Subsistence Management Recommendations and Guidance for Implementing 5 AAC 27.195

EXECUTIVE SUMMARY

Subsistence Management Recommendations:

1. Exercise existing regulatory authority to delay commercial fishery openings in order to ensure a reasonable opportunity for subsistence
2. Prohibit commercial fishery openings near areas with productive subsistence sets
3. Strictly limit the amount and timing of the commercial test fishery
4. Prohibit the commercial fishery from over-fishing large herring, *i.e*., "high grading"
5. Verify the forecasted biomass through in-season ground-truthing and adjustments to the guideline harvest level (GHL)
6. Consult with STA and subsistence harvesters during the commercial season, especially prior to commercial openings to assess impacts on subsistence uses
7. Use the best available information in all management and research decisions
8. Apply the precautionary principle to all management decisions
9. Conduct a Management Strategy Evaluation after the 2021 season in collaboration with STA and subsistence harvesters

Factors for Determining Whether There is a Reasonable Opportunity for Subsistence:

a. The Amount Necessary for Subsistence (ANS)
b. Quantity of Herring Spawn on Branches, Kelp, and Seaweed
    i. The forecast biomass
    ii. The effect of commercial harvests on the quantity of herring spawn available for subsistence harvesters
c. Quality of Herring Spawn on Branches, Kelp, and Seaweed
    i. Location of spawn (substrate)
    ii. Accessibility of herring spawn to subsistence harvesters
    iii. Duration (mile-days) of spawning events in subsistence areas
d. Age and Weight of Spawning Population
e. Effects of the Commercial Fishery on Subsistence Harvests
    i. Proximity of commercial openings to subsistence areas
    ii. Duration and timing of commercial openings
    iii. Test fisheries
    iv. Intensity of commercial effort

INTRODUCTION

In December 2018, STA filed a lawsuit against the State of Alaska to protect subsistence harvesters' rights to collect herring spawn within Sitka Sound.[1] One of the central issues in the lawsuit was ADF&G's management of the commercial and subsistence herring fisheries. In 2020, the superior court ruled in favor of STA. The court concluded that ADF&G's interpretation and implementation of its duties under 5 AAC 27.195, and its management of the commercial fishery since 2003, was illegal.

In light of the court's rulings, ADF&G must adopt a new management approach for the Sitka Sound herring fishery in 2021. ADF&G may not continue to illegally prioritize the commercial fishery's efforts to achieve the maximum guideline harvest level (GHL) over subsistence harvesters' needs. When the Alaska Board of Fisheries adopted the current regulations governing the herring fishery, the Board specifically directed ADF&G to make determinations regarding whether subsistence harvesters have a reasonable opportunity to harvest the amount of herring spawn necessary for subsistence (ANS) and to disperse the commercial fishery by time and area to ensure a reasonable opportunity is maintained. The court rejected ADF&G's narrow interpretation of its authority under 5 AAC 27.195 and made it clear that ADF&G has failed to follow the Board's direction to manage the commercial fishery to protect the opportunity for subsistence harvesters.

STA has developed the following subsistence management recommendations and guidance for ADF&G to implement 5 AAC 27.195 during the 2021 herring season and beyond. Part I details management recommendations for ADF&G to implement in order to comply with their legal obligations under the Alaska Constitution, Alaska's subsistence statute and the Board's regulations. The management recommendations are aimed at ensuring ADF&G manages both the subsistence and commercial herring fisheries to ensure the subsistence priority is achieved as required by law, and that subsistence harvesters have a reasonable opportunity to harvest the amount of quality herring spawn necessary for subsistence uses. The management recommendations are also predicated upon a stance of transparency and cooperative management, and recognize the necessity for pre-season, in-season, and post-season consultation with representatives of the Sitka Tribe of Alaska, which interacts regularly with subsistence herring egg harvesters and Local and Traditional Knowledge bearers before, during, and after the herring fishery each year.

[1] *Sitka Tribe of Alaska v. State of Alaska, Department of Fish & Game*, 1SI-18-00212CI.

Part II provides guidance for implementing 5 AAC 27.195 during the 2021 season. ADF&G's management must ensure that subsistence harvesters have a reasonable opportunity to harvest the amount of herring spawn necessary for subsistence.

To date, ADF&G has not articulated a clear strategy for managing the commercial fishery consistent with 5 AAC 27.195. ADF&G's 2021 Southeast Alaska Herring Sac Roe Fishery Management Plan states that if ADF&G "determines that either a reasonable opportunity in the subsistence roe fishery will not be achieved through the implementation of existing regulations or that commercial fishery will not permit adequate quality and quantity of subsistence roe harvest, then the department will make those adjustments in fishing time and area for the commercial fishery that it believes will provide a reasonable opportunity for the subsistence harvest of quality roe on branch, kelp, or seaweed." But the Fishery Management Plan does not indicate how ADF&G will determine whether there is a reasonable opportunity for subsistence.

It is ADF&G's responsibility to determine whether a reasonable opportunity for subsistence exists. According to the court, reasonable opportunity "determinations are important; they have the potential of directly altering the allocation of the fishery between the subsistence and commercial harvests." ADF&G must make the determination "before opening the commercial fishery" and must articulate a connection between the available information and a decision to open the fishery.

STA expects that ADF&G will consider all of the available information in determining whether there is a reasonable opportunity for subsistence, including at a minimum the factors and information discussed in this Guidance. It is incumbent on ADF&G to explain its decisions, including how it considered all of the relevant factors in a manner that allows the public to understand ADF&G's reasoning with sufficient time to object to the decision prior to a commercial opening.

PART I – SUBSISTENCE MANAGEMENT RECOMMENDATIONS

For over three decades, STA has worked with ADF&G, subsistence harvesters, and the commercial fishing industry to analyze and understand the unique management challenges presented by the Sitka Sound herring fishery. The herring resource has immense environmental, cultural, and economic value; and a certain level of competition between

user groups may be unavoidable. ADF&G's task is to balance the competing demands within Alaska's unique legal framework that guarantees a *priority* for subsistence.[2]

STA submits the following management recommendations for ADF&G to implement during the 2021 season. ADF&G has the authority and legal obligation to manage the commercial fishery to ensure a reasonable opportunity for subsistence. These recommendations will help ADF&G manage a successful fishery in 2021 and beyond.

1. Exercise existing regulatory authority to delay commercial fishery openings in order to ensure a reasonable opportunity for subsistence

ADF&G must consider whether it is necessary to delay commercial fishery openings in order to provide increased opportunity for subsistence harvests. ADF&G has the authority to implement a "full delay"—prohibiting the commercial fishery from opening, even if herring size and roe conditions are optimal, in order to ensure an adequate amount of spawn is achieved and minimize disruptions to herring spawning patterns. ADF&G also may implement "partial delays"—allowing small openings (less than 2,500 tons per day) or waiting a certain number of days between commercial openings.

There is no longer any dispute that ADF&G has the existing regulatory authority under 5 AAC 27.195 to delay the commercial fishery to ensure a reasonable opportunity for subsistence. In 2018, ADF&G erroneously argued that it could not delay commercial openings because doing so would prevent the full commercial GHL from being harvested. According to ADF&G, "[d]elaying [the] start of the fishery until after spawning beings represents a fundamental shift in the way sac roe herring fisheries are managed that could, in some years, result in an inability to harvest the full biologically allowable [GHL]."

ADF&G's mistaken interpretation of its authority was clearly rejected by the court. In the March 31, 2020 decision, the court clarified that ADF&G must explain how it determined whether to open the "commercial fishery during a particular time" and ADF&G may not subordinate "its duty to distribute the commercial harvest by time and area to opening the commercial harvest *in any way*" (emphasis added). ADF&G's "time" authority under 5 AAC 27.195 clearly includes the ability to delay the commercial fishery specifically to increase subsistence opportunity, even if that means the commercial GHL cannot be harvested.

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[2] *See* Ch. 1, § 1(c)(1), SSSLA 1992 ("[S]ubsistence uses of Alaska's fish and game resources are given the highest preference, in order to accommodate and perpetuate those uses.").

ADF&G's decisions must clearly explain *how* it considered whether to delay the commercial fishery in order to provide a reasonable opportunity for subsistence. There is ample evidence that delaying the commercial fishery will provide increased subsistence opportunity. The commercial fishery and subsistence harvesters rely on the same subset of larger, older herring to produce quality herring eggs. According to ADF&G, in 2021, the commercial fishery has indicated that it will target herring with an average weight of 112 grams. These are predominantly 5+ year old herring (the average weight of 5-year old fish is 109 grams). This is also the same age range (5 to 8-year old) that produces the highest quality herring spawn on branches and is desired by subsistence harvesters. (MacCall et al. 2019). As a Tlingit elder and long-time subsistence and commercial fisherman relates: "The three-year old herring don't spawn completely. They show the sign of spawn, but the spawn is sparse. The matured herring, only the matured herring, the seven-year old [+] herring completely spawn and that's the spawn they harvest in Sitka: seven-year old herring." (Al Martin in Thornton et al. 2010:130). Older, larger herring typically produce more eggs and larger eggs, which yield higher quality spawn on branches set in the water by subsistence harvesters. Thus, delaying commercial fishery openings is expected to increase the quantity and quality of herring spawn on branches that is available for subsistence harvesters.

There is also evidence that delaying the commercial fishery will allow more herring to spawn in accessible subsistence areas, including the closed area, which in turn will increase the quantity and quality of herring available for subsistence harvesters. Local and traditional knowledge of herring suggests that herring spawning patterns follow the "Go With Older Fish" model. (MacCall et al. 2019; Thornton et al. 2010). In other words, younger fish follow older fish to spawning grounds, a process sometimes referred to as entrainment. (Petigas et al 2006). When large portions of older fish are harvested, factors leading to previous reproductive success of the population are lost and the spawning patterns of younger fish are disrupted, leading to spawning discontinuities and irregularities, including concentration in fewer spawning areas and abandonment of traditional areas that for centuries have been reliable, productive spawning grounds for subsistence uses. (MacCall et al. 2019; Thornton et al 2010).

Selective commercial harvests of older herring from the Sitka Sound herring population have likely changed spawning patterns and negatively affected subsistence harvests. The 2016 age class of herring returned to spawn in 2019 and 2020, but ADF&G's spawn maps indicate that those herring are predominantly spawning in new, non-traditional

areas, including inaccessible shorelines of Kruzof Island. These non-traditional spawning areas have harsher environmental conditions, making spawning less likely to be successful. In addition, the spawning areas that younger fish are selecting tend to be farther away from Sitka, making it less accessible to most subsistence harvesters. The above information and data support the conclusion that delaying the commercial fishery will allow more older herring to reach traditional spawning areas, which in turn will increase spawning consistently and will increase the quantity and quality of herring spawn available to subsistence harvesters.[3]

Although ADF&G's rationale for allowing commercial fishery openings has focused on the availability of marketable herring, there are indications that a successful commercial fishery can occur even if it is fully or partially delayed. For example, in 2009, one of the only decent years for subsistence harvests (an estimated 213,712 pounds was harvested) a high commercial catch (14,755 tons) was also taken. In that year, ADF&G deliberately spread out the openings to not take too much herring in a large initial opening. Instead four smaller openings were scheduled between March 22 and April 2. It is likely this temporal spacing, especially not taking large proportions of the quota prior to spawning, took pressure off of the schools of spawning herring and helped subsistence users. Yet, the commercial fishery still produced plenty of marketable of fish. This suggests, as commercial fishery representatives have acknowledged, that it is possible to effectively harvest marketable sac roe after herring have begun to spawn. Moreover, taking fewer herring prior to the commencing of spawning in subsistence use areas is the best way to ensure reasonable opportunity for mature herring to reach customary and traditional spawning grounds and thus to ensure reasonable opportunity for subsistence uses.

Importantly, the commercial fishery can be partially delayed while still providing an opportunity to harvest marketable sac roe *and* increasing the quality and quantity of herring spawn on branches. Before 2002, ADF&G area managers often allowed spawning to occur before opening the commercial fishery. This allowed for returning herring to reach traditional, productive spawning areas—accessible to subsistence harvesters—before the commercial fishery opened, a fact noted repeatedly by subsistence users. (Thornton et al

[3] The information and recommendations regarding test fisheries below apply with equal force to ADF&G's authority, and legal responsibility, to delay the commercial fishery if necessary in order to ensure reasonable opportunity. Allowing significant commercial fisheries prior to the beginning of the spawn is clearly more disruptive than allowing test fisheries. Prior to authorizing a commercial opening, ADF&G must fully consider the potential for disruption and displacement to spawning herring and subsistence uses that may result from the openings.

2010). Comparatively, after 2002, the commercial fishery was opened approximately 5.5 days earlier on average than the first day of spawning and in some years the fishery was opened 10-15 days earlier than the first spawn.[4] The temporal shift leading to earlier commercial fishery openings is a relatively recent development and indisputably helpful for commercial efficiency, but pre-spawn openings are historically and practically unnecessary to provide a commercial fishing opportunity.

While a delayed commercial opening, or a partial delay with smaller daily harvest limits, will likely make it more difficult for the commercial fishery to harvest efficiently, the commercial fishery will be able to locate smaller target schools to harvest throughout Sitka Sound, including schools that are farther from the subsistence area. Under that management approach, a cooperative-style commercial fishery would be advantageous, although not legally required. Full or partial delays in the commercial fishery can be achieved under the existing regulatory authority of 5 AAC 27.195.

As discussed in the Guidance, below, ADF&G must explain its determinations regarding whether it is necessary to distribute the commercial fishery by time and area in order to ensure a reasonable opportunity for subsistence. As part of those determinations, ADF&G must clearly articulate how it considered whether temporally distributing the commercial fishery is necessary, including whether fully or partially delaying the commercial fishery is necessary to provide a reasonable opportunity for subsistence. The determinations may not rely on the erroneous assumption that ADF&G lacks regulatory to delay the commercial fishery solely to increase subsistence opportunity. Given the fact that the status quo (the current harvest rate strategy and large biomass) has proven insufficient in past years to ensure a reasonable opportunity for subsistence, ADF&G must actively engage with the option of delaying the commercial fishery, including analyzing the available evidence indicating that delaying commercial openings will increase the quantity and quality of herring spawn on branches. Delaying the commercial fishery is critical to ensuring a reasonable opportunity in 2021.

2. Prohibit commercial fishery openings near areas with productive subsistence sets

ADF&G should exercise its authority under 5 AAC 27.195(a) to prohibit commercial openings in proximity to subsistence sets where there is potential for those sets

[4] These estimates are based on a comparison of fishery opening dates with dates of first spawn (open circle) provided in Dressel (2021).

to receive productive herring spawn to enhance subsistence opportunity and to reduce the chance of conflicts between subsistence harvesters and the commercial fishery. This recommendation applies to subsistence sets that are outside of the regulatory closed area, where ADF&G retains authority to distribute the commercial fishery. In past years, ADF&G has allowed commercial openings to occur within close physical proximity to subsistence sets without considering the effects on subsistence harvesters. Such management decisions are clearly inconsistent with Alaska's subsistence priority and ADF&G's obligations under 5 AAC 27.195(a)(2) to ensure subsistence harvesters have a reasonable opportunity to harvest the amount of herring spawn necessary for subsistence uses.

In addition to directly hindering subsistence harvesters' opportunities, allowing commercial openings adjacent to subsistence sets has produced distrust and animosity between the two user groups. Because subsistence harvest sets are inherently fixed and not moved once spawning begins, and the commercial fishery is highly maneuverable and mobile, ADF&G should make it clear to the commercial fishery prior to the 2021 season that commercial openings in proximity of subsistence sets with the potential to harvest herring spawn will be prohibited. ADF&G should make in-season determinations regarding commercial openings in consultation with STA and subsistence harvesters and take into consideration the known occurrence of spawning events, or the likelihood of potential spawning events, in proximity of the subsistence set when deciding whether to allow commercial openings in the area. The extent of the buffer between the subsistence set and any commercial opening should be sufficient to ensure reasonable opportunity and good quality roe, and should be a focus of consultation with STA.

3. Limit the amount and timing of the commercial test fishery

A decision to allow a test fishery for the commercial fishery is a management decision that is subject to the mandate in 5 AAC 27.195(b) requiring ADF&G to consider the quality and quantity of herring spawn on branches when making management decisions. It is beyond dispute that the duration and density of spawn in areas accessible to subsistence harvesters are important factors when considering the quality and quantity of spawn on branches. While it may be technically correct that ADF&G cannot force or direct a spawn in subsistence areas, ADF&G's management practices can and do disrupt herring during the critical period of time when schools are close to spawning. These management practices, especially allowing numerous and significant commercial openings and frequent

test fisheries before spawning begins, diverts herring from spawning in historically productive spawning areas and traditional subsistence harvest areas.

Historical data documenting spawning locations, including traditional knowledge, verifies that herring reliably spawned in areas traditionally used and accessible to subsistence harvesters. (Shewmake 2013; Thornton et al 2010, Thornton and Kitka 2015; *see* Figure 9 in Sill and Lemons 2021). Recent aerial survey charts show that spawning locations are shifting away from traditional areas, including outside of key parts of the core area which have been traditionally most reliable (e.g., Figure 7 and 8 in Sill and Lemons 2021, 2019, respectively).

Local and traditional knowledge gained through close observation of Sitka Sound herring for hundreds of years overwhelmingly documents the vital importance of not disturbing herring prior to the beginning of the spawn. (Thornton 2015; Thornton et al 2010). This traditional knowledge is supported by the observations and conclusions of commercial fishermen and Board of Fisheries members. For example, during the 2018 Board meeting, members Ruffner and Jensen confirmed that both commercial and subsistence users testified that the test fisheries stress the herring and can cause false spawns and negative impacts on the "both the spawn and catching herring," and that ADF&G was aware of the negative impacts of test fisheries. Furthermore, scientific studies document the adverse effects of stress caused by catch and release of fishes immediately prior to spawning, including herring seine fisheries. (Schreck et al. 2010, Tenningen et al. 2012). This information supports the conclusion that the years of pre-spawning disruption, including fisheries openings before spawning begins since 2002, is one cause for spawning patterns in Sitka Sound changing and occurring more frequently away from traditional spawning and subsistence harvest areas.

Thus, there is sufficient information to require ADF&G to take a very precautionary approach to managing test fisheries. The law requires that the subsistence fishery is the priority. If there is no data to support that test fisheries are benign on subsistence uses, or there is uncertainty regarding test fishery impacts, doubt must be resolved in favor of ensuring reasonable opportunity. STA therefore recommends that ADF&G should acknowledge the disruptive impact test fisheries have on the herring spawn and consequently on subsistence opportunity. ADF&G should be cautious about the extent of test fisheries it allows and should not authorize test fisheries simply to enhance opportunities and proportions of "marketable fish" for the commercial fishery.

4. Prohibit the commercial fishery from over-fishing large herring, *i.e.*, "high grading"

ADF&G should end the commercial fishery's practice of harvesting a disproportionate amount of larger, older herring. The commercial fishery specifically targets larger, older herring, which have marketable roe size. Commercial fishery data indicates that in some years, the harvest rate for these 5-8 year old herring has exceeded the regulatory 20 percent harvest rate and reached up to 27 percent in the oldest herring. (STA analysis of ADF&G ASA model data). In some cases, commercial sets are sampled and released when the netted herring do not meet market size demands, leading to undue stress on herring just before spawning.

High grading results in the disproportionate removal of older fish, which has negative effects on herring population dynamics. According to the "go with old fish" model, older herring play an important role in leading younger herring to historical spawning areas. (MacCall et al. 2018). Targeting older herring for market value distorts the age structure of the population to younger less productive fish, and consequently reduces the productivity and fidelity (to spawning areas) of herring spawning schools, resulting in more concentrated spawning and more vulnerability to predation both in season and across seasons. ADF&G must consider these impacts and potential shifting population dynamics in managing the herring fisheries.

High grading also has direct negative effects on subsistence harvests. As discussed above, the subset of larger, older herring that are targeted by the commercial fishery are also the most desired by subsistence harvesters. (Thornton et al. 2010). High grading directly reduces the availability of quality herring spawn on branches.

ADF&G has the existing regulatory authority to prevent high grading during the 2021 season. ADF&G should close the commercial fishery if herring in nets are being tested and then released by commercial vessels if too small. The practice of sampling and releasing commercial nets is aimed directly at high grading and is particularly harmful to the herring population. (Schreck et al. 2010, Tenningen et al. 2012). As shown above in the recommendation to limit test fisheries, herring caught in commercial nets are known to "false spawn" and there is evidence that the disturbance disrupts the schools' spawning patterns. (Thornton et al. 2010). When ADF&G becomes aware that commercial vessels are sampling and releasing netted herring, essentially conducting unauthorized test fisheries, the commercial fishery should be closed immediately.

5. Verify pre-season forecasts of spawning biomass through in-season ground-truthing and adjustments to the GHL

ADF&G should verify pre-season forecasts to confirm the biomass of spawning herring before opening the commercial fishery. Verification is important because the commercial fishery GHL is set based on the forecast. Thus, if the forecast overestimates the returning biomass, the commercial fishery will have an inflated GHL that is not based on the actual biological conditions in Sitka Sound.

There have already been instances in which ADF&G's forecast overestimated the spawning biomass, resulting in the commercial fishery chasing "paper fish." For example, in 2012, the ADF&G forecast was 144,143 tons of spawning biomass, but this forecast overestimated the actual biomass by approximately 67,000 tons or nearly two times the actual biomass based on post-season surveys. During the 2012 season, however, the commercial fishery continued fishing to achieve the artificially high GHL, which was established based on the inaccurate pre-season forecast and never corrected in-season. Because ADF&G did not adjust the GHL mid-season when it became apparent that the forecast was inaccurate, the commercial fishery, through excessive test fisheries, continued to attempt to harvest the full GHL.

Verifying and adjusting the forecast biomass is also important because ADF&G's models have inherent uncertainty. ADF&G acknowledges that there is a uncertainty associated with the forecasts. Unfortunately, ADF&G has not adopted modeling tools that account for and describe uncertainty in the forecast estimates. For example, ADF&G commissioned an expert report to analyze ADF&G's Age-Structured Analysis model and make recommendations to improve forecast estimates. Dr. Steve Martell produced a report that was delivered to ADF&G in 2016; however, ADF&G has yet to implement the recommendations, including updating biological models to better account for uncertainty.

In light of ADF&G's reliance on outdated models, in-season verification of the returning biomass should play an important role in ADF&G's in-season management. ADF&G should verify the forecasted biomass continually throughout the season and make adjustments to the GHL accordingly to ensure reasonable opportunity for subsistence uses.

6. Consult with STA and subsistence harvesters during the commercial season, especially prior to commercial openings

ADF&G's in-season manager should consult with subsistence harvesters, STA, and ADF&G's Division of Subsistence when making management decisions regarding the commercial and subsistence fisheries. As the Board of Fisheries recognized when it adopted the regulations governing the Sitka Sound herring fishery, STA and subsistence harvesters possess information that is vital to ADF&G's decision-making. ADF&G should develop a process to consult with STA and the Division of Subsistence pre-season, in-season, and post-season.

The consultation process should include STA, along with a representative from the Division of Subsistence and ADF&G's Sitka Area Management biologist. The goal of in-season consultation is to determine how herring spawning in subsistence use areas are assessed and how the commercial fishery should be managed for quality and quality of herring eggs to ensure a reasonable opportunity for subsistence. The process should also include a procedure through which STA can communicate information and concerns effectively and timely prior to a final decision to announce a commercial opening.

7. Use the best available information in all management and research decisions

ADF&G's constitutional obligations require management of the Sitka Sound herring population according to scientific principles of management intended to sustain the yield of the herring resource for present and future generations. One of the most important principles of scientific management is using the best available information. ADF&G must incorporate the best available information from the biological, geophysical, and social sciences and other appropriate sources into its decision-making. It is not acceptable to ignore important information simply because it is considered *a priori* "anecdotal," was not collected by ADF&G, or does not fit directly into ADF&G's model. The best available information standard also requires ADF&G to acknowledge and incorporate scientific information regarding climate change, shifting baselines, and local and traditional knowledge into its decision-making. ADF&G should document its use of the best available information in all decision documents and research reports, including explicitly acknowledging uncertainties, assumptions, and information gaps.

8. Apply the precautionary principle to all management decisions

ADF&G is frequently faced with making decisions based on imperfect or incomplete information. Whenever this occurs, ADF&G's decisions should explicitly acknowledge missing information or data. Because ADF&G acknowledges that there are many unknown effects of the commercial fishery, ADF&G should adopt a precautionary approach to managing the commercial fishery. A precautionary approach is particularly important when setting the GHL, authorizing commercial test fishery sets, and opening the commercial fishery in particular times and areas because each of those management decisions involves a high degree of uncertainty and risk (to the population's sustainability and subsistence harvesters' ability to meet their needs). The precautionary principle requires ADF&G to adopt the management decision that errs on the side of conserving herring rather than allowing a commercial harvest.

9. Conduct a Management Strategy Evaluation after the 2021 season in collaboration with STA and subsistence harvesters

After the 2021 season, ADF&G should initiate a Management Strategy Evaluation (MSE) to determine how governance can be more effectively integrated with evaluation methods to improve management of the herring fisheries in the Gulf of Alaska. (cf. Punt, et al 2016; Armitage, et al 2019). A management strategy evaluation is warranted due to the precipitous declines and shifted baselines (Pauly 1995) in local and regional herring populations throughout Alaska and British Columbia since the rise of industrial herring fishing in the early twentieth century, compounded by the intensive removals of the commercial sac roe fisheries on spawning populations since the 1970s. This has resulted in major losses in herring biomass and dozens of spawning areas such that today only Sitka Sound in Alaska and one area in British Columbia remain viable for commercial sac roe fishing. An increasing number of scientific studies and stakeholders regard the present herring management model as flawed, leading to suboptimal outcomes for marine ecosystems, subsistence users, and commercial fisheries alike. As a result, opposition, protests, and lawsuits have arisen against herring fisheries management throughout the Pacific Northwest region (Thornton and Moss 2019). The risks of "business as usual" management are untenable.

A Management Strategy Evaluation enables independent assessment of the strengths and weaknesses of present management against alternative approaches. As a result of management strategy evaluations, fisheries management elsewhere has moved

away from single-species management models for Maximum Sustainable Yield (MSY), like that used by ADF&G and DFO (in British Columbia) for herring, and toward Ecosystem Based Fisheries Management (EBFM). NOAA, for example, now "strives to adopt an ecosystem-based approach throughout its broad ocean and coastal stewardship, science, and service programs." This is because the agency has come to recognize that EBFM is better able "to maintain ecosystems in a healthy, productive, and resilient condition so they can provide the services humans want and need."[5] Such an approach has proved especially important in reforming forage fish management in light of the significant ecosystem service benefits species like herring and anchovies provide. (Pikitch et al. 2012, Majluf et al. 2017). A management strategy evaluation of the Gulf of Alaska herring fisheries would enable ADF&G to reassess the strategy, models, metrics, and techniques used for herring management against other approaches like EBFM. (Shelton et al. 2014).

With any management strategy evaluation, it is important to bring together the best science (e.g. Punt et al 2018), social science (Charnley et al 2017), and Local and Traditional Knowledge (Thompson et al. 2020, Thornton and Scheer 2012), including present stakeholders and outside expertise, and to follow a rigorous process of objective interrogation of the principles, goals, and processes of management, including indigenous models of stewardship. Given that the sustainability of subsistence and commercial herring fisheries alike are threatened, distrust of and opposition to current management is growing, and oceanic change factors appear to be impacting herring and the marine environment in ways not currently accounted for in management, we recommend that a comprehensive management strategy evaluation be undertaken of Gulf of Alaska herring fisheries immediately.

[5] (NOAA https://www.fisheries.noaa.gov/national/ecosystems/ecosystem-based-fisheries-management).

PART II – GUIDANCE FOR IMPLEMENTING 5 AAC 27.195: ENSURING A REASONABLE OPPORTUNITY FOR SUBSISTENCE DURING THE 2021 SEASON

In 2002, the Board of Fisheries adopted an innovative and novel management strategy for the Sitka Sound herring fisheries. The resulting regulation, 5 AAC 27.195, represented a compromise between STA and subsistence harvesters, ADF&G, and the commercial fishing industry. The Board directed ADF&G to make in-season management decisions regarding whether subsistence harvesters have a reasonable opportunity to harvest the amount necessary for subsistence, and to distribute the commercial fishery by time and area to ensure a reasonable opportunity for subsistence is maintained.

5 AAC 27.195 provides:

> (a) In managing the commercial sac roe fishery in section 13-B north of the latitude of Aspid Cape (Sitka Sound), the department shall . . .
>
> > (2) distribute the commercial harvest by fishing time and area if the department determines that it is necessary to ensure that subsistence harvesters have a reasonable opportunity to harvest the amount of herring spawn necessary for subsistence uses specified in 5 AAC 01.716(b).
>
> (b) In addition to the provisions of (a) of this section, the department shall consider the quality and quantity of herring spawn on branches, kelp, and seaweed, and herring sac roe when making management decisions regarding the subsistence herring spawn and commercial sac roe fisheries in Section 13-B north of the latitude of Aspid Cape.

Although 5 AAC 27.195 requires ADF&G to distribute the commercial fishery by time and area in order to ensure a reasonable opportunity for subsistence, for the past 17 years ADF&G has not implemented that mandate. First, ADF&G has never considered distributing the commercial fishery by area in order to ensure a reasonable opportunity for subsistence. ADF&G argued that it had no authority to distribute the commercial fishery by area beyond the regulatory "closed areas"—traditional subsistence harvesting areas near

Sitka that were closed to commercial fishing by the Board.[6] Instead, ADF&G claimed that it distributed the commercial fishery by area throughout Sitka Sound "regardless" of subsistence opportunities, but ADF&G's commercial fishery distribution was aimed at ensuring the full GHL was harvested. According to ADF&G, it would only consider moving the commercial fishery to an area away from subsistence harvesters if there was an "equal" opportunity for the commercial fishery elsewhere.

ADF&G has also never considered distributing the commercial fishery by time in order to ensure a reasonable opportunity for subsistence. As explained above, distributing the commercial fishery by "time" may include delaying the commercial fishing openings until herring have a had a chance to spawn. ADF&G argued that "[d]elaying start of the fishery until after spawning beings represents a fundamental shift in the way sac roe herring fisheries are managed that could, in some years, result in an inability to harvest the full biologically allowable [GHL]." While ADF&G has determined the commercial fishing openings based on timing of mature roe in commercial test sets, it has erroneously believed that it lacked authority to delay openings specifically to provide increased subsistence opportunity.

The court explicitly rejected ADF&G's unlawful interpretation of its "area and area" authority under 5 AAC 27.195. In the March 31, 2020 decision, the court explained that "[t]o the extent that ADF&G interprets subsection (a) as requiring the subordination of its duty to distribute the commercial harvest by time and area to opening the commercial harvest in any way, the interpretation is unreasonable and inconsistent with the plain language and context of the regulation." Thus, ADF&G may not base its decisions regarding whether to open a commercial fishery in a particular time and area exclusively on the needs of the commercial fishery. ADF&G must consider whether subsistence harvesters have a reasonable opportunity, and if not, ADF&G must consider distributing the commercial fishery by time and area to increase subsistence opportunity.

Second, ADF&G has never considered the quality and quantity of herring spawn on branches, kelp, and seaweed when making management decisions regarding the commercial fishery, as required by 5 AAC 27.195(b). ADF&G admitted that it did not collect or analyze data regarding the quality of herring spawn on branches "at all." On November 30, 2020, the court concluded that ADF&G's failure to comply with subsection 195(b) was illegal:

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[6] *See* 5 AAC 27.150(7) (closing "traditional subsistence areas" of Sitka Sound to commercial fishing).

> "[Subsection (b)] imposes a mandatory duty on ADF&G to consider the important factor of quality and quantity of herring roe on branches, kelp, and seaweed, and herring sac roe when making a management decision concerning the subsistence and commercial herring sac roe fisheries, including when making required determinations under 5 AAC 27.195(a)(2). . . .
>
> ADF&G must meaningfully consider [quality and quantity] in some reasonable way before making such a management decision."

The court's decisions recognize that ADF&G's determinations regarding whether subsistence harvesters have a reasonable opportunity to harvest herring spawn are the crux of Sitka Sound herring management. Reasonable opportunity "determinations are important; they have the potential of directly altering the allocation of the fishery between the subsistence and commercial harvests." The court's ruling makes explicit the underlying fact that the commercial fishery may not be opened unless there is a reasonable opportunity for subsistence.

Importantly, ADF&G has not provided any indication of how it intends to determine whether there is a reasonable opportunity for subsistence during the 2021 season. Prior to the court's rulings, ADF&G claimed that reasonable opportunity determinations must be left to the Board. That is no longer a tenable position. In 2021, ADF&G must articulate its reasonable opportunity determinations with evidence that demonstrates "that it, and how it" considered all of the important factors, including quality and quantity of herring spawn on branches, kelp, and seaweed. STA submits the following analysis of relevant factors that must be considered when determining whether there is a reasonable opportunity for subsistence.

a. The Amount Necessary for Subsistence

The starting point for determining whether there is a reasonable opportunity for subsistence is the amount necessary for subsistence (ANS). In 2009, the Board determined that the ANS for Sitka Sound is a range between 136,000 and 227,000 pounds of herring spawn per season.[7] Although harvesting amounts within the ANS range is not solely determinative of whether there is a reasonable opportunity for subsistence, past subsistence

[7] 5 AAC 01.716(b).

harvests compared to the ANS range is a key indicator of reasonable opportunity. Subsistence harvest results, particularly recent trends, can help predict the likelihood of success of a normally diligent participant in the subsistence fishery.

For Sitka Sound herring, ADF&G must acknowledge and consider the current trend showing clearly that ANS is not being achieved. Subsistence harvest data since 2002 indicate that in the 18 years from 2002 to 2019, the minimum range of ANS has been met seven times (2002, 2003, 2004, 2006, 2009, and 2014), while the high range of ANS has been met only four times (2003, 2004, 2006, and 2009). During that same time period, the average subsistence harvest for all years in which the commercial fishery exceeded 11,000 tons was 113,988 pounds, which is 16 percent below the minimum range of ANS. Since 2010, the minimum range of ANS has been met only once (2014). Figure 5 from ADF&G's 2019 Subsistence Harvest report illustrates this trend.

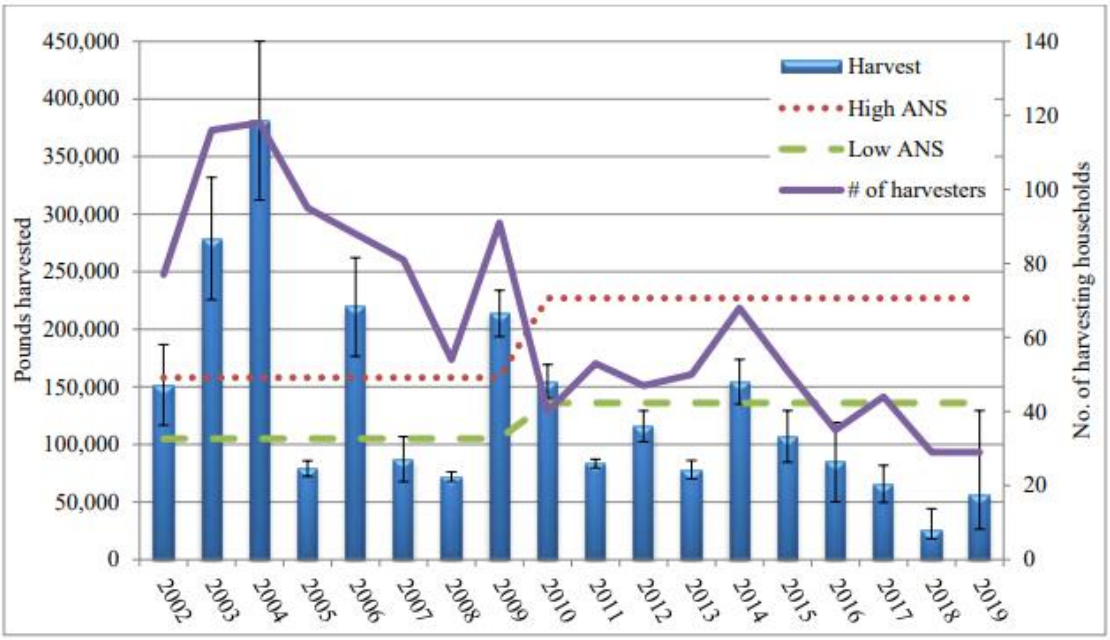


Figure 5.–Total pounds usable weight of herring spawn harvested, number of harvesting households, and amount reasonably necessary for subsistence (ANS) of herring spawn on all substrates in Sitka Sound, 2002–2019.

Because ADF&G's pre-2021 management approach has not allowed the high range of ANS to be achieved in any year since 2009, ADF&G must adopt new management approaches that are more protective of subsistence opportunity. ADF&G may not rely solely on its past interpretation and implementation of the existing regulations to provide a reasonable opportunity. Those same regulations and conditions have existed in past years but have failed to result in ANS being achieved. For example, ADF&G may not continue

to manage the commercial fishery by maximizing the ability for the commercial fishery to harvest the full GHL and only directing the commercial fishery away from subsistence harvest areas when an "equal" opportunity for the commercial harvest exists elsewhere—as ADF&G explicitly stated it did in past years. The status quo in management approaches has unequivocally failed to ensure a reasonable opportunity for subsistence. ADF&G must explain in its decision documents what new management approaches it has adopted, or plans to adopt during the 2021 season, and explain why ADF&G believes that those new management approaches will be successful in ensuring a reasonable opportunity for subsistence.

ADF&G must also consider declines in subsistence catch per unit effort ("CPUE"), which indicates that subsistence harvesting is becoming less productive, less efficient, and more resource-intensive.[8] The decline in subsistence CPUE undermines the frequent claim that the failure to achieve ANS is caused by the declining number of households participating in the subsistence harvest. CPUE declines suggest that corresponding declines in participation is likely caused by poor subsistence harvests, and not the inverse. When herring spawning patterns are disrupted and herring spawn farther away from the traditional subsistence areas, or "core area," fewer harvesters are able to participate in the subsistence fishery. STA tribal citizen, Roby Littlefield described his experience with this scenario in an affidavit submitted to the Board of Fisheries in 2002:

> "I went to the local Alaska Department of Fish and Game office in Sitka to report my observations and unfilled needs following our subsistence herring egg season. I was told that I should consider traveling to Goddard to get my herring eggs. I responded to them, "Why do I have to go to Goddard, you go to Goddard. I only have a little skiff to feed my family.
>
> Goddard is approximately 30 miles from Sitka and requires getting out into open waters. I only have a 16 foot skiff and I often take my daughter or niece or other young person with me to harvest so that they will learn how to gather our foods."

The decline in subsistence CPUE indicates that participation in the subsistence harvest is becoming more time-consuming, resource-intensive, and expensive. As CPUE

[8] "Catch per unit effort" refers to the amount of herring roe harvested (pounds) per hemlock branch.

declines, ANS is also likely to be unmet as fewer subsistence harvesters are able to participate. But importantly, this does not mean that the conceptual amount necessary for subsistence is lower; a majority of harvesters surveyed indicate that they share herring with those who are unable to harvest for themselves. The Board recognized that herring is traditionally and culturally shared throughout Alaska, Canada, and the Lower 48. Sharing and distributing herring spawn on branches remains an essential cultural aspect of subsistence, and a growing number of community members within and outside of Sitka now rely on shared herring eggs because they are unable to harvest on their own. Thus, the decline in CPUE and increased failure to meet ANS is disrupting subsistence as a way of life, not only for subsistence harvesters but also for more than 40 communities in Alaska and beyond that depend on the large distribution of Sitka Sound herring eggs. (Thornton, 2019).

b. Quantity of Herring Spawn on Branches, Kelp, and Seaweed

5 AAC 27.195(b) requires ADF&G to consider the quantity of herring spawn on branches, kelp, and seaweed when determining whether there is a reasonable opportunity for subsistence. It is axiomatic that a reasonable opportunity for subsistence requires a sufficient amount of herring spawn to be available for subsistence harvesters. If environmental conditions do not produce the amounts of herring sufficient to meet subsistence harvesters needs, the law requires that other user groups be limited from harvesting herring first, in order to provide the conditions that allow a reasonable opportunity for subsistence.[9]

When considering the quantity of herring spawn that is available for subsistence harvesters, ADF&G must take into account: (a) the forecast biomass and (b) the effect of commercial fishery on the quantity of herring spawn available for subsistence harvesters.

i. The Forecast Biomass

ADF&G must consider the biomass of herring in Sitka Sound each season, including the reliability and uncertainty associated with forecasted biomass estimates. The forecast biomass is a key component for managing the commercial fishery; however, ADF&G must incorporate the uncertainty and limitations of the estimate, and the lack of robust in-season

[9] AS 16.05.258(b)(4) ("[I]f the harvestable portion of the stock or population is not sufficient to provide a reasonable opportunity for subsistence uses, the appropriate board shall (A) adopt regulations eliminating consumptive uses, other than subsistence uses . . .").

verification, into its management decisions. Without adopting more robust, available scientific models to account for uncertainty in the estimated biomass model, and without ground-truthing in-season to verify the estimate, ADF&G unreasonably shifts the burden of errors in the forecast biomass to subsistence harvesters. The inherent burden-shifting must be acknowledged and analyzed when determining whether there is a reasonable opportunity for subsistence.

The Board has the responsibility for setting the harvest control rule in regulation. Under 5 AAC 27.160(g), the Sitka Sound GHL is set based on a sliding scale harvest rate (between 12 and 20 percent) of the forecast spawning population size, provided the forecast spawning population size exceeds the threshold of 25,000 tons. ADF&G's responsibility is to calculate the forecast spawning population size, apply the sliding scale harvest control rule (a 12% harvest rate at the threshold (25,000 tons) scaling up to a 20% harvest rate above 45,000 tons), and establish the 2021 GHL.

ADF&G's forecast methodology lacks the ability to account for uncertainty and should be updated to incorporate the best available information and methodology. Specifically, ADF&G's estimates of the weights of 3- and 4-year old herring returning in 2021 are also based on less representative data because samples of pre-spawned herring were not taken in 2020. Shifting baselines in herring population dynamics indicate that the weight-at-age is declining, meaning the population is shifting to smaller herring. Without incorporating new weight-at-age data, ADF&G's forecast may overestimate the amounts of older herring. Ultimately, the overestimate of older herring may have negative effects on subsistence because it means that ADF&G also overestimates the amounts of herring spawn on branches available for subsistence harvesters.

Additionally, ADF&G's forecast model fails to incorporate the Martell Report's recommendations for a Bayesian statistical analysis, which would better account for uncertainties in the predicted spawning biomass. Although ADF&G applied a downward adjustment to the 2021 forecast, which reduced the GHL, ADF&G's adjustment was based on potential assumed error in a single age class. If ADF&G had applied the Martell Report's recommendations to account for uncertainty in multiple variables, ADF&G's 2021 forecast would be improved and more reliable because it would describe uncertainty associated with the forecast. Other management areas already apply Bayesian analysis to herring forecasts, including Prince William Sound and British Columbia. ADF&G has not explained why it has refused to implement the Martell Report's recommendations for Sitka Sound herring.

Without verifying the returning biomass forecast in-season and adjusting the commercial GHL to account for pre-season overestimates, ADF&G effectively shifts the risk of errors in the forecast to subsistence harvesters. ADF&G assumes that the returning biomass is sufficient for both the subsistence harvest and the commercial fishery achieving the full GHL; however, if the forecast (and resulting GHL) overestimates the returning biomass, the commercial fishery is still permitted to harvest the full GHL but subsistence harvesters are left without sufficient older, larger herring to provide quality spawn on branches. Indeed, in 2014 and 2017, the commercial fishery's harvest exceeded the 20 percent harvest rate set by the Board. ADF&G must address the role that risks over overestimates in the forecast play, and the disproportionate impact of that risk on subsistence harvesters.

ii. The effect of commercial harvests on the quantity of herring spawn available for subsistence harvesters

ADF&G's management paradigm for Sitka Sound herring incorrectly assumes that a large spawning biomass will necessarily provide a sufficient quantity of herring spawn for subsistence harvesters after the commercial fishery harvests the full GHL. That assumption is incorrect. Although a large biomass is important for the ecosystem, commercial fishery, and subsistence harvesters, the quantity of returning herring alone is not inherently sufficient to ensure a reasonable opportunity for subsistence. The effects of the commercial fishery on the quantity of herring spawn available for subsistence harvesters must be considered when determining whether there is a reasonable opportunity for subsistence.

The data indicate that large commercial harvests decrease the likelihood that ANS will be achieved. Between 2009 and 2018, the commercial fishery harvests were predicted to have caused a 34 percent reduction in subsistence catch per set by large harvesters and a 31 percent reduction in catch per set by small harvesters, on average. This finding of an adverse effect of the commercial sac roe fishery on roe harvests is consistent with findings reported by Shelton et al. (2014), who stated *"for any level of egg harvest, slightly increasing [adult harvest] results in a dramatic decline in mean egg catch"* and *"increasing harvest of adult herring caused precipitous declines in egg catch, whereas increasing harvest of herring eggs produced much slower declines in adult catch"*. Scientific evidence supports the conclusion that the commercial fishery disturbs herring spawning patterns, reducing the herring biomass that is available to provide spawn on branches in accessible

locations for subsistence harvesters. (Thornton et al. 2010; Thornton and Kitka 2015). The commercial fishery typically opens before herring spawn, and before subsistence harvesters collect their sets, which means that an overestimate in the forecasted biomass, along with any effects of the commercial fishery, will negatively affect subsistence harvesters after the commercial fishery has ended. ADF&G must consider the effects of the commercial fishery when determining whether subsistence harvesters have a reasonable opportunity for subsistence.

Importantly, the assumption that a large biomass will provide sufficient herring for may be appropriate when applied to ecosystem or commercial fishery needs, but it is inapt when applied to the subsistence harvest. The assumption ignores the practicalities of harvesting herring spawn on branches, kelp, and seaweed. While the commercial fishery is highly mobile and can locate and fish herring schools throughout Sitka Sound, subsistence harvesters rely on fixed locations to place their subsistence sets (hemlock branches). (Schroeder and Kookesh 1990). Subsistence harvesters rely on carefully selected locations that have the appropriate environmental conditions and are accessible according to the harvesters' transportation options. (Schroeder and Kookesh 1990; Shewmake 2013). Subsistence harvesters, by and large, do not have the option of simply harvesting somewhere else; they rely on a sufficient quantity of herring spawn in certain, traditional areas. (ADF&G Subsistence harvest surveys and reports; Shewmake 2013; Thornton 2019) Thus, the assumption that a large biomass of spawning herring will provide a reasonable opportunity for subsistence is fundamentally incorrect.

ADF&G must adopt a more conservative commercial fishery management approach that considers how the amount, timing, and location of commercial openings affect subsistence opportunity. In 2021, ADF&G should not simply assume that the large biomass forecast and the current harvest rate strategy will provide a reasonable opportunity for subsistence. ADF&G must address the commercial fishery's effects on subsistence harvesters when analyzing whether a reasonable opportunity for subsistence exists.

c. Quality of Herring Spawn on Branches, Kelp, and Seaweed

5 AAC 27.195(b) requires ADF&G to consider the *quality* of herring spawn on branches when determining whether there is a reasonable opportunity for subsistence. According to the court, the regulation "imposes a mandatory duty on ADF&G to consider the important factor of *quality* and quantity of herring roe on branches" when making management decisions regarding the commercial fishery.

To date, ADF&G has never considered the quality of herring spawn on branches when managing the commercial fishery. ADF&G has insisted that it does not have data regarding the quality of herring spawn on branches, and thus, it has no analysis of quality to consider when determining whether a reasonable opportunity exists. Nevertheless, the plain language of the regulation requires ADF&G to "meaningfully consider" the quality of herring spawn on branches before opening the commercial fishery, and not doing so in 2021 would be unlawful.

In light of ADF&G's failure to identify how it plans to consider the quality of herring spawn on branches before opening the commercial fishery, STA has identified three physical conditions that are necessary for, and generally indicate high quality herring spawn on branches: the location of spawn (substrate), accessibility of spawning locations, and the duration of spawning events in accessible areas. Those physical conditions may be used as proxies to estimate and analyze the quality of the upcoming subsistence harvest. ADF&G should consider each of those physical conditions, including the effects of the commercial fishery on the quality of herring spawn on branches.

Ultimately, determining the quality of a subsistence harvest depends on individual preferences of harvesters and cultural expectations. Subsistence harvesters may consider the quality of eggs based on thickness, color, sand contamination, etc. (ADF&G Subsistence research data; Thornton et al. 2010, Thornton 2019, Thornton and Moss 2021) Therefore, in addition to considering the physical conditions that are necessary and conducive to producing quality herring spawn on branches, ADF&G should consult with subsistence harvesters regularly throughout the herring season regarding the quality of herring spawn on branches.

i. Location of Spawn (Substrate)

The substrate on which herring spawn is one of the most important conditions that contributes to the quality of herring spawn on branches. Spawn on sandy substrate will likely yield sub-par quality roe because the sand becomes mixed with the eggs. For example, subsistence harvesters have noted that subsistence sets placed on the Kruzof Island shoreline (south of Point Brown) yield harvests that are contaminated with sand and unusable. In contrast, high-quality herring spawn on branches is typically found on protected, rocky coastlines—away from sandy areas and rough waves. Traditional and local knowledge has recognized that the quality of herring spawn on branches is highly

dependent on local conditions (topography, currents, density), and subsistence harvesters carefully choose sites to place their branches accordingly. (Schroeder and Kookesh 1990; Thornton et al. 2010).

Before authorizing a test fishery or opening the commercial fishery, ADF&G should analyze whether those management actions have the potential to disrupt spawning events in areas with productive substrate. Those areas are typically used by subsistence harvesters (i.e., the traditional subsistence areas), and are identified in maps produced by the Subsistence Division. In-season aerial surveys demonstrating a lack of spawn in traditional areas that are likely to have productive substrate should factor into ADF&G's determination of reasonable opportunity, indicating that the subsistence harvest will not have a sufficient amount of quality herring spawn on branches.

ii. Accessibility of Herring Spawn to Subsistence Harvesters

In addition to the substrate beneath spawning events, the location of spawning is important for providing quality herring spawn on branches. ADF&G must consider whether herring spawn is occurring or likely to occur within areas that are accessible to subsistence harvesters before opening the commercial fishery.

As discussed above, subsistence harvesters are typically limited in the areas that they can access in Sitka Sound. Ordinarily diligent harvesters may use skiffs that are not capable of crossing open waters. These harvesters rely on traditional subsistence areas between Dorothy Narrows and Neva Strait, for spawning events commencing in the Core Area, and lasting for three weeks, with "waves" of spawners coming to deposit their eggs on laid hemlock boughs and other substrate. (Schroeder and Kookesh 1990, Thornton et al 2010; Thornton and Kitka 2015).Thus, spawning events that occur in inaccessible areas would not yield "quality" herring spawn on branches. ADF&G must consider the geographic distribution of spawning when determining whether there is a reasonable opportunity for subsistence.

iii. Duration (Mile-Days) of Spawning Events in Subsistence Areas

The duration of herring spawning events in accessible areas has been identified as one of the key indicators of quality herring spawn for subsistence harvesters. Local and traditional knowledge holders report that quality spawn on branches requires 2 to 3 days of spawn in an accessible area. (Thornton et al. 2010) ADF&G should consider in-season

data regarding herring spawning areas from daily aerial surveys to analyze the likelihood that subsistence harvesters will be able to access quality herring spawn on branches.

ADF&G produces maps of herring spawning areas using "miles of spawn" estimates from daily aerial surveys conducted in the management area beginning with the first signs of spawning activity. Miles of spawn are mapped and/or photographed. Occasionally these data have been shared in real time (photos), but are otherwise logged for later analysis, along with egg deposition samples, to produce data on the herring reproduction for stock assessment (e.g., active spawn-mile days; Dressel 2021).

Although ADF&G has put little effort and thus has little to no scientific information or data into understanding how the commercial fishery management model affects a reasonable opportunity for subsistence, some of the data already collected by ADF&G can be applied with local and traditional knowledge in an attempt to develop metrics to estimate subsistence opportunity and guide management of the commercial fishery. For example, a simple extension of Shewmake's analysis (2013) uses mile-days of spawn in the Core Area as a measure of opportunity for subsistence users. Traditional knowledge users have stated that at least three consecutive days of spawn in appropriate habitat are necessary for subsistence harvesters (Thornton et al. 2010) and the Core Area serves as a simple, well-delineated proxy for spawn in accessible and appropriate habitat.

As a first approximation, STA staff reviewed in-season announcements from ADF&G and post-season stock assessments from 2009 to 2018 to estimate the miles of spawn deposited in the Core Area each day. For days when ADF&G updates included maps, STA used the Measure tool in Google Maps to attempt to recreate ADF&G spawn maps and estimate miles of spawn in the Core Area. For days without maps, STA employees used whatever other information was readily available (parsing written descriptions of spawn, interpolating from adjacent days with maps, flight logs from post-season stock assessments, newspaper clippings) to make a best estimate of miles of spawn in the Core Area. Because STA did not have maps for each day, there will of course be uncertainty in the estimates of spawn in the Core Area. However, the first approximation shows subsistence harvests closely track mile-days of spawn in the Core Area. This preliminary analysis suggests that at least 90 mile-days of spawn are required in the Core Area for subsistence users to meet the lower threshold of the Amount Necessary for Subsistence. A management tool derived from this could be that ADF&G refrain from opening the commercial fishery until this threshold of mile-days of spawn in the Core Area and any additional quality metrics are met. Importantly, ADF&G already collects the data

needed to track this metric in-season. It would not require substantially more in-season effort by ADF&G. While not a perfect predictor of subsistence harvests, mile-days of spawn in the Core Area is a substantial improvement from ADF&G's current lack of in-season tracking of subsistence harvest. STA welcomes the opportunity to help develop this metric for use in-season to allow spatiotemporal distribution of spawn to guide management of the commercial fishery.

d. Age and Weight of Spawning Population

ADF&G must consider the age and weight of spawning herring when determining whether there is a reasonable opportunity for subsistence. As discussed above, subsistence harvesters rely on the same subset of older, larger herring to produce quality herring spawn on branches. ADF&G's false assumption that a large biomass of spawning herring will provide a reasonable opportunity for subsistence fails to consider that the commercial fishery targets "marketable" herring sac roe, which is the same herring spawn desired by subsistence harvesters. High grading by the commercial fishery has already changed population ages and weights, i.e., a shifting baseline. The commercial fishery's removal of the oldest, largest herring disrupts spawning behavior that allows the oldest herring to show younger herring where to spawn (Thornton et al 2010; MacCall et al. 2019, Thornton and Moss 2021).

e. Effects of the Commercial Fishery on Subsistence Harvests

i. Proximity of Commercial Openings to Subsistence Areas

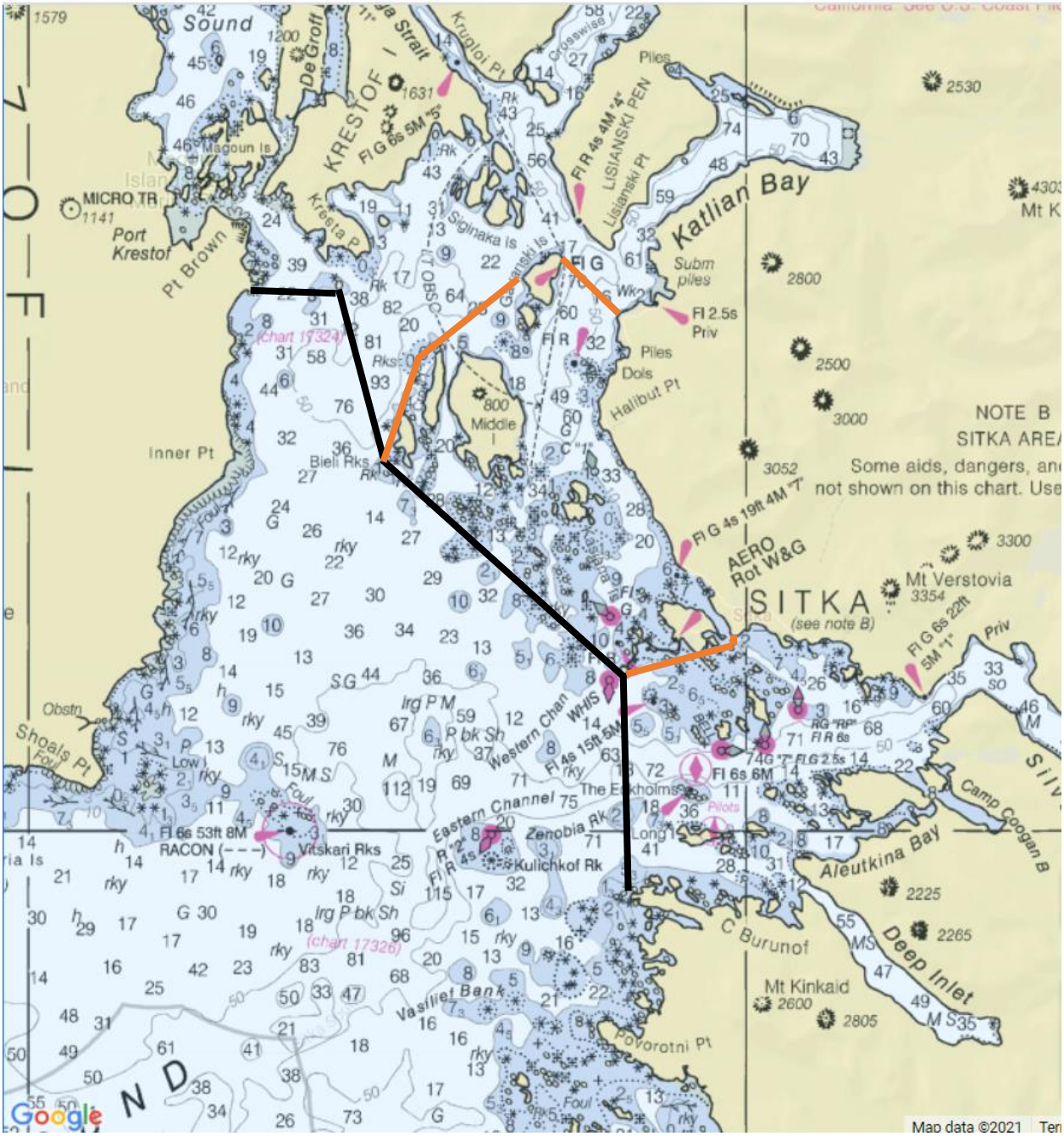
ADF&G must consider distributing the commercial fishery by area throughout Sitka Sound in order to ensure a reasonable opportunity. This requires ADF&G to consider the effects of the commercial fishery's opening locations on the quantity and quality of herring spawn available for subsistence harvesters. In particular, ADF&G should be aware that commercial fishery openings in proximity to traditional subsistence areas make it extremely unlikely that a reasonable opportunity for subsistence is ensured.

Commercial fishing in close proximity to spawning areas disturbs spawning herring and selectively removes older/mature herring leading younger herring to a (wider) variety of spawning areas. Younger herring may then condense into fewer spawning areas as a result (MacCall et al 2019) rendering the spawning population more vulnerable, and reducing opportunities for subsistence in traditionally reliable spawning areas.

Furthermore, scientists conclude that older/larger fishes contribute disproportionately more to future production (Hixon et al. 2014, Barneche et al. 2018); selective removal of older herring should not be allowed to exceed the guideline harvest rate for the overall population, as it has in recent years.

Spatiotemporal distribution of spawn is exceptionally important for subsistence harvesters. In years like 2017 and 2018, there was effectively no harvestable spawn in the closed area. LTK holders suggest these spawning patterns and subsequent abysmal subsistence harvests are anomalous. The closed area helps prevent the sac roe fishery from stressing herring nearing spawning in a small area, but the closed area in of itself cannot provide reasonable opportunity for subsistence. But ADF&G has allowed the fishery to operate immediately adjacent to the closed area boundary and STA has observed seiners going into the closed area to drive herring out of the protected area so they could be targeted for commercial capture. This should be prevented: no commercial boat should be allowed into a closed area, except minimally to get in and out of harbor.

Commercial openings farther from town would likely minimize the direct impact on the subsistence harvest due to environmental conditions and accessibility. Commercial openings west of a line from Cape Burunof to the most western point on Makhnati Island to Bieli Rocks to the southern end of Guide Island, west to a point on the of Kruzof Island shoreline and would include waters north of Olga Pt. and south of Frosty Reef, as shown on the following map, would be expected to have the least effects on the subsistence harvests.


Sound
DeGroff
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Piles
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Middle I
Siginaka Is
Kresta P
Port Krestof
Pt Brown
MICRO TR
Magoun Is
Inner Pt
Bieli Rks
Foul
Obstn
Shoals Pt
Low I
Fl 6s 53ft 8M
RACON (- - -)
Vitskari Rks
Western Chan
Fl 4s 15ft 5M
WHIS
Eastern Channel
Zenobia Rk
Kulichkof Rk
Fl R 4s
Fl G 4s 19ft 4M "7"
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Google
Map data ©2021

ii. Duration and Timing of Commercial Openings

ADF&G must consider the effects of the timing and duration of commercial openings on the quantity and quality of herring spawn available for subsistence harvesters. The commercial fishery attempts to harvest herring just before they spawn, creating substantial disruption to a sensitive and important part of the herring's life cycle. Subsistence harvesters cannot harvest herring eggs until after a substantial amount of spawn has been deposited in accessible and appropriate habitat.

iii. Test Fisheries

ADF&G must consider the effects of the commercial test fishery on the quantity and quality of herring spawn available for subsistence harvesters. As discussed above, test fisheries disrupt herring spawning patterns and may be used to target and harvest a disproportionate amount of older, larger herring—the same population subset desired by subsistence harvesters.

Because the decision to allow a test fishery is a management decision, ADF&G must explain its determination that there is a reasonable opportunity for subsistence before authoring a test set. ADF&G's reasonable opportunity determination must demonstrate how it considered whether subsistence harvesters have a reasonable opportunity to harvest the quality and quantity of herring spawn on branches necessary for subsistence. ADF&G's decision must also explain how it considered the effects of the commercial test fishery on subsistence harvest opportunities.

iv. Intensity of Commercial Effort

Finally, ADF&G must consider the effects of the intensity of the commercial fishery's effort to harvest the full GHL within a short time period. In addition to avoiding large initial harvests prior to significant spawning has commenced in subsistence use areas (discussed above), there is an additional concern that intense commercial harvests in the management area significantly reduce opportunities for subsistence. In fact there is an alarming trend in subsistence harvests when commercial harvests exceed 11,000 tons. In the 18 years from 2002-2019 for which data on commercial harvest can be compared to subsistence harvest survey results, the midpoint in the current ANS range (136,000 to 227,000 pounds), or 181,500 pounds of herring eggs, has only been achieved once when the commercial harvest exceeded 11,000 tons (in 2009). During that same period, the

average subsistence harvest for all years in which the commercial fishery exceeded 11,000 tons was 113,988 pounds, 16% below the low point in the ANS (136,000 pounds) and 37% below the midpoint (181,500 pounds), with the high point (227,000 pounds) never being achieved. This indicates that large commercial harvests (> 10,000 tons), especially when concentrated intensively in Sitka Sound, drastically increase the likelihood that the ANS will not be met, regardless of overall biomass. This is true even when subsistence harvesters increase their catch per unit effort (CPUE). These data suggest that subsistence opportunity is harmed by large commercial harvests in Sitka Sound even with larger biomass, and thus the intensity of commercial effort in time, in space, and in overall catch, must be taken into account in managing for subsistence opportunity.

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