Intertidal Forage Fish Spawning Surveys in the Smith and Minor Islands Aquatic Reserve

Final Monitoring Report

Grant #: PC-00J29801-0: Ensuring regulatory effectiveness in Puget Sound's most special places

Prepared for:

Smith and Minor Islands Aquatic Reserve Citizen Stewardship Committee
Washington Department of Natural Resources

Prepared by:
Robin Clark
Whidbey Watershed Stewards
and
Jerry Joyce
Washington Environmental Council

September 2014

Publication Information

This Monitoring Report describes the research and monitoring study of forage fish beach surveys conducted in 2013-14 in the Smith and Minor Islands Aquatic Reserve. This project has been funded wholly or in part by National Estuary Program (NEP) of the United States Environmental Protection Agency (EPA) under assistance agreement PC-00J29801-0 to Washington Department of Natural Resources (WDNR).The contents of the report do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Copies of this Report will be available from the Washington State Department of Natural Resources at http://www.dnr.wa.gov/ResearchScience/Topics/AquaticHabitats/Pages/aqr_rsve_aquatic_reserves_program.aspx and http://www.aquaticreserves.org/resources/.

Cover photo: CSC members Cassie Williams and Rose Whitson and Citizen members Kelly Zupich, Bill Viertel, Mitch Incarnato.

Author and Contact Information

Robin Clark
Whidbey Watershed Stewards
P.O. Box 617
Langley, WA 98206
robin@whidbeywatersheds.org

Jerry Joyce
Washington Environmental Council
1402 Third Avenue
Seattle, WA 98101
206-440-8688
JerryJoyce@MoonJoyce.com

Contents

Figures ii
Tables ii
Abstract 3
Introduction 3
Goals and Objectives 7
Sampling Design and Procedures 7
Training 7
Narrative of the field research 8
Results 10
Discussion 13
Completeness of the Survey 14
Assessment of the feasibility of this study 15
Recommendations for any modification of the procedures 15
Conclusions 15
Literature Cited 16
Appendix A: Acknowledgements and Volunteers 17
Appendix B: Sampling Procedures 19
Standard Sampling Procedure: 19
Adapted Information for Volunteers on the Protocol 20
Equipment and Materials 20
Prior to Going into the Field 20
Before you leave the parking lot 21
On the Beach 21
Subsequent sample sites 22

Figures

Figure 1: The Smith and Minor Islands Aquatic Reserve boundaries 4
Figure 2: The Smith and Minor Islands Aquatic Reserve and surrounding areas 5
Figure 3: Establishing the transect line and sample sites. 8
Figure 4: Taking a sample. 9
Figure 5: Winnowing the sample. 10
Figure 6: Access points and beach designations 11
Figure 7: Number of samples taken during each survey date. 12
Figure 8: Location of samples taken in Smith and Minor Island Aquatic Reserve. 12
Figure 9: Locationsof previously documented spawning beaches 14
Figure 10: Example of labeling for sample jars. 20

Tables

Table 1: Dates of beach surveys 11

Intertidal Forage Fish Spawning Surveys in the Smith and Minor Islands Aquatic Reserve

Final Monitoring Report

Abstract

The Smith and Minor Islands Aquatic Reserve is a Washington Department of Natural Resources Aquatic Reserve West of Whidbey Island, WA in the Salish Sea. A program to support Forage Fish Beach Surveys was developed in June 2013 and follows the WDFW Intertidal Forage Fish Spawning Habitat Survey Protocols. The purpose of the program is to sample intertidal areas for the presence or absence of Pacific sand lance and surf smelt eggs throughout one year. The team collected 55 samples between July 9, 2013 and June 27, 2014. No fish eggs were found in any of the samples by the citizen project, and one confirmed and three unconfirmed samples were detected by the PSC. This supports the general presumption that the high-energy beaches of West Whidbey are not highly used by forage fish for spawning. The goals and objectives of establishing a sampling program were met, and trained citizen-science volunteers continue to be available for future sampling efforts. Ongoing monthly sampling in the Aquatic Reserve ended as of July 2014.

Introduction

The Smith and Minor Islands Aquatic Reserve Forage Fish project began in June 2013. This project was selected by the Smith and Minor Islands Aquatic Reserve Citizen Stewardship Committee (SMIARCSC) in partnerships with the Whidbey Watershed Stewards (WWS), the Washington Environmental Council (WEC) and in association with the Washington Department of Natural Resources (WDNR) and Washington Department of Fish & Wildlife (WDFW). The survey supplements the surveys conducted by WDFW in the past and the current effort by the WDNR Puget Sound Corps (PSC) and uses established WDFW protocols. The purpose of the program is to sample beach sediments for the presence or absence of Pacific sand lance (*Ammodytes hexapterus*) and surf smelt (*Hypomesus pretiosus*) eggs over time.

The Smith & Minor Islands Aquatic Reserve was designated as a WDNR Aquatic Reserve in 2010. The management plan for the reserve was released in October 2010. The reserve encompasses approximately 36,308 acres of state-owned WDNR managed tidelands and submerged bedlands. The aquatic reserve is located in the Salish Sea with the boundary including the western coast of Whidbey Island, Washington from the northern boundary of Joseph Whidbey State Park to just south of the southern boundary of Fort Ebey State Park. Figure 1 shows the boundaries of the Aquatic Reserve in association to the geographic and manmade features and Figure 2 shows a regional view of the area.

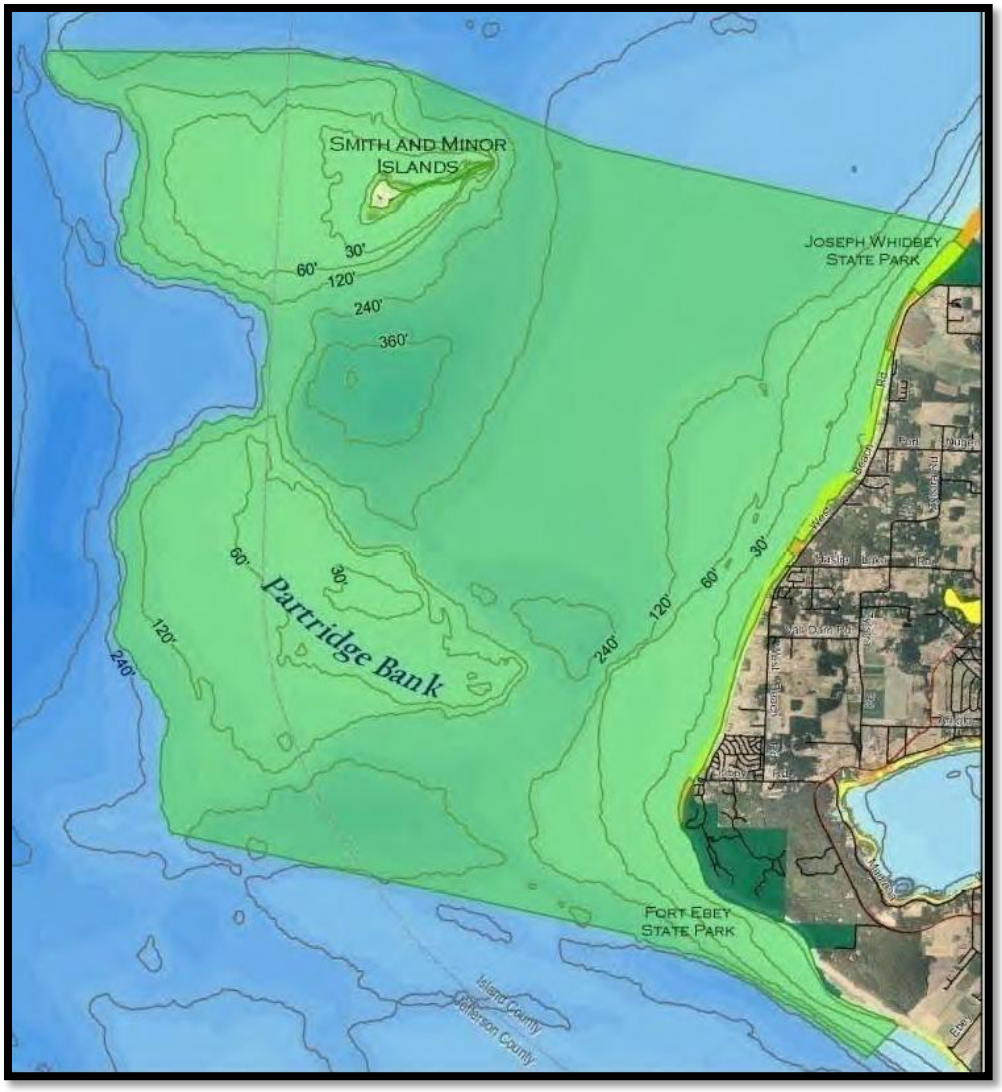

Figure 1: The Smith and Minor Islands Aquatic Reserve boundaries (Source: WDNR, 2010)

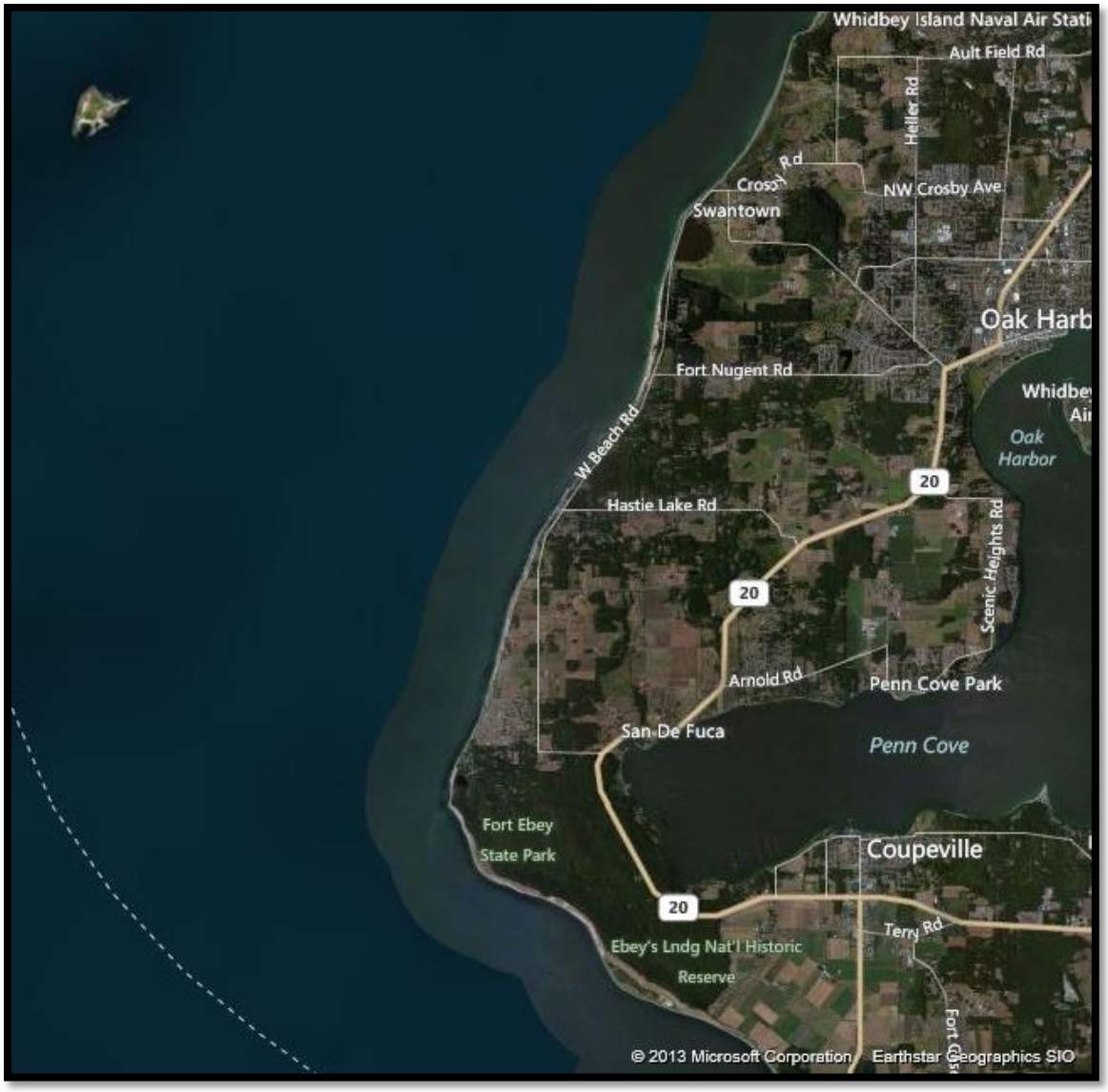

Figure 2: The Smith and Minor Islands Aquatic Reserve and surrounding areas (Source: Bing maps).

Smith and Minor Islands Aquatic Reserve is designated as an Environmental and Scientific Reserve. One of the main reasons for the Environmental Reserve designation is to protect areas of bull kelp, especially since there has been a large reduction of kelp beds in the nearby Protection Island Aquatic Reserve. The bull kelp bed west of Smith Island is the largest bed in the state. The area also supports a large number of seabirds, including nesting colonies on Smith Island. Smith and Minor islands are part of the San Juan National Wildlife Refuge and the US Fish & Wildlife manages the island land with a 200-yard restricted use buffer around the islands. One of the primary reasons that the area is designated as a Scientific Reserve is because of the continuing monitoring and research being conducted near and on Smith and Minor Islands. Most of the hydraulic processes in the reserve, including intact drift cells and sediment transport and deposition, are functional and mostly undisturbed, except by some limited shoreline armoring. Numerous feeder bluffs are intact. The area is strongly influenced by the confluence of waters from the Strait of Juan de Fuca, Admiralty Inlet, and Rosario Strait.

The reserve also supports some spawning of forage fish, particularly surf smelt which lays eggs in a narrow band on the beach within the intertidal zone. Approximately 15 percent of the beaches of the reserve have documented surf smelt spawning, surveyed by Dan Penttila of WDFW in seasonal surveys from 2001-2003. No known surveys have been conducted since that time until the current PSC and SMIARCSC surveys. The high-energy environment and substrate of the reserve shorelines makes it unlikely that there would be high usage of these beaches for spawning by surf smelt or sand lance, and no sand lance eggs had been previously documented. However, little is known about spawning timing and overall usage of these beaches by both species, and this effort was planned to help fill in knowledge gaps for the aquatic reserve (WDNR, 2010).

The management plan identifies four main goals for the reserve:

Goal One: Preserve, restore, and enhance the functions and natural processes of aquatic nearshore and subtidal ecosystems of the Aquatic Reserve.

Goal Two: Identify, survey, and monitor sensitive habitats, species, and natural processes and provide and support opportunities for scientific research.

Goal Three: Support and provide opportunities for outdoor education and interpretive studies.

Goal Four: Collaborate with other reserve management partners, programs, and management actions to ensure connectivity across the Aquatic Reserve Program.

This monitoring program was developed to address goals Two through Four.

In the development of the 2012-13 Action Agenda, the Puget Sound Partnership established a near-term action for forage fish in Marine Protected Areas, including the Aquatic Reserves (PSP, 2012)

B3.1 NTA 1: Marine Protected Area Effectiveness. By June 2014, PSP, in collaboration with WDFW and WDNR will identify the threats, coverage gaps, and conservation concerns addressed by existing Puget Sound marine protected areas and assess the potential effectiveness of these MPAs to protect threatened species and habitats, including rockfish and forage fish.

The importance of forage fish in the Puget Sound ecosystems has long been recognized. WDFW (1998) established a policy (POL-C3012) for the management of forage fish that requires that management practices be based on monitoring data. A poster by Pierce, et al (2012) summarizes much of the past sampling of forage fish in Puget Sound.

A symposium on forage fish was held in September 2012 (Liedtke et al, 2013) that both summarized current work and presented new research. One of the conclusions of the symposium was that

"The lack of reliable, and stock-specific, abundance estimates is a large data gap for most forage fish species in the Salish Sea. It is difficult to assess whether forage fish populations are stable, growing, or declining without a baseline population estimate and a means of assessing abundance on a relevant time scale. Herring are the only forage fish species in Puget Sound that are regularly monitored (by WDFW), and the group recommended that future effort be more balanced across all forage fish species."

Pacific sand lance and surf smelt spawn in coarse sand to fine gravel substrate of the upper intertidal zone, depositing eggs in specific zones. Forage fish beach spawn surveys have been recognized as a

reliable way of monitoring forage fish spawn abundance and determining critical spawning habitat sites (Moulton and Penttila, 2001).

Additional details regarding the development and design of the program are given in the Quality Assurrance Project Plan (QAPP) *Intertidal Forage Fish Spawning Surveys in Washington Department of Natural Resources Aquatic Reserves* (Grilliot & Joyce, 2013).

Goals and Objectives

The goals of the intertidal forage fish-spawning survey are to:

- Collect time sensitive baseline data throughout the reserve
- Document changes over time in forage fish usage of the beaches using established methods that will provide data comparable across reserves and monitoring years.
- Add to the existing DNR and WDFW database for forage fish spawning beach locations.

The objectives of this project are to:

- Train and empower citizen scientists in conducting surveys using a standardized protocol
- Implement the surveys on a regular and consistent basis.
- Create a sustainable, locally operated structure to continue this work after the end of this grant.

Sampling Design and Procedures

The sampling design follows the WDFW Intertidal Forage Fish Spawning Habitat Survey Protocols, Procedures for Obtaining Bulk Beach Substrate Samples (Penttila, 2011). The protocol is shown in Appendix B.

Sampling was scheduled monthly July 2013-November 2013, twice monthly December 2013-February 2014, and monthly starting in March 2014 with the citizen team supplementing efforts by the Puget Sound Corps team. Essentially, the procedure is to establish and document the location of the sampling transect (Figure 3), collect samples along the transect (Figure 4), pass the samples through a series of sieves and use a winnowing technique to separate the light fraction of the sample (Figure 5). The light fraction is then stored in a sample jar, the jar labeled, stored, and eventually transferred to WDNR staff for analysis.

Training

After the Citizen Committee selected the forage fish project, a day of sampling and planning coordination was set up with the PSC staff on March 25, 2013. A core group of the Citizen Stewardship Committee performed sampling again with the PSC members on June 3, 2013 to enhance training. Using the information gathered during initial field visits, the formal public training was planned and outreach to the public was conducted. On June 15, 2013, Whidbey Watershed Stewards' staff biologist, Robin Clark, and PSC member Cassie Williams conducted training. Fifteen community members were trained in sampling protocols, and all volunteers were assisted in sampling by Robin Clark during survey days. Two people with previous experience joined the group later, and were trained in the field by Robin Clark, bringing the total group of volunteers to 17. A follow-up training was conducted in May 2014 when a smaller group of volunteers participated in sampling with the new group of PSC members.

Figure 3: Establishing the transect line and sample sites.

Narrative of the field research

The intention of this effort was to add capacity to the PSC effort. When the PSC comes to Whidbey Island to sample, they are typically able to collect 10-12 samples from approximately three beaches. The survey effort added 3-8 samples to this total for monthly sampling. In addition, PSC members were able to access Smith Island in spring of 2014 and sample there. Monthly sampling efforts typically employed 3-4 volunteers plus Whidbey Watershed Stewards staff, and sampling occurred on one or two beaches, coordinated with PSC efforts. A map (figure 6) was created of the access points to the Reserve beaches, and a numbering system for the beaches was created to reduce confusion about locations. As the

beaches were investigated, some areas were eliminated as not being suitable habitat. The stretch of beach along Swantown Lake that has private tidelands and continuous bulkheads or riprap was never sampled during the effort, but all other areas with potential forage fish spawn habitat were sampled at least once. After samples were collected, Stockards solution was added to samples as a preservative since the logistics of the transfer of the samples and data sheets to Olympia was sometimes difficult, and took some time.

Figure 4: Taking a sample.

Figure 5: Winnowing the sample.

Results

The results of this study are primarily descriptive of the collection of samples and field observations, as the majority of 2014 samples have not yet been analyzed in the laboratory. Therefore, the results and are not intended to be used in statistical analysis of forage fish spawning.

Samples were collected between July 2013 and June 2014. Table 1 shows the dates beach surveys were conducted. Other sampling took place prior to July 2013 in association with PSC, and sampling occurred in July 2014. Those results are not included in this report, which covers the year from July 2013-June 2014.

Figure 7 shows the distribution of these dates throughout the sampling year with the number of samples collected in each survey. The geographic distribution of the sampling is shown in Figure 8.

Figure 6: Access points and beach designations

2013	**2014**
July 9	Feb 3/5
August 16/17	Mar 27
Sept 16/17	May 13
October 23	June 16/17
Nov 11/12	
Dec 13	

Table 1: Dates of beach surveys

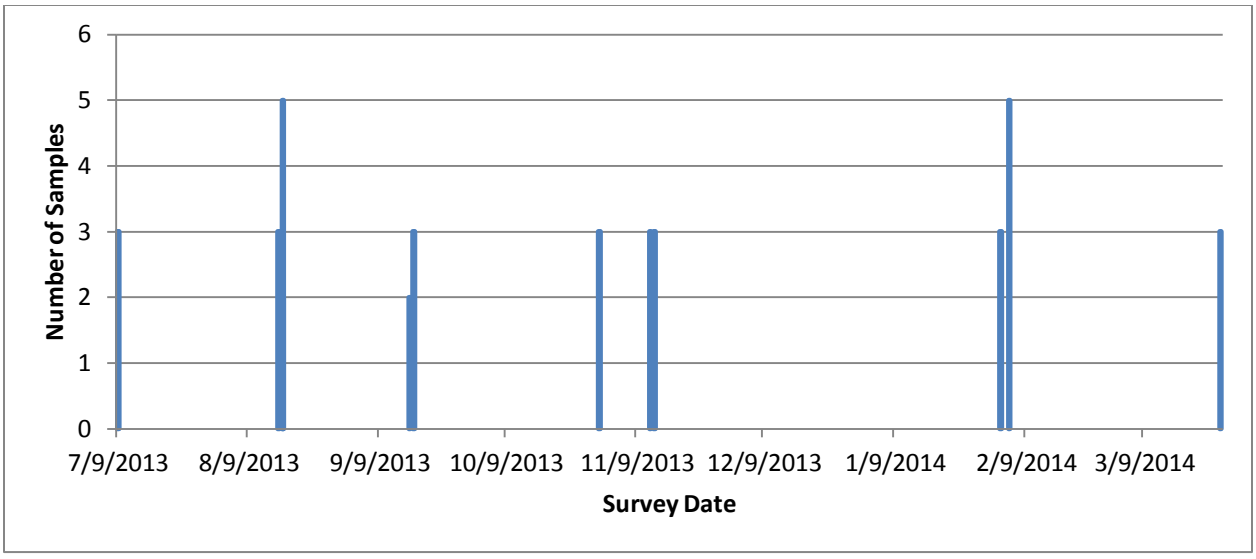

Figure 7: Number of samples taken during each survey date.

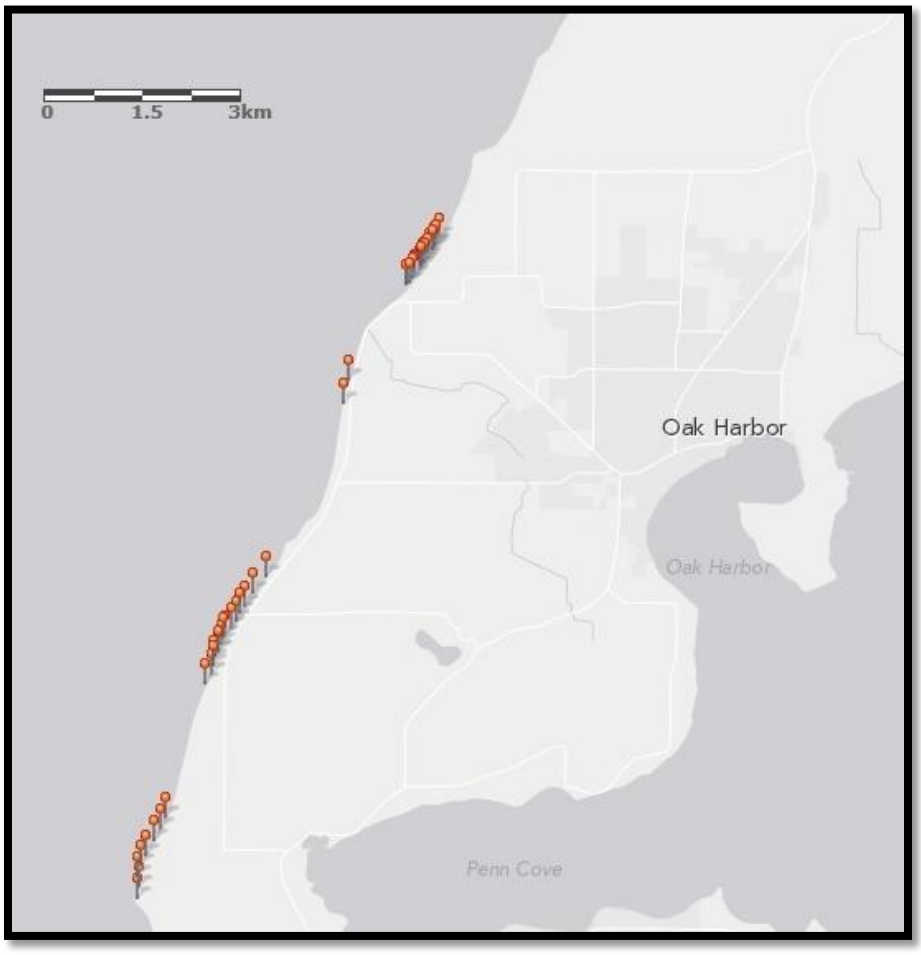

Figure 8: Location of samples taken in Smith and Minor Island Aquatic Reserve.

There were 15 survey days from July 2013 – June 2014. Additional days for preparing for training and performing surveys with the PSC team added an additional three days of sampling for which no samples were recorded for the citizen-science team. There were a few months when local volunteers did not collect samples due to availability of volunteers, weather, or tides. These volunteers contributed 232 hours collecting 55 samples during this year of sampling. No forage fish eggs were identified in any of the samples collected by the citizen-science teams.

Discussion

This was the first year of this study directed by SMIARCSC, and volunteers used the WDFW protocol for the collection and preservation of the samples. Volunteers were well trained, supported by staff, and worked with two groups of PSC team members who offered additional training. This effort added significantly to previous sampling efforts that had occurred on the reserve, and adds support to the hypothesis that there is not much spawning activity on the high-energy beaches of West Whidbey. Dan Penttila previously surveyed beaches in the reserve from 2001-2003 and documented spawning locations near Swantown Lake, but it was his conclusion that these beaches were not ideal spawning locations for forage fish (WDNR, 2010), and produced few eggs. The locations of his sampling effort are shown in Figure 9.

No forage fish eggs were observed in any of the samples taken in this project. While it is difficult to eliminate possible survey limitations for the lack of eggs found by the SMIARCSC team, such as poor sampling methodology or insufficient effort, this result is likely a reflection of the status of spawning in the area. Previous and concurrent surveys within the reserve by PSC found only one set of eggs along the West Whidbey beaches plus one more on Smith Island. Given the extensive training and the similarity in results between the sampling efforts of both the PSC and the citizen team, it is assumed that the sampling methodology was appropriate. It is also possible that population changes have occurred since the initial sampling by Dan Pentilla, last performed in 2003.

As shown in Figure 8, the sampling locations were extensive throughout the intertidal area of the reserve, with the exception of those at Smith and Minor islands. Table 1 and Figure 3 show that sampling effort was distributed throughout the year. Despite the sampling effort not quite meeting the specifications of sampling twice a month from December to February and monthly for the other months, sampling was conducted in all months by the teams. It seems likely that if there were substantial spawning on these beaches, it would have been detected during some of this sampling.

Therefore, the program's stated goals and objectives were met. The first goal, to create a time-sensitive dataset of spawning throughout the reserve was achieved, albeit showing little or no spawning, at least during this year of survey.

The second goal, to document change over time and area, has been addressed by systematically collecting data throughout the year, but needs additional years of sampling to detect any spawning events and any changes and trends over time. With the small amount of sampling done and small amount of spawning that has ever been documented, it is not possible to draw conclusions about the population of forage fish. By using a standardized protocol and training, the monitoring should be compatible with monitoring at other reserves and areas and be repeatable.

The establishment of the monitoring program meets the objectives of this project. Citizen scientists have been trained to collect samples using the established protocol, and the volunteer program is planned to continue past the end of this grant although they will be sampling other locations on Whidbey Island. To create more interest, volunteers have been encouraged to join efforts at Fidalgo Bay, and a monitoring plan for Whidbey Island as a whole is being devised.

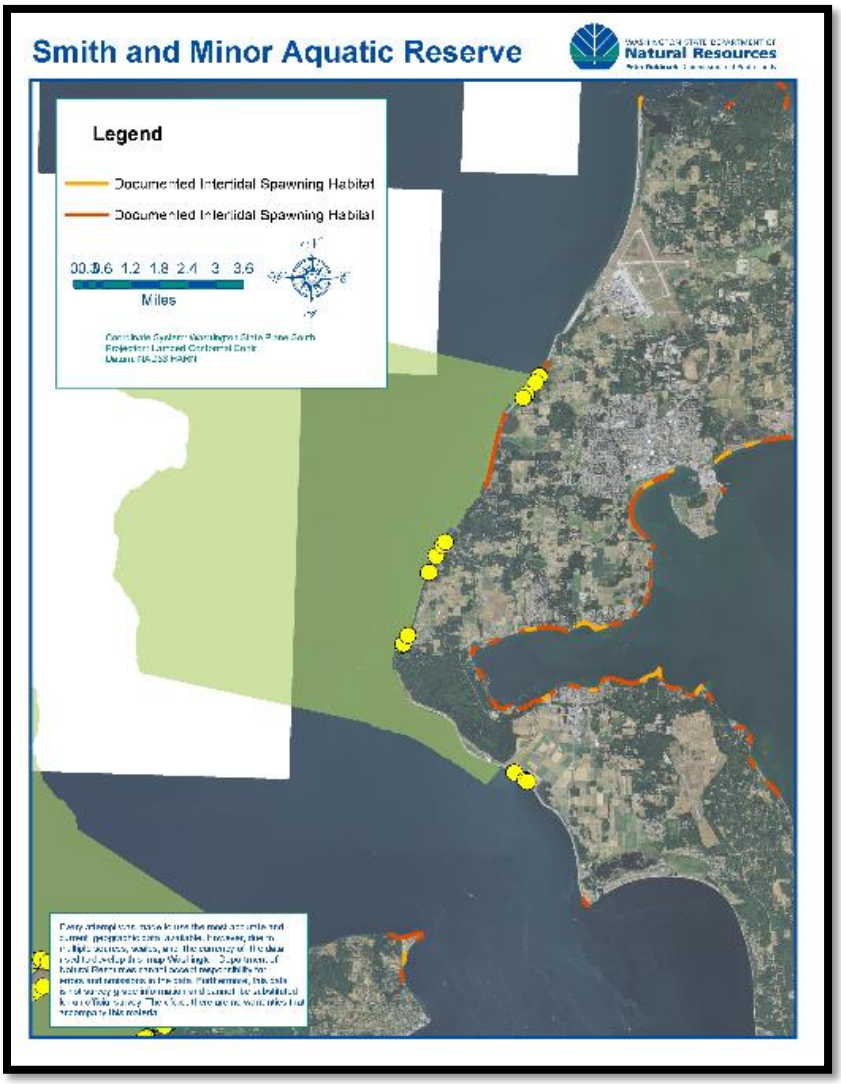

Figure 9: Locationsof previously documented forage fish spawning beaches. Yellow dots represent individual documented sites, and lines represent continuous spawning areas.(WDNR, 2010)

Completeness of the Survey

The target for completeness is to successfully collect beach samples for 95% of the planned bimonthly and monthly sampling events (Grilliot and Joyce, 2013). This was not achieved as ten out of a possible 15 sampling events were completed for a rate of 66%. The citizen-science team did not implement the bimonthly effort, but since the PSC was also sampling, the intended sampling frequency was achieved. Considering the difficulty of sampling on these high energy beaches during the winter, the goal of 95% may too ambitious.

Assessment of the feasibility of this study

This type of sampling effort is realistic for a trained and committed group of volunteers. Once a core group is established, they can lead the effort and assure the quality of the sampling. The group did not process samples, but this could be added to the procedure over time, as it is being done by the Fidalgo Bay Aquatic Reserve volunteers. Surveying in areas where spawning is taking place, and where volunteers experience finding eggs is critical to maintaining enthusiasm, and for educating volunteers.

Recommendations for any modification of the procedures

The established protocols have worked well for volunteers, and for establishing credible data for the agency over time. The procedure description has been updated to be more user friendly, and the data sheets should be updated to correct minor errors and eliminate confusion. Suggested updates are included in Appendix B, and other Reserve Committee groups may add to this list.

Conclusions

This program was successfully implemented, and useful data was contributed. The sampling in this program is a supplement to existing sampling conducted by PSC. Further expansion of the beaches surveyed will cross agency boundaries, but should continue the involvement of volunteers. The lack of fish eggs in the collected sampling over this years' effort seem to be indicative that the high-energy beaches of the reserve have limited productivity for forage fish, but it may also reflect a decrease in populations using West Whidbey. Other potential variables include interannual or decadal weather patterns that can influence substrate size and distribution in upper intertidal areas. After additional collections and analysis of population trends, a review of the efficiency of these surveys should be conducted.

Literature Cited

Grilliot, Michael and Joyce, Jerry, 2013. Quality Assurance Project Plan; Intertidal Forage Fish Spawning Surveys in Washington Department of Natural Resources Aquatic Reserves. Available at http://www.aquaticreserves.org/resources/ (accessed September 26, 2014)

Liedtke, Theresa, Gibson, Caroline, Lowry, Dayv, and Fagergren, Duane, eds., 2013, Conservation and Ecology of Marine Forage Fishes—Proceedings of a Research Symposium, September 2012: U.S. Geological Survey Open-File Report 2013-1035, 24 p. http://www.nwstraits.org/uploads/pdf/NWS-2013_FF_Symposium.pdf (accessed March 26, 2013)

Moulton, Lawrence L and Penttila, Daniel E. 2001 (Revised 2006). San Juan County Forage Fish Assessment Project Forage Fish Spawning Distribution in San Juan County and Protocols for Sampling Intertidal and Nearshore Regions Final Report June 2000. Available at http://www.nwstraits.org/Uploads/pdf/sjc_forage_protocols.pdf (accessed April 4, 2013).

Penttila, Dan. 2011. WDFW Intertidal Forage Fish Spawning Habitat Survey Protocols; Procedures for obtaining bulk beach substrate samples. WDFW Protocol FF-01 Version 1.0, July 2011. Reformatted by Dayv Lowry and available on request from Dayv Lowry at WDFW (dayv.lowry@dfw.wa.gov).

Pierce, Ken; Penttila, Dan; Benson, Brian; Krueger, Kirk; Quinn, Timothy; and Price, David 2012. Spatiotemporal Detection of Forage Fish Eggs Derived from Long-term Spawning Surveys. Poster available at http://wdfw.wa.gov/publications/01211/wdfw01211.pdf (accessed March 26, 2013)

PSP, 2012: Puget Sound Partnership The 2012-13 Action Agenda for Puget Sound. (page 134) Available at: http://www.psp.wa.gov/downloads/AA2011/083012_final/Action%20Agenda%20Book%202_Aug%2029%202012.pdf (accessed March 26, 2013)

WDFW, 1998. Forage Fish Management Policy, Goals and Plan. http://wdfw.wa.gov/commission/policies/c3012.html (accessed March 26, 2013)

WDNR, 2010. Smith & Minor Islands Aquatic Reserve Management Plan. http://www.dnr.wa.gov/Publications/aqr_rsve_smithminor_plan.pdf (accessed April 1, 2013)

Appendix A: Acknowledgements and Volunteers

We thank the following volunteers who attended trainings, surveyed beaches or participated in committee work. Without these dedicated citizens, so much would go unnoticed:

In alphabetical order:Susan Berta, Jim Bruner, Steve Ellis, Howard Garrett, Finn Gatewood, Jill Hein, Gladys Howard, Mitch Incarnato, Kelly Keith, Phyllis Kind, Mellissa Lebo, Cheryl Lowe , Joanne McMillen, Gayle Nixon, Flossie Pearson, Gary Rassner-Donovan, Sandy Shipley, Bill Viertel, Fred Walsh , Kelly Zupich, and Matt Zupich.

We would also like to thank the Americorps volunteers of the Puget Sound Corps and the staff and supporters of the program from the Washington Department of Natural Resources.

We thank Tom Gries and Jamie Kilgo for their reviews of earlier drafts of this report.

Appendix B: Sampling Procedures

The sampling design follows the WDFW Intertidal Forage Fish Spawning Habitat Survey Protocols, Procedures for Obtaining Bulk Beach Substrate Samples (Penttila, 2011). Slight modification of the protocol has been made in steps 9 and 10 to eliminate the need to use preservatives when possible. Description of the winnowing method is given in the QAPP (Grilliot & Joyce, 2013). The sampling protocol is as follows:

Note: Sampling should occur on the lowest tide practicable. Prior to sampling any site, consult tide tables to ensure you will be able to access the +7-9 (surf smelt) and +5-8 (sand lance) tidal height. It may also be necessary to obtain permission to access the beach from private or corporate landowners.

Standard Sampling Procedure:

1. Upon arriving on the beach, fill out the header information on the attached data sheet. Do not fill in "Reviewed by." Before conducting the first sample, describe the character of the upland and beach environment using the codes provided on the back of the data sheet. For additional details on sample codes, see Moulton and Penttila (2001).
2. Identify a landmark from which you will measure the distance to the bulk substrate sample tidal elevation. Typical landmarks include the upland toe of the beach, the last high tide mark or wrack line, and the edge of the water.
3. Measure the distance from the landmark to the tidal elevation to be surveyed.
4. Stretch a measuring tape at least 100 feet along the selected tidal height. Note that beach contours may cause the landmark to be "wavy" and that the tape should remain a consistent distance from the landmark.
5. Standing at the 50-foot mark of the measuring tape, record a GPS fix on the data sheet.
6. Using a 16-ounce sample jar or large scoop remove the top 5-10 cm (2-4 in) of sediment from the location recorded in Step 5 above. Place the sediment in an 8 inch x 24 inch polyethylene bag or large, sturdy Ziploc. You may need to take two scoops to get sufficient sediment, depending on the coarseness of the beach.
7. Walk ten paces (single steps) along the measuring tape, repeat the sediment scooping action, and place the sediment in the bag. Move an additional ten paces and repeat. Move an additional ten paces, approximately to the end of the tape, and repeat. The bag should now have sediment from four locations along the tape and be at least ½ to ⅔ full. Place completed waterproof sample label in bag with sediment. Label should include reserve name, Beach# sample#, data, and sampler initials.
8. If additional transects, representing various tidal heights, along the beach are to be surveyed, place the sample bag in a cool, shady place and repeat the above procedures at these additional locations. If no additional samples will be taken, move on to wet sieving and winnowing the sample as described in the companion protocol *Procedures for recovering winnowed light fractions subsamples of forage fish egg-sized material from bulk beach substrate samples*.
9. Place each winnowed subsample in a sample jar, making sure threads are clean to ensure a tight seal. Label each jar (in pencil) with reserve name, date, and beach# sample#. If samples may not be transported within 24hours, the preservative Stockard's Solution may be added. If it is added, the closed jar should be inverted at least three times to be sure all the preservative is distributed. When using Stockard's Solution, mark the jar with a large X to indicate a preservative has been used. See Figure 10 as an example of labeling.

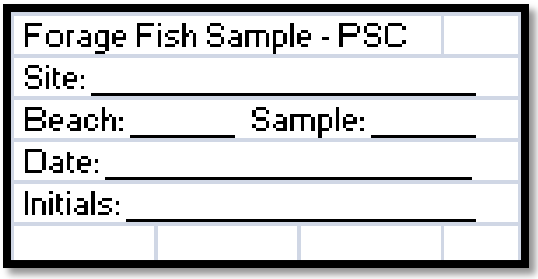

Figure 10: Example of labeling for sample jars.

Store sample collections in a cool location, making sure the samples are not frozen. Transport samples to WDFW personnel for analysis within 24 hours of collection unless a preservative has been used.
If you have a camera, take several photos of the survey area showing sampling locations. Be sure to take photos from several perspectives (i.e., both up and down, as well as along, the beach). For each photo, record the cardinal direction you are facing on the data sheet in the comments field. For our purposes, one photo of the transect from either end is sufficient, but highly encouraged! It is still important to record cardinal direction.

Adapted Information for Volunteers on the Protocol

Smith and Minor Island Aquatic Reserve Forage Fish Spawning Surveys

Field Procedures

Equipment and Materials

Team equipment

Measuring tape (100 feet)
Scoop
Poly bags or Ziplocs
Data sheets
Two plastic buckets
Sieves
Dishpan
Sample jars
Stockards solution
Data sheets and labels
Trash bags

Individual equipment

GPS/iphone with btopo (free app)
Camera
Tide table (also free apps available)
Small/medium backpack to carry samples
Sunglasses, sunscreen
Beach appropriate shoes or rubber boots
Clothing suitable for changing conditions
Pedometer (optional or as an app)

Prior to Going into the Field

Sampling should occur on the lowest tide practicable. You will want to do all your sampling at a +5 tidal height or lower. Surf Smelt use +7-9, and Sand lance use +5-8, we are looking for both.

1. Sign up for a time and beach to be sampled.
2. Make contact with your sampling partners to discuss the individual equipment needed.
3. Gather needed materials, and arrange the meeting time and place, double check tides.

Before you leave the parking lot

Meet with your team, and double check that you have all the equipment you need. Look at the weather and bring the appropriate clothing and gear. At least one person in your group will need to be in the wet to process samples, and will need rubber boots.

Agree on the beach segments you will be working on, and the approximate time limitations that you have, so you can be sure to finish collecting and winnowing the samples that you will gather. Decide on how far down the beach you will go, or if you have arranged for a one-way sample. Begin filling out the data sheet:

1. Fill out the **beach number** using the schematic of the Aquatic Reserve, and the name given.
2. Fill in the **start time** (always use 24-hr time, f.ex. 8am= 08:00, 1pm = 13:00, 8pm=20:00, etc)
3. Fill out the **last high tide** and the time that occurred using your tide chart.
4. The **location** is the Smith and Minor Aquatic Reserve.
5. Fill in today's **date**.
6. **GPS** – fill in the type of GPS you are using: a unit, or app (btopo).
7. **Camera** – fill in the type of camera you are using (iphone, other)
8. Do NOT fill in the **reviewed by, Entered, or Scanned** fields. These are for the analysis team.

On the Beach

Know your pacing (a pace is two steps counted at strike of the same foot), use a pedometer, or count your paces against the 100 ft. tape when you lay it out for your first sample. Recheck your pace occasionally or on different types of substrates.

900 feet = .170 miles (1000ft=.189 miles) F. ex. if you are 5'3" (2,395 x .170=407 steps or 203 paces)

Height	Steps per Mile	Height	Steps per Mile
5'1"	2,473	5'7"	2,252
5'2"	2,433	5'8"	2,218
5'3"	2,395	5'9"	2,186
5'4"	2,357	5'10"	2,155
5'5"	2,321	5'11"	2,125
5'6"	2,286	6'0"	2,095

1. Walk to your farthest destination, enjoy the walk, and look for trash!*
2. To begin filling out the data matrix, use the **beach number** from the top of the sheet.
3. The **sample number** will be in order that you take them during the day's effort. So, start with number 1 and consecutively number each sample for each beach.
4. Note the **time** of each sample.
5. Using your GPS, note the **Latitude and Longitude** of the start of each 100-foot sample. (Our location latitude always starts with 48., and the longitude always starts with -122.)

6. For the code section of the data sheet:
    a. Describe the character of the **upland** and **beach** environment using the codes.
    b. Decide on the best **landmark** to use from which you will measure the distance to your sample segment. Typically, the upland toe of the beach, the last wrack line, or edge of water.
    c. Measure from your landmark to the start point of your **sample zone**. Note it in feet to where you took your lat./long.
    d. **Tidal elevation, smelt, Sand Lance, Rock sole, and Herring** sections are all filled out by the analysis team in the office.
7. Stretch the 100 ft. measuring tape out parallel to your landmark, at approximately the same tidal height and take a picture of the sample area.
8. Take a scoop of the top 1-2 inches (3-4cm) of sediment, picking spots with the best sediment (sand and gravels) within the habitat band along the tape, and place it in the bag. Walk about 10 steps between samples, and collect about 4 times so that a gallon bag is ½ to 2/3 full.
9. At the end of the 100-foot segment, take another picture looking back along the sample area. You can do this with people in the shot –
10. Fill out a sample label, put it in the bag, tie up the bag, and place it in your backpack.
11. Before you leave your segment, look at the area and estimate the **width** of the potential spawning substrate band judging by the character of the sediment or the presence of spawn.
12. The **length** of the beach that the sample is in would end if there are barriers (rock walls or bulkheads) and be measured. At Smith and Minor, all our sample beaches are "C" for continuous.
13. See the codes for **shading**, noting that you are looking at the whole 1,000 feet of your station area (your 100-foot sample is in the beginning of this area). It is your interpretation of the season, and what happens over the entire day. Shadow from bluffs is not included, look at overhanging vegetation or shade from trees on the slope. Most of the beaches are 1= fully exposed.
14. Note any **comments** or clarifications you may have. Describe your landmark if you are unsure, or anything unusual or troubling.

Subsequent sample sites

After your first sample, have someone count paces to equal 900 feet to the start of the next sample site. Use the pace table, or a pedometer, it doesn't have to be precise. When you get to the next sample site, repeat the procedure. Gauge your time, so that you will have time to return to your car and to winnow and prepare the sample. If you are passing equipment on to another team when you are done, this will be very important – so keep a watch on time, and adjust your pace of work accordingly!

*Note on TRASH PICKUP: Tsunami trash is being tracked by the Dept. of Ecology. If you suspect garbage is of Japanese origin, take a picture and report it to Washington State Marine *Debris Hotline* (1-855-922-6278) or online at **http://marinedebris.wa.gov/ .** It is unlikely that any radioactivity remains and you can remove it if you wish, but do report it. If you see organisms on the debris, or any organisms that are invasive, take photos and report it to the invasive species hotline **1-360-902-2700.** Many volunteers also work with coastsavers, and photograph garbage and remove it. We do not have any way of disposing of the trash ourselves, for now it will have to go in your recycling or garbage, but picking up trash on the beach (especially small stuff – bottle caps, cigarettes, etc. is always great!)