staff, the information was processed using the Statistical Package for the Social Sciences (SPSS), Version 19. 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 ADF&G 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.

ADF&G 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. These households were further divided into groups, or strata, by harvester, non-harvester, and community boats. Valid responses for each group were used to develop averages for invalid or missing responses within the same group, and the same averages were extended to all uncontacted households in the group. 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. These totals were then summed to provide a community-wide estimate:

$$H = \sum_{k=1}^{K} N_k \left(\frac{\sum x_k}{n_k} \right) \quad (1)$$

Where

H = total estimated harvest,

N_k = total number of households identified for strata-group 'k',

n_k = number of sampled households in strata-group 'k',

x_k = reported harvest for household within strata group 'k',

k = strata group, and

K = total strata groups.

In this approach, each strata group is estimated separately and thus percentages are derived from the estimated values rather than samples. This assumes that the un-contacted households within each strata group are, on average, the same as those contacted and also that each strata group has different harvest patterns.

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 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:

$$CI\% = \frac{t_{\propto/2} \times \sqrt{\frac{1}{N}\sum_{k=1}^{K} N_k(N_k - n_k)\frac{s_k^2}{n_k}}}{H} \quad (2)$$

Where

s_k = sample standard deviation for strata group 'k',

n_k = sampled households for strata group 'k',

N_k = total households identified for strata group 'k',

N = total households identified in the community,

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

H = total estimated community harvest,

k = strata group, and

K = total strata groups.

A small CI percentage indicates low variance in household harvest amounts and that the actual mean is likely 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.

DISSEMINATION OF SURVEY RESULTS

Each year the data are presented at a Southeast Alaska sac roe herring preseason meeting held in Sitka in February. In addition, results are presented at a preseason meeting held by STA. In 2016, preliminary results were not available prior to these meetings and were not presented. The written report is reviewed within ADF&G as well as by the Southeast Alaska Herring Conservation Alliance and STA. The final report, once published, is available on the ADF&G website. Hard copies are distributed to STA.

2. 2016 RESULTS

Data from all years of the annual monitoring program, as well as household surveys conducted in 1983, 1987, and 1996, are presented in Table 1, including confidence intervals for the harvest estimates (excluding 1983, for which the confidence interval is not available). In 2016, all project objectives were satisfied. Sixty-four of 94 households identified as potential harvesters of herring spawn were interviewed, including the STA boat, a boat sponsored by the Southeast Herring Conservation Alliance (SHCA), and 3 other community harvester boats. As reported in Table 1, an estimated 38 households attempted to harvest herring spawn and 35 were successful.

The second objective of the project was to estimate the total subsistence harvest of herring spawn in Sitka Sound during 2016. Table 2 presents the total estimated harvest (84,554 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 approximately 82% of the herring spawn was harvested by the community harvester boats (including the STA and SHCA 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 2016, these boats came from Hoonah, Kake, and Metlakatla; additional boats were sponsored by SHCA and the STA Traditional Foods program, each of which also harvested for distribution in Sitka. Regardless of who harvested the spawn, the most commonly used substrate for the harvest was hemlock branches (Figure 1). Ninety-nine percent (83,844 lb) of estimated harvests occurred on hemlock branches, while less than 1% was herring spawn-on-kelp (459 lb), or spawn harvested on hair seaweed (251 lb) (Figure 1; Table 3). The 2016 spawn-on-kelp harvest amount was less than what has been estimated in years past. Harvesting households were also asked if their harvest was the same as, less than, or more than their harvests in recent years. Approximately 80% of the respondents felt they harvested less herring eggs than in recent years, with only 15% reporting similar harvests to years past and no households saying they harvested more (Table 4).

As seen in previous years, the majority of the 2016 harvest was shared with the community of Sitka and beyond. Of the surveyed households that harvested herring spawn in 2016, 75% shared at least some of their harvest (Table 1). This survey only attempted to interview harvesters of herring spawn; however, household surveys in Sitka and elsewhere have shown that households further share received resources. Of the total estimated amount of herring spawn that was harvested, only 3% was kept for use by the harvesting household; the remainder was given away—46% of the pounds harvested remained in Sitka and 51% shipped outside of Sitka (Figure 2; Table 3). In part, this finding is influenced by the overall high proportion of the harvest that comes from the community harvester boats; these boats are treated as individual households and all the harvest from the boat is assigned to that household (even though the individuals on board the vessel participating in the harvest may come from several different households). Spawn on hemlock branches composed most of the harvest, by weight (92%), kept for the harvester's personal use, but that is largely a factor of the overall higher harvest amounts of spawn harvested on branches (Table 3). The majority of the spawn-on-branches harvest was shared, with only about 3% kept for personal use (Table 3). In contrast, 38% of all the spawn on kelp harvested was kept for personal use; the rest was shared (Table 3). In 2016, herring spawn from Sitka Sound was shared with residents of at least the following communities: Anchorage, Angoon, Utqiaġvik (Barrow), Bethel, Dutch Harbor, Haines, Homer, Hoonah, Hydaburg, Juneau, Kake, Ketchikan, Kotlik, Kotzebue, Metlakatla, Petersburg, Saint Mary's, Soldotna, Tuntutuliak, Wrangell, and Yakutat, as well as communities within Washington and California. In addition, as noted above, boats from Hoonah, Kake, 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 2016. The most common reasons given for not attempting to harvest were that the respondent was "working during the harvest/no time" or that eggs were "received from others." Conflicts with a work schedule and sharing from others have consistently been the most common reasons given for not participating in the harvest.

Other reasons given in 2016 were “transportation” and “personal/health reasons” (Figure 3). “Transportation” includes lack of access to a boat, a broken motor or other equipment, or too-high fuel costs. Of those harvesters who responded that they harvested less in 2016 than in previous years (Table 4), 35% felt they did so because it was a poor year or the eggs were poor quality, while 29% said it was because of resources availability (Figure 4).

Table 1.–Estimated subsistence harvest of herring spawn in Sitka Sound, 1983, 1987, 1996, 2002–2016.

Year	Number of surveyed households[a]	Percentage of households attempting to harvest	Percentage of households harvesting	Percentage of harvesting households giving away herring spawn	Percentage of harvesting households receiving herring spawn	Estimated values: Estimated number of households attempting to harvest	Estimated values: Estimated number of households harvesting	Estimated values: Estimated harvest, all substrates, pounds	Estimated values: 95% confidence interval (± %)	Estimated values: Range: low	Estimated values: Range: high
For the following 3 years, the data pertain to the entire population of Sitka, based on a random sample.											
1983[b]	139	n/a	24.0%	n/a	n/a	n/a	586	42,000[a]	n/a	n/a	n/a
1987[b]	296	n/a	9.0%	n/a	n/a	n/a	261	20,494[a]	91%	1,755	39,235
1996	150	16.0%	15.0%	n/a	20.0%	476	464	127,174	72%	35,131	219,217
For the following 15 years, the data pertain to only those Sitka households identified as potential participants in the subsistence herring spawn fishery.											
2002	86	n/a	71.0%	95.0%	40.0%	n/a	77	151,717	23%	116,701	186,734
2003	118	72.0%	71.0%	88.0%	30.0%	117	116	278,799	19%	225,704	331,895
2004	144	61.0%	60.0%	93.0%	17.0%	120	118	381,226	18%	312,224	450,229
2005	159	61.0%	52.0%	82.0%	13.0%	111	95	79,064	9%	72,272	85,856
2006	127	58.0%	55.0%	91.0%	27.0%	93	88	219,356	20%	176,484	262,228
2007	126	55.0%	48.0%	89.0%	43.0%	92	81	87,211	22%	67,702	106,720
2008	128	45.0%	41.0%	73.0%	52.0%	59	54	71,936	6%	67,764	76,108
2009	150	48.0%	48.0%	89.0%	79.0%	91	91	213,712	9%	193,623	233,801
2010	132	30.0%	30.0%	85.0%	12.5%	40	40	154,620	10%	139,872	169,367
2011	97	38.5%	35.4%	94.0%	35.0%	57	53	83,443	5%	79,719	87,166
2012	75	45.0%	43.2%	84.0%	88.0%	50	47	115,799	12%	102,332	129,265
2013	59	64.4%	62.7%	86.1%	27.7%	52	50	78,090	10%	70,075	86,106
2014	60	68.3%	67.8%	87.5%	31.7%	68	68	154,412	13%	135,054	173,769
2015	58	67.2%	65.5%	56.9%	17.2%	52	51	106,998	21%	84,664	129,333
2016	64	40.4%	37.2%	74.8%	0.0%	38	35	84,554	41%	50,028	119,079

Sources STA and ADF&G Division of Subsistence household surveys, 2016; CSIS; Brock and Turek (2007); Sitka Tribe of Alaska household surveys, as summarized in Gmelch and Gmelch (1985); Holen et al. (2011); and Sill and Lemons (2012, 2014a–b, 2015, 2017).

Note n/a = data were not collected during the study year.

a. The number of surveyed households includes community harvester boats, which are treated as an individual household for the purposes of this analysis.

b. 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.

Table 2.–Subsistence harvest of herring spawn by type of harvester and total estimated harvest, Sitka area, 2016.

Resource	Percentage of potential participant households[a]		Estimated pounds harvested	Confidence interval		
	Attempted	Harvested	Total	CI %	Low	High
Sitka households (n=59)						
Herring spawn on hemlock branches	27.1%	25.4%	14,360.5	59.5%	5,810.8	22,910.1
Herring spawn on kelp	18.6%	16.9%	458.5	72.3%	127.0	789.9
Herring spawn on hair seaweed	6.8%	6.8%	251.4	140.8%	172.9	605.3
Subtotal, herring spawn, all types	***35.5%***	***32.1%***	***15,070.4***	***56.4%***	***6,574.0***	***23,566.8***
Community harvester boats (n=5)						
Herring spawn on hemlock branches	100.0%	100.0%	69,483.3	65.9%	23,720.6	115,245.9
Herring spawn on kelp	21.4%	0.0%	0.0	NA	NA	NA
Herring spawn on hair seaweed	0.0%	0.0%	0.0	NA	NA	NA
Subtotal, herring spawn, all types	***100.0%***	***100.0%***	***69,483.3***	***65.9%***	***23,720.6***	***115,245.9***
Total	**40.4%**	**37.2%**	**84,553.6**	**40.8%**	**50,028.2**	**119,079.0**

Source STA and ADF&G Division of Subsistence household surveys, 2016.

a. Based on the total number of surveyed households (n=64); community harvester boats are treated as an individual household for the purpose of this analysis.

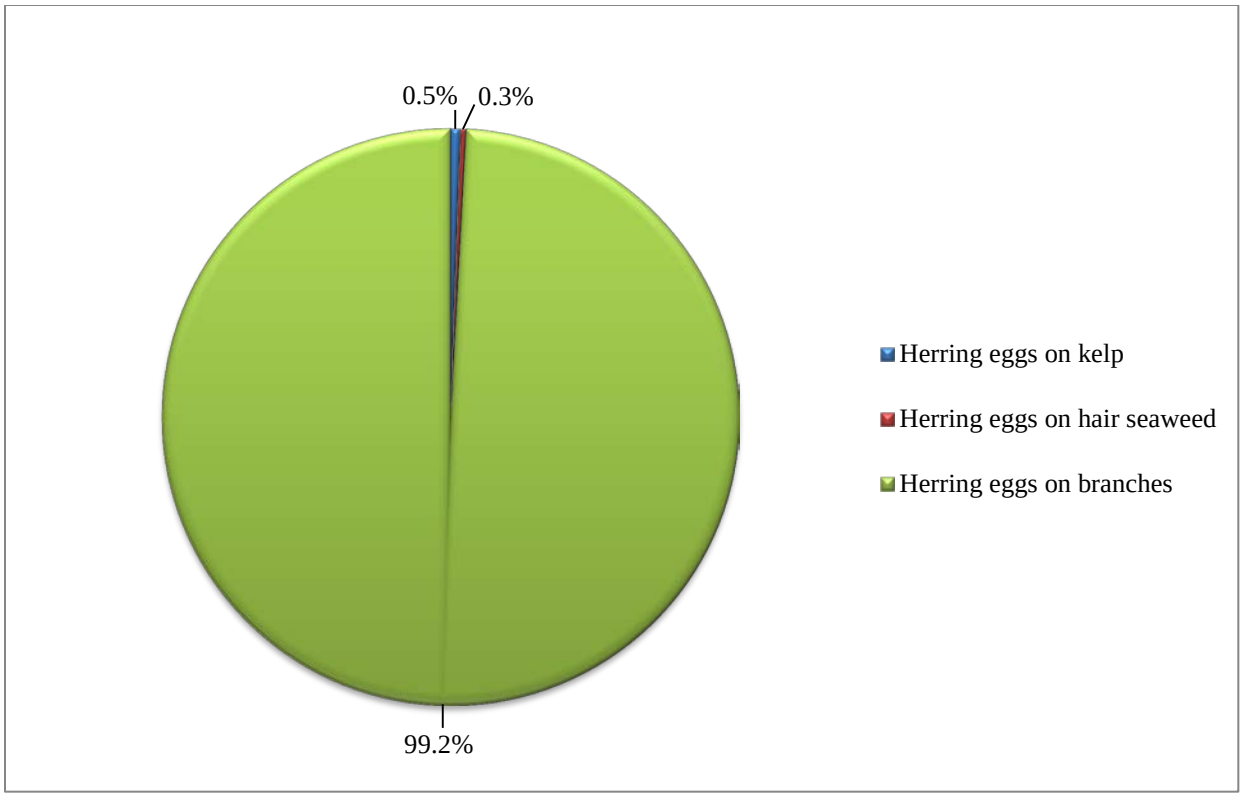

Figure 1.–Distribution of subsistence herring spawn harvest by substrate, Sitka area, 2016.

Table 3.–Distribution of subsistence herring spawn harvest, Sitka area, 2016.

	Estimated harvest						
	Kept for own use		Shared within Sitka		Shared outside of Sitka		
Resource	Pounds	Percentage of substrate harvest	Pounds	Percentage of substrate harvest	Pounds	Percentage of substrate harvest	Total pounds
Herring spawn on kelp	174	37.8%	76	16.6%	209	45.5%	459
Herring spawn, hair seaweed	23	9.1%	229	90.9%	0	0.0%	251
Herring spawn on hemlock branches	2,241	2.7%	38,328	45.7%	43,275	51.6%	83,844
Herring spawn, all types	**2,438**	**2.9%**	**38,633**	**45.7%**	**43,483**	**51.4%**	**84,554**

Source STA and ADF&G Division of Subsistence household surveys, 2016.

Table 4.–Harvesting households' perception of herring spawn harvest compared to previous years, Sitka area, 2016.

Number of harvesting households responding	Household comments by percentage of responses			
	Less	Same	More	Does not use herring spawn
20	80.0%	15.0%	0.0%	5.0%

Source STA and ADF&G Division of Subsistence household surveys, 2016.

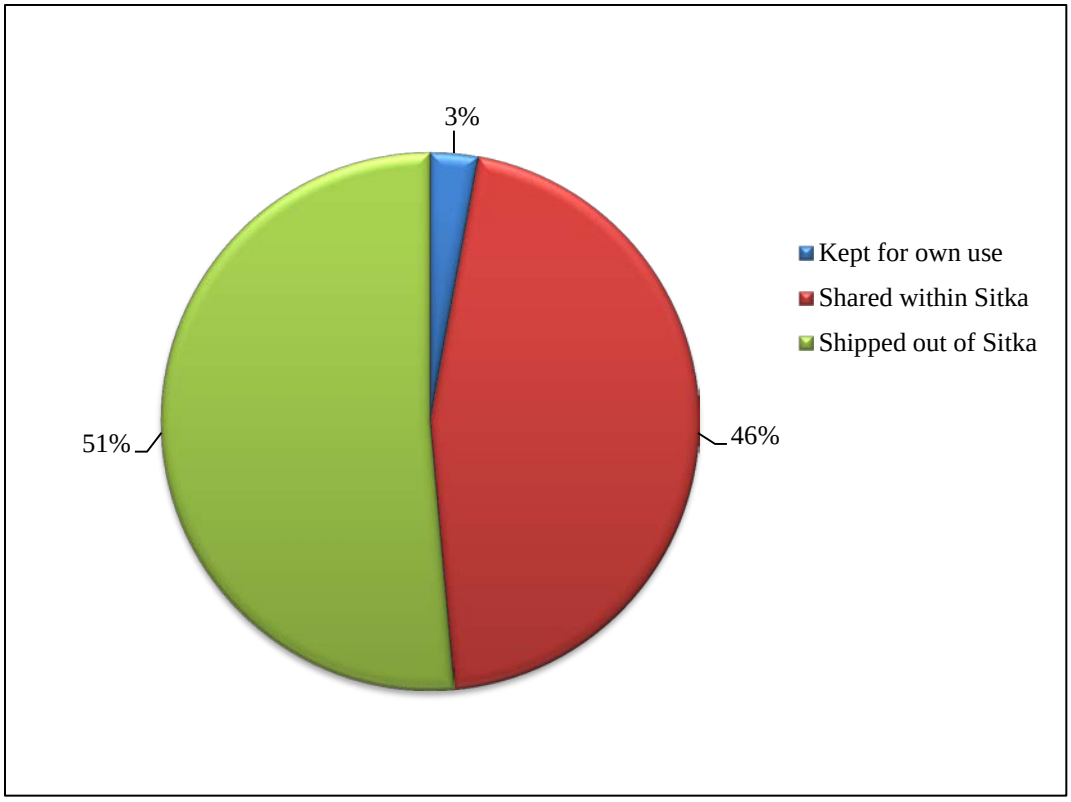

Figure 2.–Percentage of total Sitka Sound subsistence harvested herring spawn that was shared, 2016.

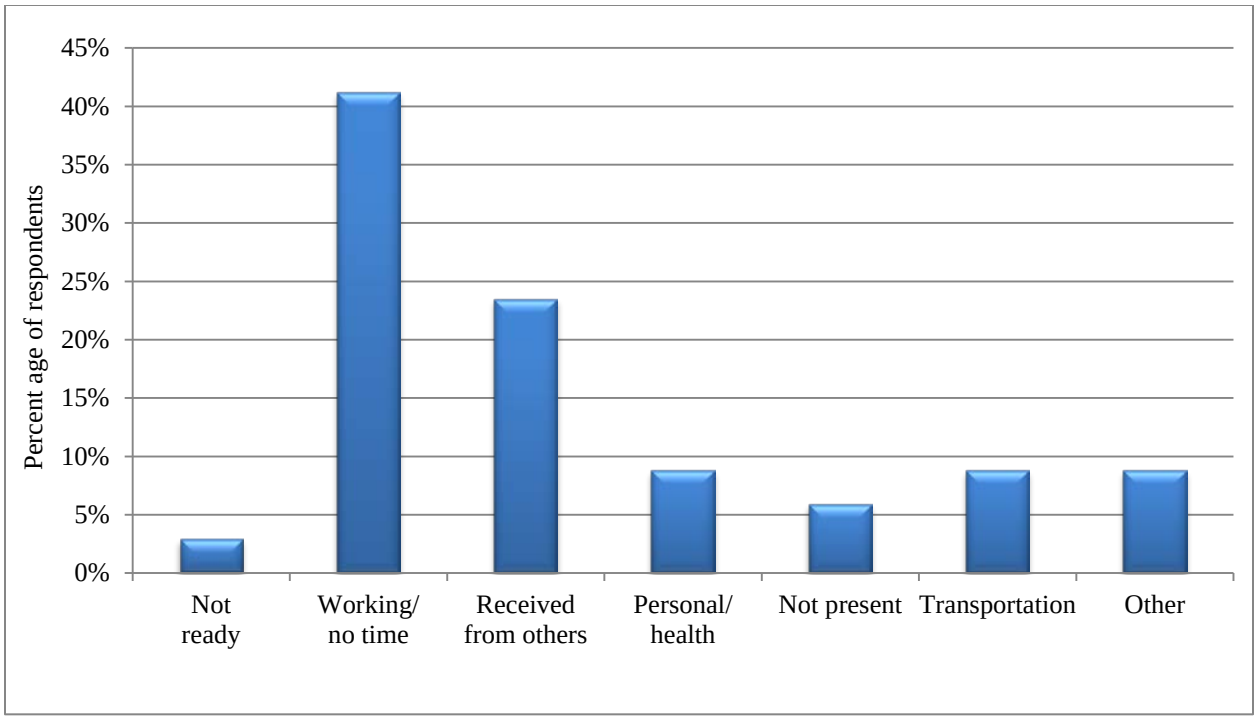

Figure 3.–Reported reasons households did not attempt to harvest herring spawn, Sitka area, 2016.

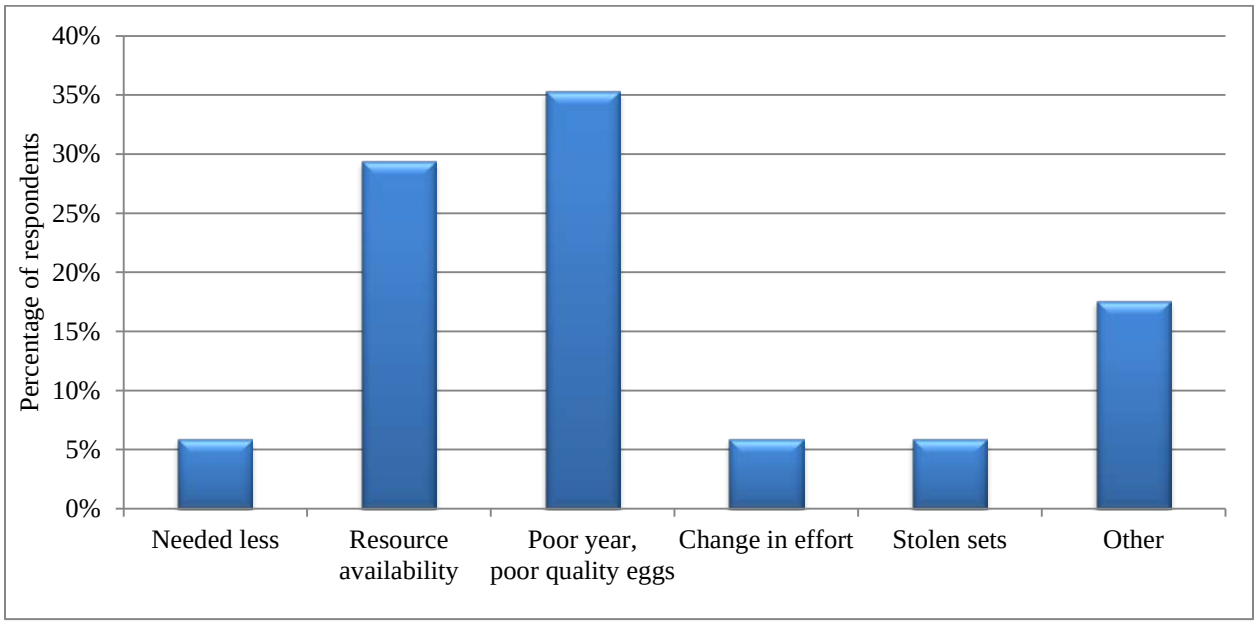

Figure 4.–Reasons given for why household harvests were less in 2016 than in recent years, Sitka Sound harvesters, 2016.

CONVERSION FACTORS

In past project years, researchers documented 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. In 2016, due to the unavailability of dock space at the winch, raw weights of branches off the boat could not be taken. Table 5 presents the conversion factors for 2010 through 2016. Conversion factors were not calculated prior to 2010. In 2014 and 2015, a conversion factor was not calculated for quart-sized bags.

Table 5.–Conversion factors for 2010–2016.

	Estimated average weight (pounds)						
Container type, spawn on branches	2016	2015	2014	2013	2012	2011	2010
Sea-Pro large (50 lb) wetlock box	55.50	53.98	48.91	52.97	59.10	53.27	57.78
Sea-Pro small (25 lb) wetlock box	25.20	25.64	24.68	22.78	28.50	24.88	25.50
Ziploc gallon bag	3.39	3.68	4.12	3.94	4.43	3.87	4.07
Ziploc quart bag	1.09	n/a	n/a	1.35	1.38	1.46	1.42
Container type, spawn on kelp	2016	2015	2014	2013	2012	2011	2010
Ziploc gallon bag	n/a	n/a	n/a	n/a	3.65	n/a	n/a
5-lb bucket	n/a	n/a	n/a	n/a	23.94	n/a	n/a
Sea-Pro small (25 lb) wetlock box	n/a	n/a	n/a	16.67	n/a	n/a	n/a

Sources STA and ADF&G Division of Subsistence household surveys, 2016; Holen et al. (2011); and Sill and Lemons (2012, 2014a–b, 2015, 2017).

Note n/a indicates conversion factors were not calculated for these years.

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 5. The majority of the harvests occurred in the core area of Sitka Sound. As can be seen more readily in Table 6, the most heavily used location in 2016 was the Crow/Gagarin islands area (17% of responding households used that location), followed by the Kasiana islands group, South Middle Island, and Big/Little Gavanski islands (13% at each location). Effort in 2016 seemed to be more distributed, with no location garnering more than 20% of the harvest effort and more documented locations than in previous years.

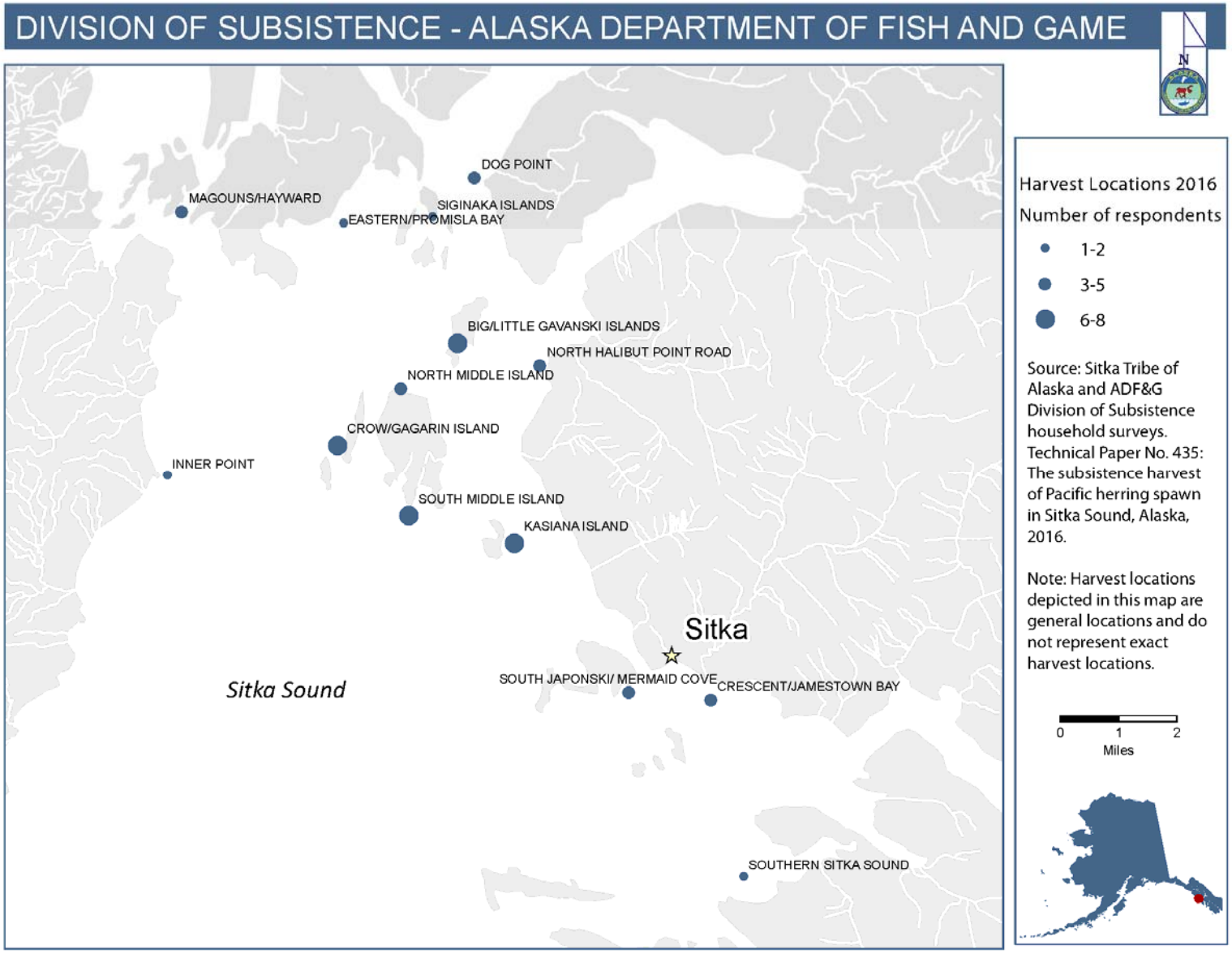

Figure 5.–Reported harvest locations of herring spawn for subsistence use, 2016.

Table 6.–Reported locations of subsistence herring spawn harvest, Sitka Sound, 2015.

Location	Reported households using each location	Percentage of harvesting households using each location
Crow/Gagarin Islands	8	17.0%
Kasiana Islands Group	6	12.8%
South Middle Island	6	12.8%
Big/Little Gavanski Islands	6	12.8%
North Middle Island	3	6.4%
Dog Point (Lisianski Peninsula)	3	6.4%
South Japonski/Mermaid Cove	2	4.3%
North Halibut Point Road	2	4.3%
Magouns/Hayward	2	4.3%
Katlian Bay	2	4.3%
Crescent/Jamestown Bay	2	4.3%
Siginaka Islands	1	2.1%
Eastern/Promisla Bay	1	2.1%
Southern Sitka Sound	1	2.1%
Other	2	4.3%

Source STA and ADF&G Division of Subsistence household surveys, 2016.

3. DISCUSSION

CHARACTERISTICS OF HERRING SPAWN SHARING, HARVEST AREAS, AND PARTICIPATION, 2016

The 15th year of the harvest monitoring program documented many characteristics similar to years past. The subsistence harvest of herring eggs was widely shared, both in quantity and in geographic breadth. Despite an overall smaller harvest than in recent years, the majority of harvesters shared a portion of their harvest. Continuing a trend of the past few years, the community harvest boats composed the largest proportion of the total harvest. The harvest remained focused on the islands just offshore from town, but in 2016 a broader geographic harvest area was documented, extending up into Salisbury Sound, south into the southern reaches of Sitka Sound, and as far west as Kruzof Island. Conflicts with work schedules and receiving eggs from others continued to be the main reasons that surveyed households did not attempt to harvest herring eggs in 2016. Herring eggs on hemlock branches continue to be the source of the majority of the harvest.

Sharing of resources is a characteristic of subsistence economies. In specialized harvests, such as of herring eggs, where specific knowledge and skills are required for a successful harvest, sharing is even more profound. The pattern of a small number of households ("super-households") harvesting and then distributing a unique resource is common since these "super-households" have the time, ability, knowledge, and equipment necessary to successfully harvest (Wolfe et al. 2010). Specialized harvesters provide the resource, in this case herring eggs, to a much larger percentage of households. In 2016, despite most harvesters feeling that they harvested less than in previous years, 75% of harvesters shared some of their harvest (Table 4; Table 1). Herring eggs on hemlock branches is the product most heavily shared with others; herring spawn on kelp and on hair seaweed tend to be reserved for the harvester's own use, though, as in 2016, some is shared every year. Because this project specifically targets potential herring harvesters, inferences about overall use of herring eggs cannot be made from these results. However, comprehensive surveys recently administered in 7 Southeast Alaska communities show herring eggs are widely used in these communities (Sill et al. 2017; Sill and Koster 2017a–b); see further discussion to follow in section "Changes in Use of Herring Spawn."

In terms of where harvesters go to set their branches, year after year there is a "core" area around the islands offshore from town. This area has historically been important to the herring egg harvest and STA was successful in requesting the Alaska Board of Fisheries to close part of the area to commercial herring fishing. In 2016, the majority of harvesters set their branches in this area, especially around Middle Island, Crow/Gagarin islands, and Kasiana islands. The area has dependable spawn, good quality substrate, and somewhat protected waters—all factors that contribute to the area's importance for the harvest. While herring eggs can usually be found in this core area, the herring spawn throughout Sitka Sound in different locations each year. In 2016, harvest was documented across a broad swath of Sitka Sound, including the northern reaches and into Salisbury Sound, as well as in the southern portion of the sound. The harvest survey does not systematically document amounts of eggs harvested from each location, so while it is seen that the majority of harvesters set branches in the core area, it is not known where the most productive harvest per unit of effort occurred (the SHCA-sponsored boat did report harvest by location, and for this boat, South Middle Island provided the most productive harvest, followed by West Kasiana Island.)

The number of harvesters and the overall amount of the harvest differ from year to year, as do the qualitative assessments from harvesters of the quality of the eggs. Other dynamic variables include the miles of shoreline that receive spawn, the number of consecutive days of spawn in an area, the days of the week spawning activity is present, and the weather.

After a general increasing trend over several years, since 2014 the number of harvesters participating in the harvest has been declining, with fewer harvesters in 2015 and 2016 (Figure 6). The estimated number

of harvesters in 2016 is the lowest number of harvesters estimated over the course of this project; the total harvest is also low, though not the lowest on record. Harvester numbers likely influence the total harvest, but other factors also affect the harvest amount. Harvester numbers vary from year to year due to a variety of reasons, including difficulty finding time to participate, receiving herring eggs from others, or the cost of fuel or boat maintenance. As in years past, one of the main reasons for not harvesting herring eggs is that the respondent was working during the harvest (41%) (Figure 3). With little advance notice of spawning events and uncertainty about how long the event will last, planning for the time off can be a challenge. Another major reason given for not participating was that the respondent had received eggs from others (24%). As potential harvesters are presented with various challenges from work schedules and the increasing costs of fuel and boat maintenance, some will rely on the availability of eggs from others in the community for any given year. The annual presence of the STA Traditional Foods program and the SHCA boat provides some assurance that some eggs will be available to those who cannot or do not harvest.

Shewmake (2013) argues that successful harvests in Sitka Sound are predicated on 2 groups of factors, broadly categorized as social opportunity and ecological opportunity. On the social side are issues like sufficient time, resources, knowledge, and skills to engage in harvesting activities. Within the ecological grouping the main factor is the quality of the eggs, which is influenced by timing, duration, location, and weather. Good quality eggs cover the substrate several layers deep and lack impurities, such as sand. Thickness of deposition is related to the number of days of the spawning activity, as well as other factors such as the size or density of the spawning school of herring. It has been found that mean consecutive 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 [2014a] and a thesis by James Shewmake (2013)]). The ADF&G Division of Commercial Fisheries documents total days of spawning activity and the number of miles of shoreline with active spawn, but there is not an analysis of how many days of spawning activity each section of shoreline receives. In 2016, 63.2 nautical miles of spawn were recorded over 2 separate spawning events lasting a total of 19 days. The nautical miles of spawn documented is about average, with a long-term average spawn of 61.0 nautical miles and a recent 10-year average of 65.0 nautical miles.[5] However, while spawning began in 2016 on March 18, STA did not have any sets with harvestable product until March 26. The first spawn ended on March 28. Other harvesters may have had different experiences from STA. For comparison, the SHCA-sponsored boat set out its branches on March 23 and began pulling its first sets with harvestable product on March 27. The overall number of miles of herring spawn in itself does not provide enough information to assess the opportunity available to harvesters because of the limitation in where quality subsistence harvests can occur. In contrast, a harvester's assessment of the length of the spawn and quality of the season is more likely 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.

5. Alaska Department of Fish and Game Division of Commercial Fisheries, "Sitka Sound Herring Fishery Announcement," news release, May 2, 2016. Available online: http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/655851430.pdf (accessed September 2017).

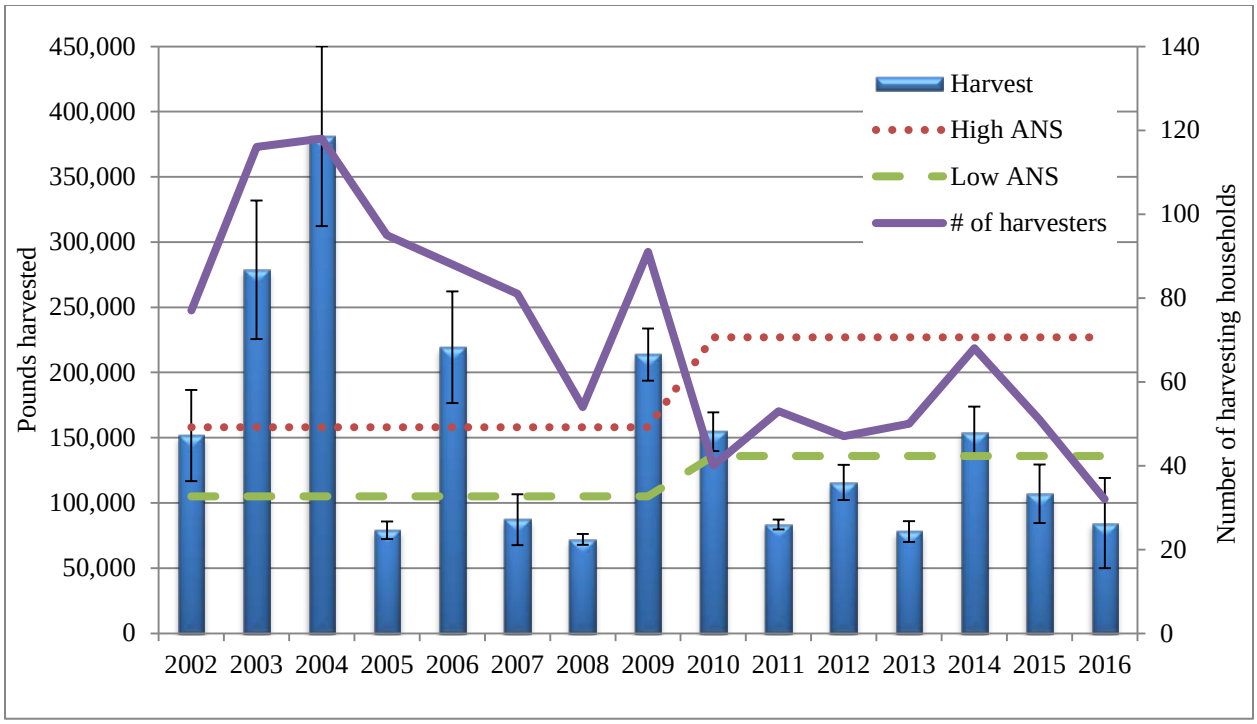

Figure 6.–Total pounds usable weight of herring spawn harvested, number of harvesting households, and amount reasonably necessary for subsistence (ANS) of herring spawn on all substrates in Sitka Sound, 2002–2016.

CHANGES IN USE OF HERRING SPAWN

As stated above, this research project targets herring egg harvesters so it does not allow for analysis of the wider use of herring eggs within Sitka or other communities. The study had been able to document a general decrease in the participation of the subsistence herring egg harvest over the last 12 years, but there are little data available to speak to changes in overall use of the resource, either within Sitka or in other Southeast Alaska communities, or overall participation in the processing of herring eggs. In 2013, 2014, and 2016, several comprehensive subsistence harvest and use studies were conducted in Southeast Alaska communities. The use of herring eggs was documented in Hydaburg, Hoonah, Haines, Angoon, Sitka, and Yakutat; Whale Pass was surveyed, but no herring eggs were used in 2012 (Sill et al. 2017; Sill and Koster 2017a–b). Sharing in all of these communities is widespread; the percentage of households using herring eggs on hemlock branches ranged from 15% in Haines to 77% in Hydaburg, while the percentage of households harvesting eggs on hemlock branches was much lower, ranging from 0% in Angoon to 23% in Hydaburg (Figure 7). The majority of respondents indicated that the eggs they used or harvested came from Sitka, with the exception of Hydaburg residents who also harvested and used eggs from the Craig/Klawock area (Table 7); the Yakutat survey did not ask respondents to identify where herring eggs used and harvested came from, but some volunteered that herring eggs were shared or bartered for from Sitka and also harvested locally. In this limited sample of communities in Southeast Alaska, the use of herring eggs from Sitka Sound remains high, and patterns of sharing remain evident and of importance. 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.

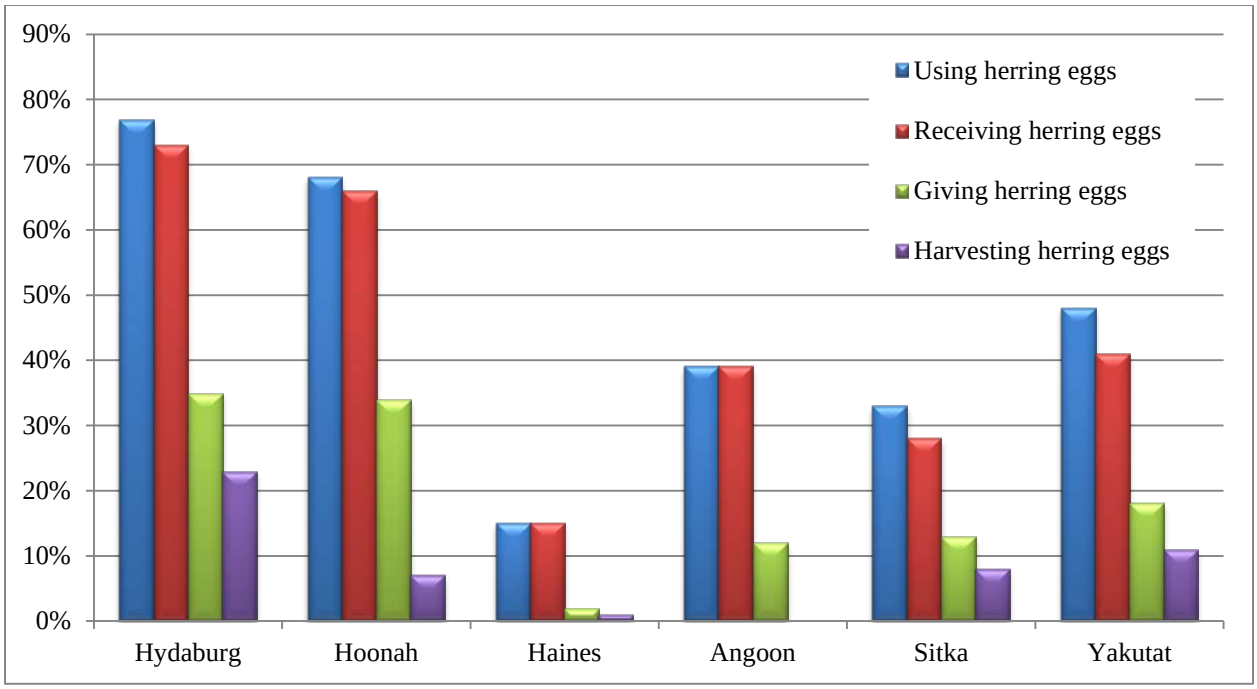

Figure 7.–Percentage of households using, receiving, giving, and harvesting herring eggs, Hydaburg, Hoonah, Haines, and Angoon, 2012; Sitka, 2013; and Yakutat, 2015.

Table 7.–Locations where residents reported herring eggs were sourced, Angoon, Haines, Hoonah, Hydaburg, and Whale Pass, 2012.

	Valid responses									
	Angoon		Haines		Hoonah		Hydaburg		Whale Pass	
Source	No.	%	No.	%	No.	%	No.	%	No.	%
Craig	0	0.0%	0	0.0%	1	1.7%	21	51.2%	0	0.0%
Haines	0	0.0%	1	8.3%	0	0.0%	0	0.0%	0	0.0%
Hoonah	0	0.0%	0	0.0%	1	1.7%	0	0.0%	0	0.0%
Sitka	20	100.0%	11	91.7%	57	96.6%	20	48.8%	0	0.0%
Total	**20**	**100.0%**	**12**	**100.0%**	**59**	**100.0%**	**41**	**100.0%**	**0**	**0.0%**

Source ADF&G Division of Subsistence household surveys, 2013.

Note Includes only valid responses containing a named city; households were permitted to identify multiple sources.

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 greater 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. 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.

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, which is also where the frequency of herring spawn is highest (Figure 8). Looking at a smaller scale, there is year-to-year variability in the locations used for the harvest within the broader core area; this variability occurs for a number of reasons. Within limits, harvesters will go where the herring are spawning. Herring do not have site fidelity like salmon; therefore, the specific beaches and coves 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 become 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 harvest. 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 affected by development.

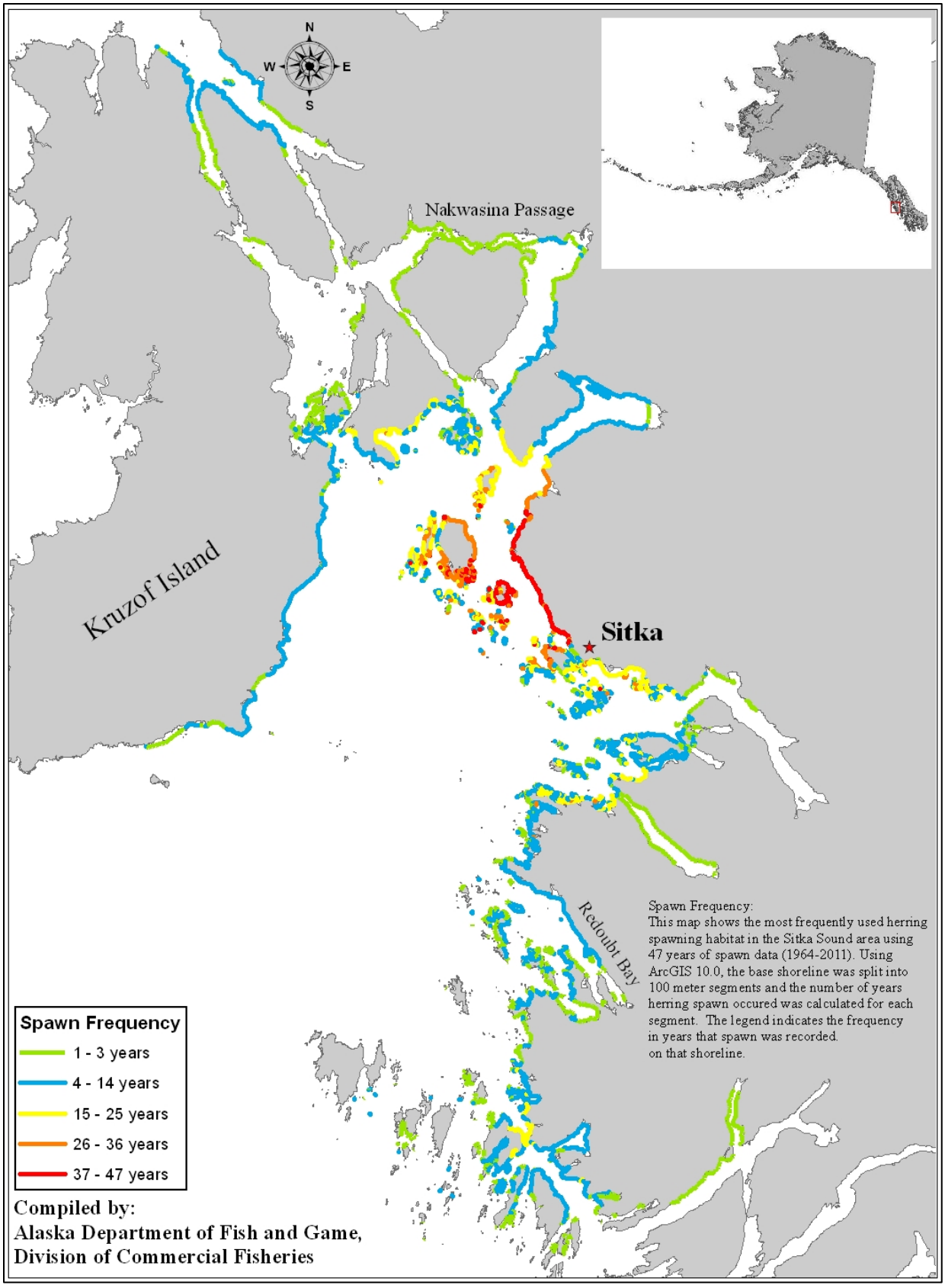

Figure 8.–Frequency of recorded spawn in Sitka Sound, 1964–2011.

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; the amount of spawn a household may harvest is not limited through this system since multiple permits may be obtained). Beginning in 2012 and continuing through 2015, researchers concentrated additional effort on identifying and contacting spawn-on-kelp harvesters. In 2016, the harvest survey estimated a relatively low 459 lb (Table 3), while the preliminary permit data show a harvest of 2,028 lb.[6] Further study of spawn-on-kelp harvesters would be warranted to compare differences in participation to that of egg-on-branches harvesters. Comparisons of success rates and responses to annual changes in geographic spawn distribution between both sets of harvesters could also be investigated.

6. Preliminary data released by the Alaska Department of Fish and Game Division of Commercial Fisheries to the Division of Subsistence.

4. CONCLUSION

Although participation in the subsistence harvest of herring spawn from Sitka Sound has generally dropped since the early 2000s, and more recently since 2014, harvesting and sharing eggs remain important cultural activities for Southeast Alaska residents. Overall harvest amounts are influenced by the amount of harvest effort, 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 due to the possible effect of the commercial sac roe herring harvesting activities 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.

ACKNOWLEDGMENTS

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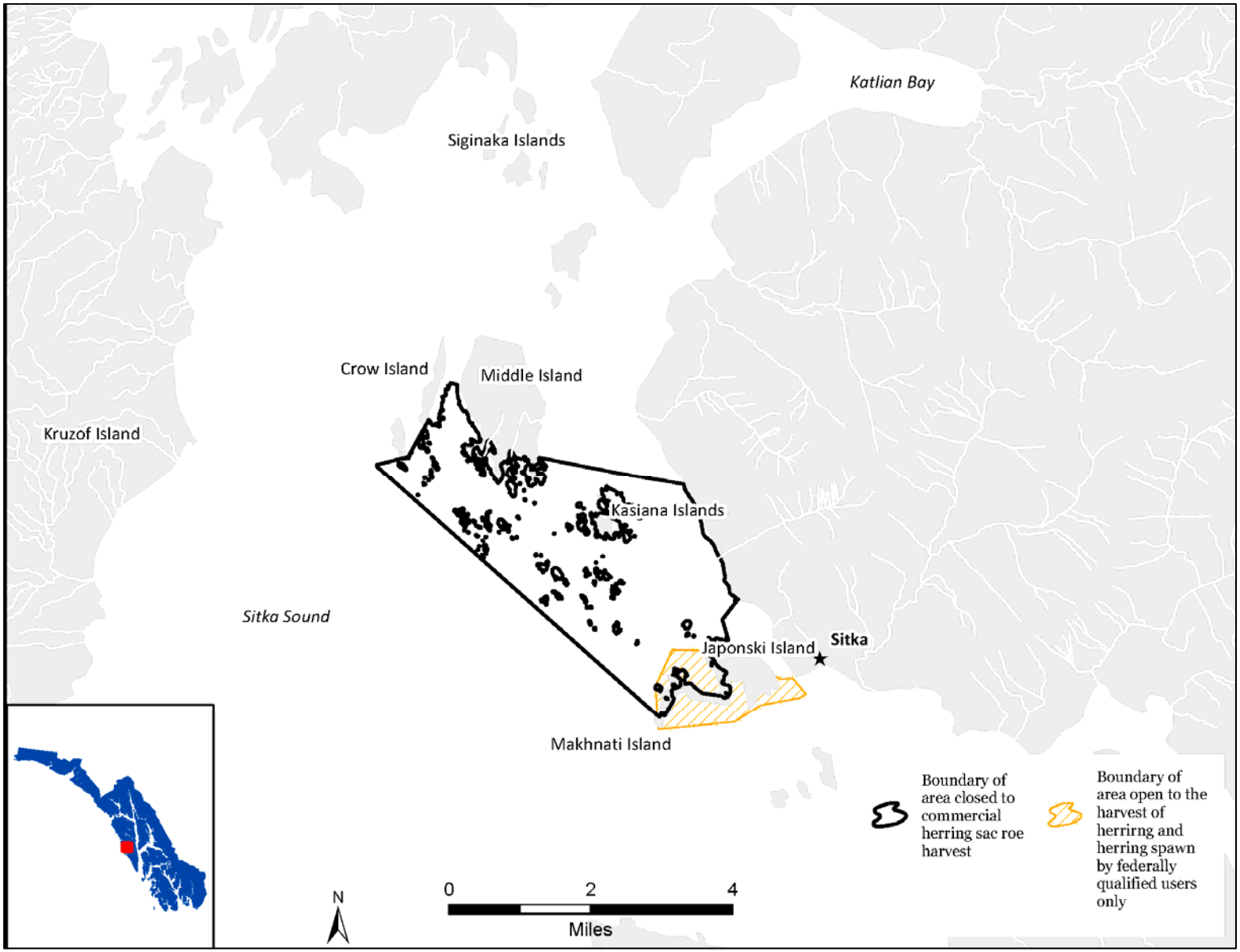
APPENDIX A: MAP OF AREAS OF SITKA SOUND WITH FISHING RESTRICTIONS



Appendix Figure A-1.–Waters of Sitka Sound with limitations on the harvest of herring and/or herring spawn.

APPENDIX B: SITKA SOUND SUBSISTENCE HERRING EGG HARVEST SURVEY, 2016

HERRING EGG SUBSISTENCE HARVEST SURVEY
SITKA, ALASKA
2016

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

907-747-7168

DIVISION OF SUBSISTENCE
ALASKA DEPT OF FISH & GAME
802 3RD STREET
JUNEAU, AK 99801

907-465-3617

HARVESTS: HERRING EGGS

HOUSEHOLD ID

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

In 2016...
...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 2016 fill out the rest of the survey. Otherwise, end survey here.

How many people lived in your household in 2016? ..... ____

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

If YES, which one? ..... _____

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 2016 DID MEMBERS OF YOUR HH...				IN 2016, 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	Units
	(circle)				*(amount used for each purpose)*			
Herring eggs on hemlock branches	Y N	Y N	Y N	Y N				LB
Herring Eggs								
Herring eggs on kelp	Y N	Y N	Y N	Y N				LB
Herring Eggs								
Herring eggs on hair seaweed (né)	Y N	Y N	Y N	Y N				LB
Herring Eggs								

These columns should include all the herring eggs harvested by members of this household in 2014.

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

COMMUNITY	

NOTES: _____

HARVESTS: HERRING EGGS **HOUSEHOLD ID**

ASSESSMENT: HERRING EGGS

What size vessel(s) did you use to harvest herring eggs in 2016?.....____

In 2016...

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

How do you feel your 2016 HARVEST was compared to other years?..... X L S M

If LESS or MORE, why was your harvest different?

_____

_____

_____

_____

If you HARVESTED LESS herring eggs in 2016, what was the last year you remember having a good harvest? _____

How many households do you typically harvest for?.....____

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

NOTES: _____

Did you notice anything this year that you think would affect herring egg survival? Y N

If yes, what? _____

_____

COMMENTS

DO YOU HAVE ANY QUESTIONS, COMMENTS, OR CONCERNS ABOUT THE 2016 SUBSISTENCE HERRING EGG HARVEST?

_____

_____

_____

_____

_____

_____

_____

HARVESTS:

HOUSEHOLD ID

Where did you harvest your herring eggs in 2016 - set branches, harvest seaweed, macrocystis kelp?

	Location	# of sets... made	# of sets... harvested	Amount harvested	Quality (coverage, thickness)	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	Siginaka 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	Southern Sitka Sound						
18	Other:						

LOCATION

SITKA: 313

APPENDIX C: 2016 CODE BOOK

Subsistence Herring Egg Harvest Survey 2016

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

Page 1: Harvests

If household did not try to harvest herring eggs in 2015, why not?	Code
Harvester - no response necessary	Blank
Didn't need	1
Working during the harvest/no time	2
Received from others	3
Personal or health issues	4
Out of town	5
Transportation/no boat/fuel costs	6
Didn't go out	7

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
Native Village of Savoonga	6
Angoon Community Association	7

Page 2: Assessments

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
no boat used - harvested from shore	6

Page 2: Assessments (cont)

If less or more HARVEST, why?

Non-harvester - no response necessary	Blank
Needed less	1
Resource availability	2
Poor year/quality	3
More effort/less effort	4
Stolen sets	5
Other	6

Last good harvest year?

2011-2015	1
2000-2010	2
1990s	3
1980s	4
1970s	5

How many households usually harvest for?

1	1
2-5	2
6-10	3
11-50	4
51-100	5
100+	6

Observations impacting herring egg survival?	Code
Commercial fishery	1
Environmental	2
Predation	3
Spawn	4

Do you have any additional comments about the 2016 subsistence herring egg harvest?	Code
Poor year compared to past	1
Traditional area not good	2
Concerned about the effect of the commercial fishery on the resource	3
More effort/less harvest	4
Thin deposition	5
Concerned about ADF&G management	6
Other (predation, behavior, theft)	7