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Assessment of Shoreline Spawning Habitats in the Northwest Straits (2001 - 2004)

with accompanying GIS Database/CD-Rom

Three years of biologic field investigations at a regional scale yield GIS databases to map forage fish spawning depositions in Puget Sound: Surf smelt/*Hypomesus pretiosus,* Pacific sand lance/*Ammodytes hexapterus and* Pacific herring/*Clupea pallasi*

Reported by:
Gary Wood JD, MRC Executive Director
Forage Fish Projects Coordinator

Principal Investigator:
Daniel E. Penttila, Fisheries biologist
Washington Department of Fish and Wildlife/WDFW

Sponsoring Grant Awards:

FORAGE FISH SPAWNING HABITAT ASSESSMENTS
Salmon Recovery Funding Board/SRFB
Grants 00-1086, 01-1673N and 01-1252N (2001-04)
to Island County Marine Resources Committee; and
SEADOC SOCIETY, Island County surveys (2001-02)

REGIONAL FORAGE FISH ASSESSMENTS
National Fish and Wildlife Foundation/NFWF
Challenge Grant 2002-0241-00 (2002-03),
Whatcom, Skagit, Snohomish & Island Counties

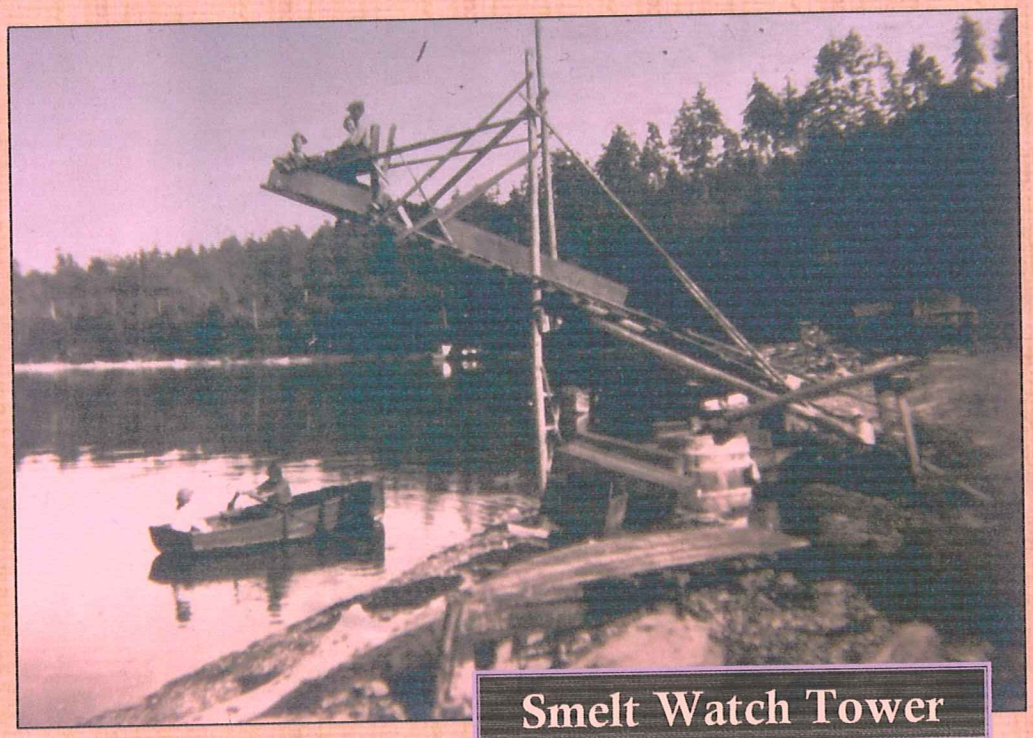
COORDINATION OF FORAGE FISH PROJECTS
SRFB Grants 00-1086 and 01-1252N (2002-03); and
Northwest Straits Commission /NWSC
Department of Ecology CZM 310 Grants to MRC (2001-04)

NORTHWEST STRAITS
marine conservation initiative

www.nwstraits.org

"Watching over a project may afford the least comfortable view."

-- Gary Wood, Coordinator



Smelt Watch Tower

ACKNOWLEDGEMENTS

Partnerships created and drove this effort in Island, San Juan, Whatcom, Skagit, Snohomish, Jefferson, Clallam, Thurston and Mason counties – enabling biologic assessments covering hundreds of miles of Puget Sound shores.

In Island County the **WSU Beach Watchers** program (200 strong) supplied the vast majority of volunteers; in Jefferson they were supplied by the **North Olympic Salmon Coalition**; in San Juan County the **Friends of the San Juans** trained and supervised volunteers.

In Whatcom, Skagit, Snohomish and Clallam counties volunteer assistants were recruited and provided through the local **Marine Resources Committees**; and in Thurston county, volunteers were the responsibility of the **Thurston Regional Planning Council.**

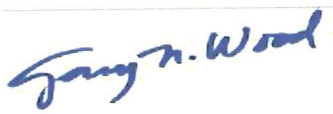
These partners were joined by **Tulalip, Squaxin and Lummi** volunteers on tribal shorelines.

Washington **Department of Fish and Wildlife** was the principal partner: the project biologists were DFW employees, supported by substantial in-kind commitments of DFW equipment, vehicles, fuel, boats, materials, chemicals, field & lab supplies, laboratory time and scientific instruments.

Additional in-kind lab support was provided by **Friday Harbor Laboratories**, a **University of Washington** facility and important project partner. Likewise, **Washington State University** participated through its Island County Extension office's essential support of regional coordination (extraordinary office and staff in-kind *nonfederal* services rendered).

These partnerships fostered unexpected and profound efficiencies. Core regional coordination tasks unified the work products, fundraising, and billing. This reduced project overhead by eliminating redundant administrative expenses.

Cooperating as we learned the subject, your remarkable collaboration was very much appreciated – for together you obtained a wealth of results whose value will enlarge over time. Congratulations!



GARY WOOD
COUPEVILLE, WASHINGTON FEBRUARY, 2005

SALMON RECOVERY FUNDING BOARD

Skagit MRC

Sea Grant Washington

MARINE RESOURCES COMMITTEE SAN JUAN COUNTY WASHINGTON OUR WATERS ARE IMPORTANT

WASHINGTON STATE UNIVERSITY

THE SEADOC SOCIETY:
a marine ecosystem health program

RIENDS
San Juans

PEOPLE FOR PUGET SOUND

NOAA Fisheries
National Marine Fisheries Service

BEACH WATCHERS

National Fish and Wildlife Foundation

North Olympic Salmon Coalition
NOSC

ISLAND COUNTY
Marine Resources Committee
SCIENCE · EDUCATION · STEWARDSHIP

PUGET SOUND WATER QUALITY ACTION TEAM

MRC
Whatcom County

CLALLAM COUNTY Marine Resources Committee

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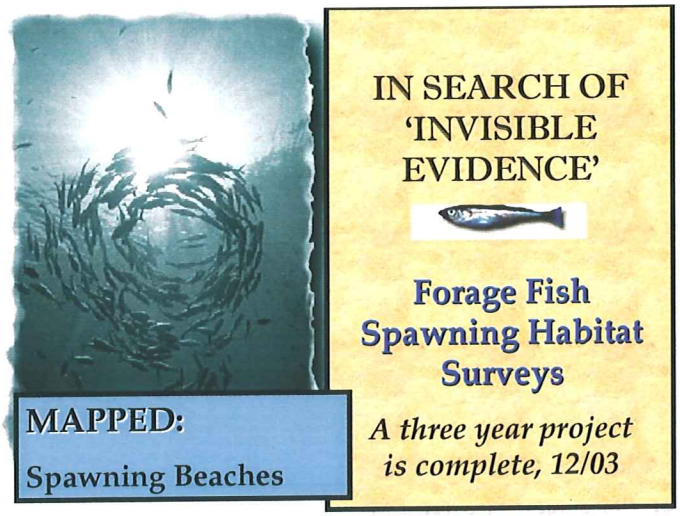


Spawning Habitats in the Northwest Straits

1.0 Background & Overview

Preface

The years of biologic-fieldwork and sampling covered by this report are one segment of a broader effort that presently constitutes the farthest reaching survey-and-mapping investigation ever undertaken to identify forage fish spawning beaches.

That was certainly not the original project design.

Instead of flowing from a large-scale, agency-managed regional investigation, these assessments were first proposed at local levels by unrelated entities, and subsequent cooperation and collaboration over time matured the assessments into an unprecedented regional campaign involving a wide variety of participants. It was, after all, a reverse-engineered campaign that generated far more data than any sponsor or participant anticipated, and has generated datasets that will be of further use and investigation for years to come.

This report and the accompanying deliverables are presented by the Island County Marine Resources Committee to publish the results of its forage fish assessments project. This investigation was performed over a four-year period and underwritten by **Salmon Recovery Funding Board** awards [SRFB Grants 00-1673N and 01-1252N Task 3]; the *Whatcom, Skagit, and Snohomish* surveys funded by the **National Fish and Wildlife Foundation** [Challenge Grant 2002-0241-00]; a SEADOC SOCIETY (MEHP) grant for Island County surveys (2001-02); and the "Regional Forage Fish Coordination (2001-2002)" provided by Gary Wood [SRFB Grants 01-1086 and 01-1252N] – see Box at page 6 re additional projects discussed *infra*..

Project design, logistics, PI selection, contract drafting, personnel matters and the submission of grant proposals for this project were started by a citizen-volunteer 'Marine Resources Committee' [hereafter referenced as the "MRC" or "committee"] on Whidbey Island, Island County - located an hour north of Seattle in the temperate waters of northern Puget Sound. That sponsorship and the persistent odyssey in search of funding constitutes but one story among many fascinating chapters compiled into the final 'forage fish assessments' accomplishment.

A remarkable and as yet not-fully-utilized end product was assembled: a <u>detailed geospatial database of the spawning sites utilized by three core-species</u> whose previous literature was wholly deficient. It must be valued, examined and employed as a *tool* that can be used in habitat-comparisons with a series of MRC databases. Each GIS layer generated by our project scientists is a work product intended as a resource-assessment tool.

The sheer geographic magnitude of the combined forage fish assessments required a collaborative, labor-intensive campaign of field-sampling over far-ranging jurisdictions for up to three-years; week-in, and week-out, usually via an 18' boat, no matter what the weather. The project's many participants were as varied as career state agency employees, tribal

biologists, retired-volunteer Audubon field-assistants and marine conservation NGOs may be expected to be; and were involved in equally diverse aspects of the work.

CAVEAT/NOTE: As described in this report more fully, there are several companion forage fish studies referenced here that were carried out under independent grants by their respective project sponsors. Those grantees submitted separate reports and deliverables pursuant to each contract. They merit discussion herein because of the collaborative methods used and the consistent data thus assembled, which were goals at the outset.

To avoid even the *slightest* confusion: this Island County report does not constitute a deliverable or final report for the sponsors below. To access those reports, links have been provided, and the sponsors should be contacted directly:

– San Juan County habitat assessments managed by **Friends of the San Juans** (FOSJ, see www.sanjuans.org/marineresearch.html), & San Juan MRC;

-- **North Olympic Salmon Coalition** spawn-surveys performed as a contractor for Jefferson County MRC; and/or as a direct SRFB grant recipient (NOSC's forage fish work is at: www.nosc.org Kevin Long, project manager);

-- **Thurston Regional Planning Council's** forage fish project, per a SRFB award (managed by Steven W. Morrison (360)786-5480 www.trpc.org/programs/environment/water/nearshore.htm)

-- Clallam County MRC's nearshore assessments performed under Anne Shaffer's lead, reported at http://www.clallammrc.org/CCMRC/ssFinal.pdf ;

-- and the Tulalip, Squaxin and Lummi tribal work is similarly distinct.

All of the above spawn deposition sampling and habitat data collection projects were coordinated – and shared protocols, training, methodology, sampling criteria under the WDFW biologists' supervision, and QA/QC.

In sum, there were separate grants in each county for which the local lead retains responsiblity. Therefore, while the several multi-county collaborations are all included for discussion in this report, they have stand alone reporting, as they should. *Multi-regional collaboration is possible only where this is respected.*

This final project record submitted by Island County's MRC summarizes with some detail the forage fish 'component' as it fits within a comprehensive nearshore habitats project initiated by the Committee in 1999.

The purpose of the subject assessments was to locate and map the spawning beaches and nearshore areas that are used by smelt, sand lance, and herring along hundreds of miles of the inland sea's shorelines. This data is now collected, and joins the eelgrass bed mapping, shoreline hardening mapping, and feeder bluffs surveys completed in the course of companion MRC evaluations.

Mapping these particular spawning beaches in itself affords recognition of the habitats by 1) by alerting permitting agencies to their locations with reliable and accurate datasets included in county planning maps; thus 2) enabling the correct application of existing state ('no net loss') legal protections where appropriate.

In the economic text of 'the abstract,' this project's objectives were well defined:

To locate, sample, and test intertidal substrates for the presence of spawn deposition. All field samples are examined via laboratory ID protocols. Site and sample data is collected in GPS-referenced format, which is then mapped in GIS protocols. The project's overriding *purpose* is to make reliable and accurate resources maps (of this and other marine elements) widely available to planners, policy makers, and residents alike (paper maps and websites). Uniform and consistent methodology was made possible through regional project coordination and a rigorous QA/QC procedure.

1.1 Project Lead – Island County Marine Resources Committee [MRC]

The unique organization of the MRC [www.islandcountymrc.org] and its determination to secure funding for these surveys were paramount to the project's success. The lead sponsor Committee is a thirteen (13) member citizen-volunteer panel whose membership is appointed by and advisory to the County Commissioners. A full-time executive director and a part-time administrative assistant staff the MRC.

> "Island County MRC is a citizen advisory group appointed by the county commissioners to help conserve and restore marine life and habitat along Island County's 212 miles of shoreline. Our members come from all walks of life and represent diverse commercial, recreational, scientific, agricultural, environmental and other interests. Together with MRCs in six neighboring counties, we provide local, broad-based, bottom-up input to the Northwest Straits Commission (NWSC).
>
> Congress authorized the Northwest Straits Marine Conservation Initiative in 1998 to examine strategies and solutions to the depletion of marine life and habitat in northern Puget Sound. The MRCs involve citizens and leaders of each county directly in discussions, decisions and restoration commitments. The MRCs gather information and raise funds through grants to inventory local marine life and map its habitat. We share our findings with interested parties, including regulatory agencies and the public. We conduct educational programs, but cannot make or enforce laws--our role is to serve in a science-based advisory, educational and fund raising capacity, and to encourage stewardship of the marine resource." (MRC mission statement from **www.islandcountymrc.org)**

Over 100 active volunteers, representing planners, commercial fisheries, tribal co-managers, and the scientific, economic, recreational, and conservation communities have accepted local MRC appointments among the seven counties.

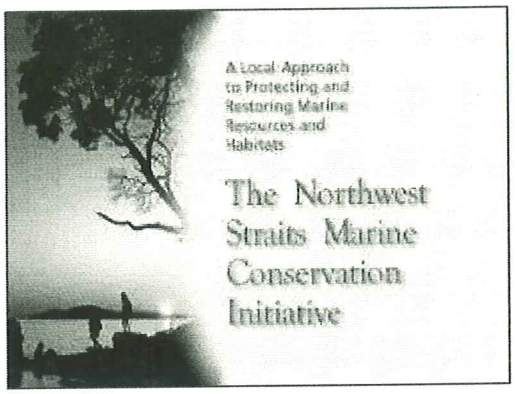
Island County's MRC includes members with backgrounds in commerce, sportfishing, WSU Beach Watchers, the Navy, a county planner, a professor emeritus in Marine Science, an Audubon Society Chairman, a retired medical researcher/medical school professor, a commercial cruise-ship company owner, an environmental engineer, the WSU Extension director, a fifth-generation Ebey's Prairie farmer, an aquaculture/shellfish owner-operator (Penn Cove Mussels), and two Port Commissioners. They meet twice monthly, as a rule, in addition to other activities.

Between them, no opinion or interest goes unrepresented.

This committee of unpaid volunteers has designed, undertaken, managed or contracted with scientists as PIs on a series of completed, near-finished, new and ongoing grant-funded projects. Their scopes of work include grant-funding:

- to recover derelict fishing gear with DNR divers;
- to GIS map county eelgrass beds using underwater videography;
- to survey and GIS map forage fish spawning habitats;
- to GIS map shoreline hardening and bulkheads; and

to assess the varied impacts of coastal geologic processes, including feeder bluffs and accretion shoreforms.



1.2 The Northwest Straits Initiative

Island County's MRC is one of seven county-participants in the congressionally-mandated NORTHWEST STRAITS INITIATIVE [www.nwstraits.org]; and is represented along with the other six panels by a representative who sits on the regional **Northwest Straits Commission (**G. Wood, since its inception). The Commission provides technical support, training and financial resources to over a hundred MRC appointees and their MRCs, and is fiscally administered by the Washington Department of Ecology under the operational supervision of the Padilla Bay National Estuarine Research Reserve.

This innovative structure employs a county-based "bottom-up" approach to the protection of the region's vital marine resources by diverse stakeholders brought together expressly for that purpose. Each MRC sets local priorities, investigates conditions by funding assessments, sponsors restoration and outreach projects, and recommends science-based marine-policy to their respective local governments.

The design is the precise opposite of an *'unfunded mandate,'* which explains its local popularity.

The seven-county Northwest Straits region

In 2002, the commission led a team of 14 state, tribal and federal partners in a pilot 'Derelict Gear Recovery' project that yielded 11 tons of recovered crab pots and purse seine nets, and more than a mile of gill nets from Puget Sound. The goal of that project is to remove lost and abandoned gear, to help restore Puget Sound and the Northwest Straits, to improve public safety, and to assist species recovery.

The White House awarded MRC director Wood the **2003 Coastal America Award** at a ceremony before 1500 attendees at the *Estuarine Research Foundation's* Seattle conference. He wrote and designed the successful grant proposal to remove derelict fishing gear from Puget Sound, which captured national attention when the award was first announced. Coastal America also honored the Northwest Straits Commission and its partners with Partnership Award plaques and letters from President Bush.

In January, 2004, the Initiative underwent its five-year review re sunset, or reauthorization. As reported locally:

A panel of experts last week recommended that Congress continue the innovative Northwest Straits Marine Conservation Initiative for up to a decade. The experts, led by former Environmental Protection Agency administrator Bill Ruckelshaus, said Congress should provide $1.6 million annually for the effort, up significantly from the $750,000 allocated this year. *Seattle PI,* COMMENTARY, April 13, 2004.

1.3 Principal Investigator

Northwest forage fish investigator Dan Penttila, joined in year three by two other full-time Washington Department of Fish and Wildlife [DFW] fisheries biologists, were responsible for all field and laboratory services for the assessments. His work on the region's forage fish and their habitats spanned a career, and included works directly on point:

- Moulton, L.L., Penttila, D.E. (2000) *Forage Fish Spawning Distribution in San Juan County and Protocols for Sampling Intertidal and Nearshore Regions,"* **Northwest Straits Commission**, Mount Vernon, WA.

- Penttila, D.E. (2002) *Effects of shading upland vegetation on egg survival for summer spawning surf smelt on upper intertidal beaches in Puget Sound;* **Proceedings, Puget Sound Research Conference, 2001;** Puget Sound Action Team, Olympia, WA.

- Manuscript report: *Documented spawning areas of the Pacific herring (Clupea), surf smelt (Hypomesus), and Pacific sand lance (Ammodytes) in San Juan County, Washington (1999*); WA DEPT. OF FISH AND WILDLIFE, Marine Resources Division, LaConner, WA.

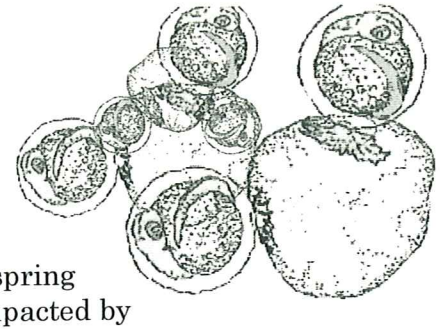
- WDFW: *Puget Sound intertidal baitfish spawning beach survey project;* **Proceedings: Puget Sound Research 95 Conference**, Vol. 1, pp. 235-241; Puget Sound Water Quality Authority

Lead biologist D.E. Penttila

1.4 Why sample/survey/assess/map forage fish habitats?

First, start with that term "forage fish." There is no such fish, not with that name anyway. The label is a generic term used to describe a group of small schooling fish that serve as a forage base for most of the marine food web. Every marine ecosystem has species filling that 'niche.'

The three species of forage fish under investigation (surf smelt, sand lance & herring) are at the core of the Puget Sound marine food web, and act to move the micro-nutrients in invertebrates, plankton etc. up to the larger, charismatic species such as salmon, sea birds, and marine mammals. Forage fish have suffered a precipitous decline in the region, despite fisheries closure.

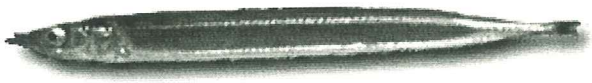


As the name suggests, forage fish --larvae and adults,-- are heavily preyed upon by other marine fish, mammals, and birds. To offset this heavy predation forage fish produce large numbers of offspring during spawning. Since forage fish spawn in areas that are often impacted by humans, minor alterations of habitat can have pronounced effects on forage fish populations.

For decades, few within the fisheries-biology field paid particular attention to the uncountable billions of "forage fish" that regularly teemed in the waters of Puget Sound. After all, smelt, sand lance and Pacific herring were the ubiquitous, staple foodstuffs for Puget Sound's salmon, birds, and marine mammals, and it was presumed that they would always serve in that role - sans notice or fanfare.

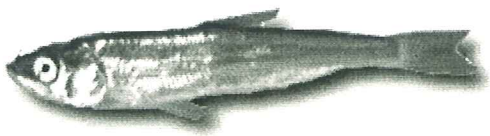
Then they started to 'disappear,' relatively speaking. Suddenly the push was on to investigate them and their habitats. From the initial effort in 2001, by mid-2003 these coordinated surveys expanded over four-fold in funding, scope and geography. If the problem with salmon was a disappearing food source, that knowledge had to be gathered.

Pacific Sand Lance - (*Ammodytes hexapterus*)

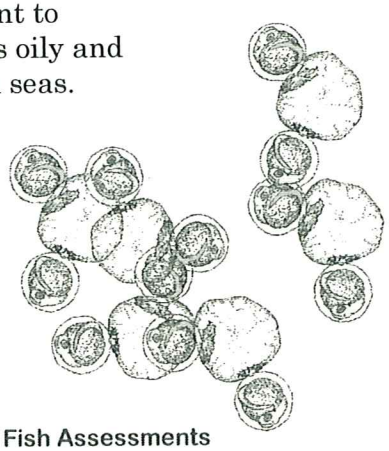


Pacific sand lance is a very important food for seabirds, marine mammals, and larger fish. As a member of the Ammodytidae family, it lives very close to shore in the colder waters of the Pacific Ocean. You can see that the sand lance is very long and slender, and that it has a "needle nose". Its body shape enables the fish to easily bury itself in the sandy ocean floor. This behavior gives sand lance its scientific name- which literally means to "dive or burrow into sand". When not buried in sand, this fish swims around with hundreds to thousands of other sand lance in large schools.

Smelts



The smelt family (*Osmeridae*) is an important group of forage fish for seabirds and predatory fish. One reason they are so important to seabirds is because their flesh is oily and high in fat. The high fat content helps seabirds stay warm on the cold seas. Pictured here is a longfin smelt (*Spirinchus thaleichthys*, which means "rich fish"). Other smelts include capelin and eulachon, both also known as "candlefish". Candlefish were important to native Alaskans, who would dry the fish whole and burn their oily bodies as you would burn a candle!



Surf smelt spawning habitat is vulnerable to a variety o f anthropogenic impacts including water quality and shoreline alteration (Shaffer, in press).

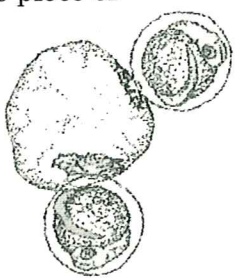
Ambient temperature has been shown to have a great effect on the incubation period of fertilized eggs. During the winter months when temperatures are cooler, hatching may occur in 27-56 days, while those brooded during the summer months may hatch within 10-15 days.

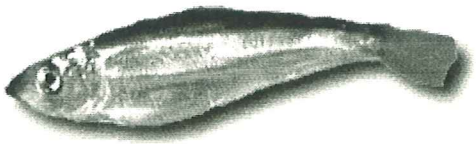
Newly hatched larvae are entirely planktonic, and measure only about 5 millimeters in length at hatching. Adult form and coloration will be achieved in three months. Most smelt fully mature and return to spawn in their second year. Mortality in all life stages is high, and can be attributed mostly to predation. As a result, maximum life span is usually no more than five years. Overhanging shade is also a primary factor in egg survival in the summer months, especially on Puget Sound spawning beaches (Penttila).

Surf smelt are commonly found in the Puget Sound. Despite their abundance, specific knowledge of this species' biology is limited. Although commonly grouped together with sandlance and herring under the generic terms "forage fish" or "baitfish", each species is both taxonomically and biologically unique.

Morphological adaptations such as temporally distinct spawning seasons and habitat preferences regarding beach composition facilitate the collection of data for separate species (Penttila 1999). Surf smelt, of the family *Osmeridae*, may be distinguished from other species of forage fish by the presence of an adipose fin (Hart 1973). Smelt deposit adhesive, semi-transparent eggs on selected beaches with a certain mixture of course sand and pea gravel (Penttila 1995).

The eggs are adapted to adhere to the substrate in which they are deposited. The outer membrane of the egg will rupture and turn inside out, forming a pedestal-like attachment structure for the egg. Due to the size of the substrate preferred for spawning (1-7mm as determined by grain size analysis), it is common to see several eggs attached to one piece of substrate. The eggs are deposited at high tide in 2-3 inches of water, but are soon dispersed by tidal and wave action and can usually be found buried at a depth of several centimeters in the beach substrate. Not only does this serve to insulate the eggs from extreme temperatures and desiccation, but it also provides protection from birds and other potential predators (Penttila, 1995).





Pacific Herring - (*Clupea herengus pallasi*)

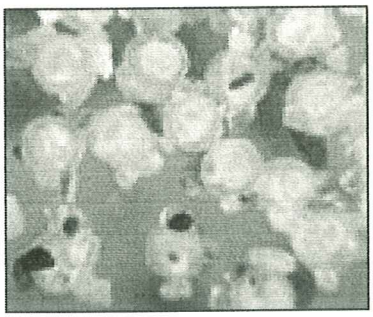
These silvery members of the Clupidae family form large schools and the juveniles are a prize catch seabirds. Humans prefer to fish for the adults. Have you heard of a kipper snack? Kippered herring is a favorite treat of hard working biologists. Other sea creatures such as salmon, sea lions, whales, and sharks feast upon adult Pacific herring. Herring is a good meal because it is high in fats and oils that these critters need to survive in the cold Alaskan waters.

1.5 Forage Fish Assessments – small beginnings

The MRC secured its first modest funding for this work from a private foundation known as MEHP – MARINE ECOSYSTEM HEALTH PROGRAM [Now the **seaDoc Society**, see www.seadocsociety] in 2000, for work in 2001. With that $17,000 grant, the MRC undertook to assess the Island County forage fish resources, historically known to have been a rich local feature of the nearshore.

To accomplish the work, the sponsoring committee negotiated an Interlocal Agreement by which the project reimbursed the state's Department of Fish and Wildlife biologist to do the work, assisted by volunteers. It is important to note that the agency's budget had ceased the funding of forage fish spawning site surveys in the early 1990's, despite the known need for the data.

The underlying habitat assessments sampled northern Puget Sound beaches and nearshore habitats for the near-invisible spawning depositions of Surf smelt, Pacific sand lance, and Pacific herring -- along hundreds of miles of shorelines.
substrates of the north Sound's shorelines.



Sand lance eggs & sand

No, this is *not* like looking for "a needle in a haystack" – indeed the task actually resembles a search for "straw in a haystack." Hundreds of miles of haystacks!

From June, 2001 to the end of 2003 the ongoing, geographically-expanding assessments resulted in the discovery of tens of *miles* of previously unreported and unmapped spawning habitats (some 22 miles in Island County alone) – rendering the identified habitats subject to "no-net-loss" protection under Washington state's Hydraulic Code and the DFW HPA permit process.

1.6 The Surveys Go Regional with Coordination

By sheer coincidence, eight unrelated grants were awarded by three unsuspecting funders to six local "forage fish" projects in late 2000. To the sponsors' dismay, the projects posed wholly inconsistent survey approaches, with no two protocols alike.
A potential hodge-podge of non-uniform, inconsistent surveys had been launched.

To avoid this unhappy, inefficient and expensive result the SRFB underwrote two years of regional coordination (via annual contracts with Island County extending from June, 2001 – May, 2002) to ensure uniformity of project deliverables, QA/QC and assessment techniques. Island County then contracted with this report's author (Gary Wood dba Intertidal Consulting) to perform the coordination tasks enumerated in the SRFB contracts.

The National Fish and Wildlife Foundation's 2002 grant award to Island County MRC enabled expansion of the field work to three additional counties, with no added administrative or indirect costs associated.

As the effort grew and evolved, ultimately nine counties (*Island, San Juan, Clallam, Jefferson, Whatcom, Skagit, Snohomish, Thurston and Mason)*, three tribes, two NGOs, seven Marine Resources Committees, two universities, hundreds of volunteers and **three full-time DFW staff biologists** engaged cooperatively in what became an immensely labor-intensive

effort at its fullest scale. Four major funders issued enabling grants in excess of $300,000 and thousands of volunteer hours were devoted on the beaches in every weather by area citizens.

In order to ensure a final technical/database outcome that was as seamless as possible, the interested parties recognized that these several widely-scattered projects *must* adopt and employ consistent field and data protocols, therefore regional coordination was agreed upon and made the responsibility of the Island County MRC director, Gary Wood (and author here).

The Coordinator's Scope of Work is set forth fully:

Forage Fish Assessment Project Coordinator
Scope of Work October 28, 2002

The goal of regional coordination of forage fish assessments is to ensure that high quality data is gathered in a consistent and efficient manner, is compatible with current and proposed forage fish survey databases and geographic information systems, and is easily accessible to researchers, planners, decision-makers, restoration and protection project implementers, and the general public.

The objectives of regional coordination are to:

- Ensure use of consistent protocols and QA/QC
- Coordinate training of volunteers
- Provide efficient scheduling of volunteers, WDFW biologists and lab work
- Help coordinate WDFW billings and reimbursement
- Provide coordinated and consistent database development, analysis and access

The Regional Forage Fish Assessment Coordinator will be responsible for coordination of forage fish assessments in Whatcom, San Juan, Skagit, Island, Snohomish, Jefferson, Thurston, Clallam and Mason Counties. The Coordinator will be responsible for:

- Coordinating sampling schedules (time and location) with project sponsors and WDFW biologists
- Coordinating training for volunteers, including instruction on the Moulton/Penttila protocols and providing protocols and other training materials for volunteers to be posted on the Internet
- Coordinating lab work at Friday Harbor Laboratories and the WDFW La Conner lab or other approved labs using Pentilla protocols
- Ensuring consistent and adequate QA/QC for field sampling
- Coordinating billings between forage fish assessment project sponsors and WDFW.
- Coordinating project management via electronic communication.
- Monitoring and coordinating development and filing of reports by individual project sponsors as required by their fundors; providing an annual regional report to the SRFB, other project fundors, and all project sponsors.
- Providing outreach, PR in coordination with project sponsors
- Meeting in person with project representatives at least bi-monthly
- Convening an in-person meeting of all project representatives every six months
- Assisting with development of interlocal agreements between WDFW and project sponsors.
- Working with WDFW to ensure adequate availability of trained field biologists

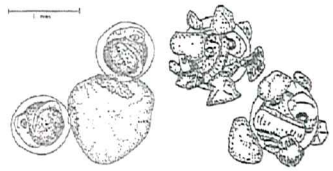
- Providing technical coordination and support to project sponsors for development of consistent databases and geographic information systems that are compatible with WDFW's and can be linked to a common Internet-accessible database or portal.
- Providing for the technical review of project data for consistency and compatibility before it is submitted to a centralized database or made available though a web portal.
- Participate with state agencies and other entities in the development of a centralized (or portal accessed) database that is accessible via the Internet and has mapping capabilities.

While the sheer magnitude of the project presented many challenges and obstacles, some of which were wholly unanticipated, in the final analysis the outcome justified the wear and tear imposed. The difficulties encountered coordinating these otherwise disparate, and competing, entities cannot be stressed enough, and the new methods developed in that process may be the surprise product the whole project. We also learned that the agency at the heart of the project is only subject to the level of outside management or coordination that it permits, regardless of contract provisions to which it was not a party.

The surveys became a noteworthy model of regional collaboration between agencies, citizen volunteers, tribes, NGOs, scientists, and local governments, with multiple independent co-sponsors sharing the funding load.

The Incredible Egg Hunt: Finding Forage Fish Spawning Habitats of the Northwest Straits, Washington (2001-2003)

Gary Wood, Island County Marine Resources Committee and Northwest Straits Commission



Surf smelt eggs attached to grains of sand.
Credit: Dan Penttila, WDFW

Background

Forage fish, also known as baitfish, are small, pelagic organisms that are food for coastal and estuarine fish populations. Living in relative obscurity in nearshore waters, forage fish spawn high on sandy beaches, laying eggs indistinguishable from sand grains. Despite the importance of forage fish as major food sources for commercially and recreationally valuable fish species, we know relatively little about their spawning distributions, life histories or population fluctuations.

Several species of forage fish are common residents of Puget Sound and adjacent Washington and British Columbia waters. Pacific sand lance, surf smelt and Pacific herring are of primary importance as prey items for marine fish and anadramous salmonids, several of which are listed under the federal Endangered Species Act. This project set out to inventory and map beaches throughout the seven northern counties of Puget Sound, collectively involved with the Northwest Straits Marine Conservation Initiative .

Methods

Following state fisheries methods, over 100 volunteers worked under the direction of state and tribal biologists to look for forage fish spawn on beaches throughout the Northwest Straits, many of which had never been documented as having a forage fish presence. The resulting field and lab work was translated into a series of GIS maps that have been turned over to county planning departments.

Results

Data from spawning surveys have been collated and mapped on a county-by-county basis, to better supply policy makers and planners with local information. As an example, Island County's 214 linear mils of shoreline are prime forage fish spawning habitat. From 2001 through 2003, surf smelt spawning was documented on 62 miles of shoreline, encompassing virtually all high intertidal beaches with mixed sand and gravel substrate. Sand lance spawning has been found on 14 percent of county shorelines.

In Washington, local and state protection is afforded to beaches and shorelines where forage fish are known to spawn. As the presence of forage fish spawn has been confirmed on beaches, local governments have moved to afford increased levels of protection to those shorelines. All seven NWS counties have incorporated the forage fish data into their critical area maps. The data are also being used extensively by applicants and by the counties for permitting and zoning decisions. Two additional Puget Sound counties have also initiated the collection and mapping of forage fish data.

Program participants

Marine Resources Committees of Island, San Juan, Clallam, Jefferson, Whatcom, Skagit and Snohomish counties

Northwest Straits Commission

Thurston and Mason counties

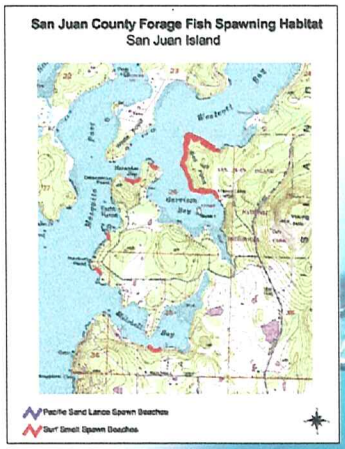
Tulalip, Jamestown S'Kallam and Lummi tribes

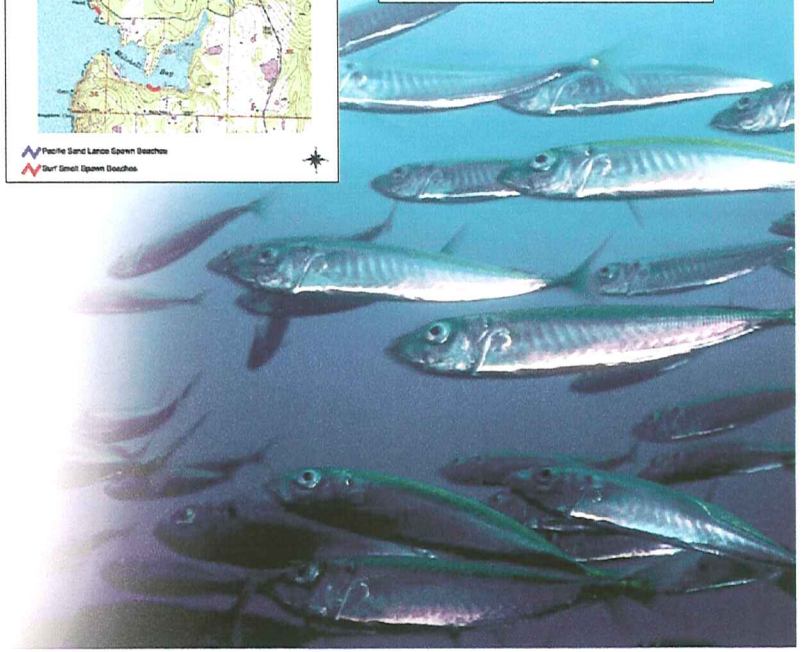
North Olympic Salmon Coalition and Friends of the San Juans.

Washington Department of Fish and Wildlife, University of Washington, Washington State University

Acknowledgements

This study was made possible thanks to generous support from the Northwest Straits Commission, the Salmon Recovery Funding Board and the National Fish and Wildlife Foundation.





2.0 THE RESULTS – SUMMARIZED

2.1 County-by-county Forage Fish Assessments

- How many beaches were inventoried?
- What per cent of priority beaches surveyed?
- Number of new beaches identified as forage fish spawning beach?

COUNTY	# of beaches or stations surveyed	% of priority beaches surveyed	# of new spawning beaches identified
Clallam	~25/year smelt ~17/year sandlance		12 smelt: 2.25 miles 2 sandlance: .5 mile
Island	1828 stations	100%	16.8 miles smelt 6.4 miles sandlance
Jefferson	2060 samples	90-95%	59 smelt stations 27 sandlance stations
Mason	397 stations		.8 mile smelt .7 mile sandlance
San Juan	1300 stations/600 beaches 80 miles	90%	40 beaches/12.5 miles, mostly smelt some sandlance
Skagit	432 MRC stations historic: 800 summer/1200 winter		2.7 miles new smelt .5 miles new sandlance
Snohomish	240 stations	100% potential, not all beaches are suitable for ff	1.7 miles smelt .2 miles sandlance
Thurston	394 stations		1.9 miles smelt .8 mile sandlance
Whatcom	355 stations	Not 100%	1.4 miles smelt .1 mile sandlance

Jefferson: All sampling is done in eastern Jefferson County. Aligned old data with new to find new beaches. Draft maps have a rough estimate of locations. Have found mapping in black and white a challenge and we need to develop a way to accurately show maps in black and white because copies will be made of colored map and data will be misrepresented. Landowners will receive a brochure with a map of spawning areas. Interested in continuing talks with others about maps and data layers, especially armoring data. Expect to complete outreach materials this winter.

San Juan: has done some herring spawn surveys as part of separately funded project. Friends has about .33FTE for applying forage fish data and expect to have all data on a web site that will include an overlay of roads, outfalls, etc. All data are final and online, as well as packaged for planners. They have distributed CD to approximately 100 people. WDFW awaiting point data from San Juan County.

Another separately funded project is occurring to plant riparian sites with vegetation that will eventually provide shade. Four sites have been done, although it will take several years to determine whether the increasing shade impacts egg survival.

Island: CD was circulated with all Island, Snohomish, Whatcom and Skagit data. All surveys are complete and complementary work has occurred – armoring survey for entire county and work on-going to improve mapping of drift cells.

Clallam: Needs additional sampling.

Skagit: North Bays Blueprint project included forage fish habitat and spawning areas, as well as shoreline hardening, vegetation, etc. The MRC is planning to do some vegetation planting along the upper edge of a few forage fish beaches in Anacortes along the trail and March's point. (Dan Penttila noted that there is a stretch of beach at March Point where there's a lot of historical data on forage fish use.) Data and maps are complete.

Snohomish: New data was compared with old.

Whatcom: Not moving forward quickly with use of data. Looking at old and new data to determine what is most useful to planners.

WDFW: Dale Gombert is the WDFW contact for data. Point data are still needed from several counties. All new positive data has been entered in the system. However, point data for San Juan, Clallam, Thurston and Mason are not entered. (Negative points)

General Questions:

- What about comparison between old/new data – do old beaches still have forage fish use?
    - Not known. Two eggs considered a positive hit. Reasons for not being used not known, could be the wrong season, decline in stock, infrequent sampling. Also, fewer eggs doesn't necessarily mean fewer fish.

2.2 Interim 2003 Island County Field Survey Reports

DATE: June 12, 2003
TO: Gary Wood, Island County Marine Resources Committee
FROM: Dan Penttila

SUBJECT: SUMMARY OF RESULTS, ISLAND COUNTY FORAGE FISH SPAWNING BEACH SURVEY PROJECT, OCTOBER 2002-APRIL 2003.

Following is a brief summary of results and activities pertaining to the Island County forage fish spawning habitat inventory completion project during the winter of 2002-03, supported by the Island County MRC.

SURVEY EFFORT:

Eighteen field sampling days (surf smelt/sand lance beaches)
14 boat-based surveys
4 on-foot surveys

377 beach substrate sampling stations:
27.9% yielded forage fish eggs
Five exploratory herring spawning habitat surveys
177 vegetation-sample sites
No new herring spawning sites found

NEW FORAGE FISH SPAWNING HABITAT DISCOVERIES:

Surf smelt: (see Figures 1 and 2)

800'	west side of "Mariner's Cove" waterway, NE Whidbey I.
2,600'	on SE Camano island
1,000'	on NE Useless Bay
1,000'	east of Polnell Point Spit

Total: 5,400' (1.02 statute miles)

Sand Lance: (see Figures 3 and 4)

9,200'	on SW Camano Island
2,800'	in Holmes Harbor area
1,000'	NE of Cornet Bay
2,000'	NW of Langley

Total 15,000' (2.84 statute miles)

DISCUSSION:

Significant amounts of new surf smelt and sand lance spawning habitat were discovered within island County during the second winter season of the project. Surf smelt spawn was again found in detectable amounts through the winter season, further indication that Island County supports virtually year-round surf smelt spawning activity at many sites, although the area is still characterized by a summer peak of spawning activity. The estimated mileage of documented surf smelt spawning habitat within Island County now stands at about 62 miles, roughly 29% of the total county shoreline. Camano Island, in particular, is rich in surf smelt spawning habitat. Virtually anywhere around the perimeter of the Island where the upper intertidal is mixed sand-gravel, and not marsh, pure sand nor cobble, surf smelt eggs have been found.

With the documentation of 2.8 additional miles of new sand lance spawning habitat found during this report period, the total sand lance spawning habitat for island County has reached approximately 30 miles, 14% of the shoreline (of all types) in the county. The criteria by which spawning sand lances select their spawning sites remains a puzzle. Many suitable-looking protected sandy shorelines within the survey area have not yet yielded evidence of sand lance spawning.

A number of exploratory herring spawning habitat surveys were undertaken within the County during February-April, during the time of year when herring spawning activity is on-going in the county's several already-known herring spawning areas (Figure 5 and 6). The standard WDFW marine-vegetation sampling techniques were used. In most cases, these surveys were the very first time that experienced WDFW forage fish unit staff had ever undertaken spawn surveys along these reaches of shoreline. Healthy eelgrass/algae beds were found in all the surveys undertaken, and it is not readily apparent why the local herring spawning stocks have evolved to spawn consistently where they presently do, "ignoring" the intervening vegetated shorelines. Nevertheless, no evidence of "new" herring spawning habitat was found, nor were we able to detect herring spawn in the area on the east side of Snatelum Point (SE Penn Cove), where a herring spawning site was newly-documented in April 2002.

PUBLIC OUTREACH:
Dispensation of public forage fish information continued to be a significant duty in the northern Puget Sound/NWSC region during the report period. During this time, new forage fish spawning habitat completion projects were commenced in Whatcom, Skagit, and Snohomish Counties. Two additional WDFW forage fish biologists were hired and trained in the protocols of the project. QA/QC lab analyses continued for a portion of the samples generated by forage fish habitat survey projects in Sand Juan and Jefferson Counties. Forage fish project volunteer orientation presentations were held in Whatcom and Snohomish Counties. The Whatcom Count MRC-sponsored "marine resource summit" as attended. The Whatcom County MRC and its video producers were assisted, with field and lab demonstrations, in the production of a public-informational video on the local forage fish spawning habitat survey project. A series of four forage fish/nearshore habitat workshops were attended at the Port Townsend Marine Science Center. A forage fish session was presented for the Island County MRC's "Soundwaters" program. The year's new class of Island County Beachwatchers were given a forage fish presentation/field trip. The proposed Bush Point public launch ramp site, and its attendant smelt spawning habitat mitigation site on west Penn Cove, were visited with project engineers and habitat managers.

A meeting of local residents and land-use managers concerning the marine resource science of Discovery Bay was attended. A combined group of marine habitat managers from several federal agencies were given an informational forage fish spawning ecology presentation at NOAA-Sand Point. The annual group of minority science students attending the WWU's Shannon Point lab were given an all-day lecture and lab on marine fishes. One day of the Georgia Strait/Puget Sound Research Conference was attended in Vancouver, BC, and found to be high in interest in forage fish matters. Elsewhere in the Puget Sound basin, field work commenced on contracted forage fish spawning habitat inventory completion projects within Mason and Thurston Counties.

2.3 FORAGE FISH PROJECT Final Biologist's Field Summary

JANUARY 4, 2004

Gary:

Hard copies of field and lab report packages for May-September 2003 FF surveys in Whatcom, Skagit, and Snohomish Counties have been mailed to county forage fish project contacts, for their information. These packages will also be mailed to Doug Kelly for data entry today. I will mail you the cover letter report for each county's data summary, operating on the presumption that you would not be able to open these reports if I attached them here.

Until you receive the report package, following is a capsule summary of the summer's work (in which the LaConner WDFW staff were involved):

Island County:

> 13 survey days, 231 stations, 34.6% with spawn, 4,800' of "new" smelt beach
> + about 600 stations undertaken 1972-1993 converted to current data forms and charts, and being entered.

Whatcom County:

16 survey days, 186 stations, 19% with spawn, 3,100' of "new" smelt beach.

Skagit County:

9 survey days, 187 stations, 16.6% with spawn, 13,990' of "new" smelt beach..

Snohomish County:

4 survey days, 88 stations, 8% with spawn, 3,300' of "new" smelt beach.

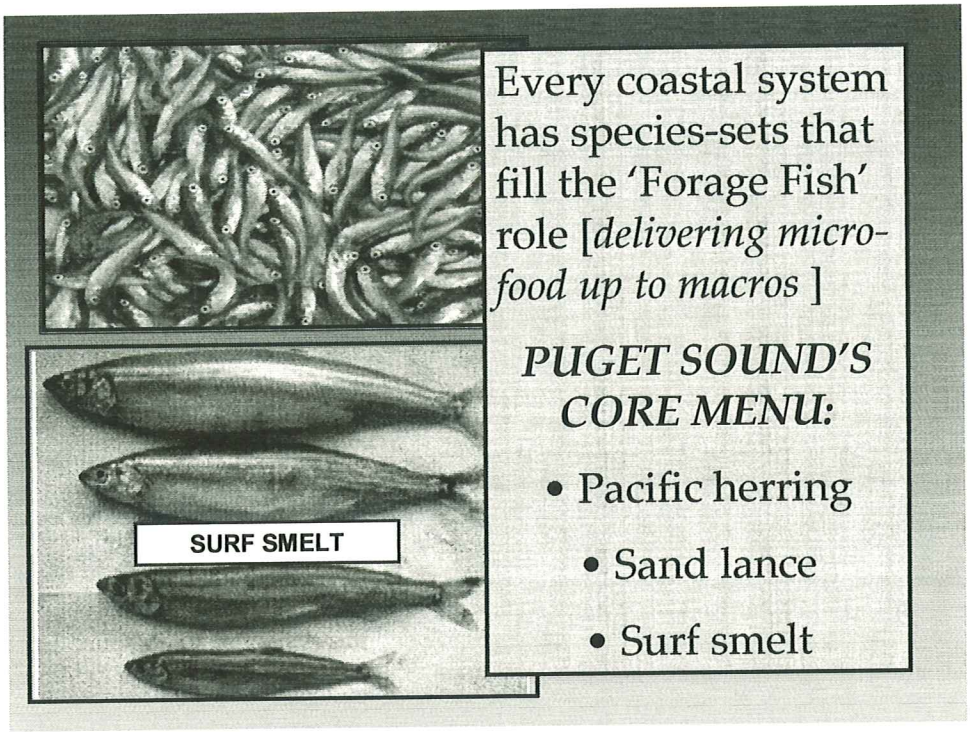
North Sound County total:

42 survey days, 692 stations, 25,190' (4.8 statute miles) of new smelt beach.

Thurston-Mason Counties:

4 survey days, 77 stations, 13% with spawn, no new smelt beaches and apparently late start to local smelt spawning season.

NOSC screen mesh-size/egg recovery experiments to be undertaken this week, 10 trials for each screen size(1mm versus 2mm), several-kg "barren" samples of beach material, "salted" with 5, 50 or 200 smelt eggs or 100 sand lance eggs, run through typical screening/winnowing/lab analyses to numbers of eggs recovered from the microscope dish. Raw data to be sent to NOSC for review. Time charged to their extant QA/QC agreement. Island County summer survey data package will be sent to Kelly as soon as I complete a cover summary report. DEP



2.4 Final Lead Biologist's Assessments Report

Comments and Conclusions ~ D. Penttila, Project lead biologist, January, 2004

PREFACE

An impressive supply of new geospatial data has been duly generated by the efforts devoted to this project, and those physical descriptions of the location of spawn, depositional qualities, etc., will be available as a Baseline as never before reliable established.

In addition, the participants have observed and recorded certain events, etc., that should be explored independently of the GIS coordinates, and evaluated rigorously as opinion and conclusion. Some issues benefit considerably by and informed discussion by those best advised of the facts.

Issue: WHAT VALUE IS FORAGE FISH HABITAT DATA?

1. Conservation of forage fish stocks

The shore-spawning forage fish species common to the Pacific Northwest (herring, surf smelt and sand lance) are ecologically important to the maintenance of certain elements of the local marine ecosystem. We conclude that the inventory and regulatory protection of forage fish spawning sites is perhaps the single most cost-effective way in which individual populations of these species can be preserved for the long-term.

The relative importance of these breeding/spawning grounds among all competing habitats has been largely unrecognized. Nonetheless, avoidable degradation of vulnerable habitats that forage fish appear to "select" [non-randomly, from the data] for reproduction, is reckless their life history has the potential for great harm to the preservation of these populations. The annals of fish and wildlife management world-wide are filled with examples of declines or extinctions of species where insufficient attention was paid to the recognition and maintenance of critical habitats as human intrusions and harvests increased, the most glaring example being the current plight of local salmon stocks.

It may well be that certain other early life history stages and habitat contexts, such as the distribution and biological oceanography of larval nursery grounds, may also play a key role in the maintenance of these species. However, this idea remains rather speculative and fiscally difficult to investigate. Mapping of forage fish spawning sites, for the purposes of the geo-physical habitat protection, is considered the most efficient and low-cost manner in which these species might be conserved, for their own sakes, protected from both purposeful and inadvertent destructive impacts by a growing human population in the region.

2. Conservation of the nearshore marine ecosystem

The shore-spawning forage fishes, in their various life history stages and ages, are known to be occupiers of key linkages in the local marine food webs. [suggest an accompanying figure]. They commonly consume macro-zooplankton, and are in turn consumed by a whole host of higher predators, many of socio-economic importance in the Pacific Northwest. In their absence, presumably the entire food web would experience marked perturbations, as members of the ecosystem tried to adapt to the lack of energy resources available at times and places where they have customarily be found to occur. Although it might be expected that members of the ecosystem do have some adaptability in terms of dietary needs and preferences, these species cannot be viewed as completely "flexible" as we humans. Their life histories may be quite tightl restricted through any number of ecological or energetic "bottlenecks" which they are powerless to avoid.

3. Regional human impacts

As non-Native human populations have proliferated through the Pacific Northwest during the last 200 years, they have brought with them a set of "European" or "Eurasian" cultural attitudes toward the local environment. There seems to have been no proper checks, balances nor cultural attitudes by which some sort of control would be exerted on the degree to which the landscape might be modified for the immigrants' perceived short-term benefit. In some cases, Judeo-Christian religious conviction and the unbridled "americanism" of the industrial revolution seems to have viewed modification of the landscape as an imperative for the establishment of a modern civilization.

It may be that no element of the local ecological landscape was more vulnerable, acre for acre, to thAmericanization of the Pacific Northwest that the sea-shore and marine estuaries. Shorelines and river mouths supported the first significant non-Native population centers, for pragmatic reasons and perhaps building upon the aquatic orientation of the local Native peoples. If they were not the first "pioneers" to step onto the shores themselves, suitable town-sites attracted a mercantile class, commonly oriented toward brash boosterism, in need of convenient transportation and buildable land. Faced with the steep, wooded hills of the hinterlands, the shoreline was the easiest place to modify toward those needs, and so began a piecemeal process of shoreline degradation.

Conversion of natural shorelines and estuarine systems in the Puget Sound basin to Euro-American uses appears to have proceeded largely unhindered by either cultural attitude or regulatory authority for a hundred or more years, in profound ignorance, before there was much awareness that such practices might be having effects on the local marine ecosystem. By that time, large proportions of many important marine/estuarine habitat types had been decimated Sound-wide, including shore-spawning forage fish habitats. In the utter absence of resource/habitat distribution data for the original condition of the Puget Sound basin, the amount of loss can only be roughly estimated.

Local shore-spawning forage fish species were only sporadically and inconsistently investigated by resource agencies or research institutions prior to 1970. With the advent of the WDF's "Puget Sound Baitfish Project" in 1972, solid data-bases on all aspects of the character of the habits and habitats of local shore-spawning forage fishes were finally being developed, and distributed to the public in a number of forms. Prior to that time, there was little ecological importance attributed to upper intertidal mixed sand-gravel beaches, positioned as they were between the birds and wildflowers of the uplands and the shellfish resources of the lower intertidal zone. Formulation of agency policies and regulations pertaining to the obvious impacts of human development activities on these habitats soon followed the advent of species-specific studies, as soon as it became apparent that existing regulations, policies and attitudes were not sufficing to protect them. Hand-in-hand with this regulatory effort has been a 30+-year, continuous process of public education and enlightenment as to the importance and vulnerabilities of forage fish spawning habitats. It formed the basis by which the several recent forage fish spawning habitat inventory completion projects sponsored by the NWSC, SRFB, and others have been justified. Public outreach efforts for vulnerable shoreline environments continues to this day, and on into the foreseeable future. In spite of our efforts at education, routinely high percentages of typical public audiences are "amazed" at the annual seasonal presence of spawning forage fishes on local shorelines that are already thought of as familiar and well-known.

Land-use planning and regulation:

With the advent of enhanced regulatory protection for forage fish spawning sites, through the Washington Administrative Code (WAC) "Hydraulic Code Rules", the forage fish spawning habitat mapping data has obvious instant usage by agency land use managers, both state and local. It has always been the policy of WDFW staff that only "documented" forage fish spawning habitat sites will receive this enhanced protection. This approach has been based on the consistent observation that only a small proportion (10-20%) of the so-called "suitable-looking" sand-gravel beaches in the Puget Sound basin apparently are used by spawning surf smelt and/or sand lance. A similar small proportion of the outwardly suitable eelgrass/algae beds along the shorelines of Puget Sound are used by herring for spawn deposition/incubation. It is felt that our efforts to defend the Hydraulic Code Rules against constant political attack and the defense of those known spawning sites from development would be made more difficult by an approach that called for blanket protection of all such habitat types everywhere, based on their "potential" to be forage fish spawning habitat. In spite of this, there continue to be calls for blanket beach-habitat-preservation regulations from some quarters.

Since Hydraulic Code protection applies only to those sites in and around where eggs have been detected and recorded by trained observers, a complete inventory of all shorelines to find

those particular ones "selected" by the spawning fish is obviously essential. The suite of present-day county-based forage fish spawning habitat inventory projects are all, on a regular basis, yielding additional "new" sites that went undetected by prior WDF/WDFW survey efforts. In some cases, forage fish spawning activity is now evident on beaches where it was not able to be detected in prior years, possibly due to an increase in local forage fish spawning-stock size in the intervening years. In many other cases, the current projects are yielding new sites in areas that had received little or no proper sampling effort in past years.

Since the very early days of forage fish spawning habitat mapping in Washington State in the 1970s, WDF/WDFW staff have provided written reports, chart sets, habitat-context photographs, sworn written and verbal expert testimony, site-specific project site inspections and substrate sampling, impromptu phone and e-mail technical comments, and field-training in forage fish spawning ecology available to anyone involved in the effort to conserve forage fish spawning sites. These services will continue to be available so long as WDFW has staff involved in forage fish matters. Forage fish critical-habitat assessment and conservation efforts will be further abetted by publically-accessible digital data-bases planned for the current suite of spawning habitat inventory projects.

Contribution of forage fish habitat data to management of other resources

Forage fish spawning habitat survey data collection is commonly the first and only objective and quantifiable resource data that has been collected on vast stretches of Puget Sound's upper intertidal shoreline shoreline. For upper intertidal sand-gravel beaches, almost totally neglected by most biological surveys and academic studies, site-specific and documentable surf smelt and sand lance spawning habitat data has been particularly important as a conservation tool for the preservation of the spawning habitats of these species. In the lower intertidal and shallow subtidal zones, documentation of the existence of herring spawning activity also call attention to special conservation needs in that area of the near-shore environment. Forage fish spawning usage information can be seen as an integral segment of a growing body of information that can be used to properly manage and conserve critical near-shore and intertidal environments in a much more rational and effective manner than has been the case in the past, as summarized below.

Marine vegetation management:

The seasonal occurrence of herring spawning activity on certain marine vegetation beds within Puget Sound "automatically" gives those specific beds enhanced protection through "no net loss" wording in the WAC Hydraulic Code. Herring spawning activity is generally highly predictable in time and place, and the same beds of marine vegetation are generally used year after year by spawning herring so long as the stock is in an "average" abundance condition.

The geographical extent of herring spawning activity appears to fluctuate in concert with the relative size of the stocks at any given time. The cumulative extent of all herring spawn-bearing shoreline areas documented by WDF/WDFW spawn surveys over the last 30+ years comprises roughly 10 % of the total shoreline of the greater Puget Sound basin. At this time, The ecological criteria and mechanisms by which the 20 or more apparently distinct Puget Sound basin herring stocks have "chosen" where to spawn are unknown. Suffice it to say that the vast bulk of shorelines in Puget Sound with healthy marine vegetation beds, including native eelgrass, the most commonly-used spawning substrate, appear not used by spawning

herring. Initial WDF herring spawning ground surveys in the 1970s were guided by sketchy accounts in old agency reports and correspondence. It was and still is presumed that the cultural and economic importance of herring to both Native peoples and the early Euro-American immigrants to the region had led to a fairly complete list of anecdotally-reported list of herring spawning sites by that time. Nevertheless, a few major post-1972 herring spawning ground discoveries suggest that it was possible for the folk-knowledge of the existence of a herring spawning stock to pass out of the collective memory of a human water-front community.

An integral part of some of the county-supported forage fish habitat inventory completion projects is a schedule of exploratory marine vegetation sampling surveys along local shorelines that, by the character of their marine flora and their proximity to known spawning sites, are considered potential herring spawning areas. Generally, these surveys would employ the same near-shore grapple-sampling methods used in routine WDFW herring spawn surveys. Most of the exploratory surveys would be conducted on reaches of shorelines that have never before been surveyed with this intent by WDF/WDFW or any other knowledgeable observers in the modern era. Commonly, these exploratory surveys are aided by new knowledge of the occurrence of eelgrass and other marine vegetation beds gathered by previous county-based surveys undertaken during smelt spawn surveys during low tides in prior summer months. They would also be aided by marine vegetation bed mapping surveys being undertaken by the counties coincident to the forage fish habitat survey programs.

Marine riparian (terrestrial) vegetation corridor management:

In the Puget Sound region in recent years, there has been an increasing awareness and concern regarding the possible ecological importance of the so-called 'marine riparian vegetation corridor" to the near-shore marine ecosystem. The importance of overhanging, shading forest corridors along freshwater streams for temperature moderation and inputs of organic matter and terrestrial prey organisms is a well-established concept. The parallel concept of conserving, maintaining or re-establishing intact forest corridors along Puget Sound shorelines is still in its infancy. Island County summer-spawning surf smelt beaches have served as sources of data illustrating the clear benefits of overhanging trees shading surf smelt spawning substrate zones to moderate beach surface temperatures and promote higher in-situ spawn survival, compared with adjacent beaches fully-exposed to the sun. It is also thought that shoreline vegetation corridors also provide near-shore-dwelling juvenile salmonids with continued sources of terrestrial insect prey for a time period after they have actually exited their freshwater streams at the start of the marine phase of their life history.

All public forage fish life history/spawning ecology presentations now include a discussion of this concept of conserving shoreline forests and vegetation zones along the backshore zone immediately above the extreme high tide line, in hopes that it will eventually become accepted common knowledge and a best- management practice to be routinely integrated into otherwise-permissible shoreline development activities.

Forage fish fishery management:

It should also be noted that the annual WDF/WDFW herring spawn survey programs undertaken in the Puget Sound basin since the early 1970s have necessarily concentrated on documenting herring spawn deposition in the historically-known spawning areas. The

calculation of annual "spawning escapement estimates" for the known spawning grounds has been an integral part of stock status monitoring for management purposes. Due to the ecological and political importance of the species to the local food web and harvester cultures, it is thought that the continued monitoring of local herring stocks of all sizes is important, even in the absence of any possibility of human harvest fisheries upon virtually any of them under existing management guidelines.

Occasionally to this day, wholly new herring spawning sites are identified, and the geographical extent of the new stock's spawning activity is then mapped over a period of several spawning seasons. At this point, our presumption is that the heretofore un-reported spawning stock has always existed, undetected or at least unreported to local resource agencies during the historical period. It is well-known that herring stocks can fluctuate greatly in biomass over relatively short periods of time, and could conceivably dwindle to a point where they become undetectable to local residents or even agency stock-status survey methods. However, it is thought that spawning activity and subsequent larval survival within a suitable oceanographic micro-habitat is such a critical point in the fishes' life history that such 'new" spawning sites should not suddenly and spontaneously appear at sites of no previous spawning usage.

On-going exploratory marine vegetation/herring spawn surveys are noted above. In some cases, these exploratory surveys may follow-up tips and reports by private citizens of some near-shore activity they interpreted as herring spawning. At all public forage fish presentations region-wide, the attendees are familiarized with the appearance and expected seasons of herring spawning activity, typical herring spawning habitat contexts, and the appearance of herring eggs on typical substrate plant species, and a few of the non-herring-spawn objects that might be found on marine vegetation and could be mistaken for herring spawn. The fact that most Puget Sound shorelines have not been adequately surveyed for herring spawning activity and that new herring spawning sites continue to be found are pointed out. Attendees are requested to report any "suspicious" activity, eggs on washed-up vegetation, etc. promptly to agency staff, so that exploratory surveys can be directed to an area in a timely manner, and perhaps yet another herring spawning stock and its critical habitat brought under regulatory protection.

The exploratory herring spawn survey program in Island County in 2002-2003, yielded evidence of previously-unreported herring spawning habitat in the eastern side of Snatelum Point, near Coupeville, in early April 2002. Re-survey of the site in the spring of 2003 failed to confirm herring spawning activity at the site, nor along several miles of Saratoga Passage shoreline to the south on Camano and Whidbey Islands.

At the present time, the results of surf smelt and sand lance spawning habitat surveys are not used for fishery management purposes in the localized areas, because of the extremely patchy nature of these species' spawning activity and difficulty in attributing field-sampled spawn densities to the biomasses of spawning fish that might have produced the deposits. Surf smelt sport and commercial fisheries are "semi-artisanal" and are thought to impact only very small percentages of the local stocks. They take place directly upon the spawning beaches during the spawning activity. While there might conceivably be some local impact on abundance by human harvest, the vast bulk of known surf smelt spawning beaches are unknown or inaccessible for a public fishery, thus forming a vast de-facto conservation reserve for most stocks. By regulation, commercial harvest of Pacific sand lances is prohibited in Washington

State. Like surf smelt, the species is to be conserved for its ecological value by steadfast regulatory protection of all of its known spawning sites.

Salmon recovery efforts:

The active conservation of local forage fish stocks, through the preservation of their documented spawning sites, is thought by many to be integral to regional salmonid stock recovery efforts, due to the recognized importance of these species as elements of the diet of some salmonids at various life history stages of both prey and predator. Federal and state agency review of shoreline hydraulic permit applications includes a strong adherence to "no-net-loss" concepts for documented forage fish spawning habitats. Strong funding support for the recent county-based forage fish habitat surveys has been forthcoming from the state's Salmon Recovery Funding Board, which customarily devotes most of its effort and funding toward freshwater salmon habitat restoration projects.

There has also been a recent emerging concept of requiring thorough sampling of all "potential" forage fish spawning habitat sites, based on an outward appearance of the shoreline, as part of a permit application. Obviously, thorough and well-documented a-priori sampling for forage fish spawning activity would ease the regulatory burden in these cases, especially when it should be noted that evidence of forage fish spawning activity can be found on only 10-20% of the 'likely-looking" shorelines within Puget Sound.

Shoreline sediment management:

The existence and continued maintenance of surf smelt/sand lance spawning habitat sites on Puget Sound shorelines depends almost entirely in the maintenance of those terrestrial sources of beach sediments that have evolved in the past few thousand years since the end of the most recent Ice Age. Those sources are: sediment inputs from the erosion of shoreline bluffs and sediment inputs from streams entering Puget Sound. It is thought that the former is relatively more important as a source of beach sediments. The recognition of the importance of these sources of sediments in maintaining shoreline beaches as we presently know them has only become apparent with the expanding investigations of Puget Sound surf smelt and sand lance spawning sites and requirements by WDF/WDFW staff since 1972. Prior to that time, it appears that very little attention was paid to the importance of maintaining upper intertidal sand-gravel beaches for the benefit of the marine ecosystem. In our collective ignorance, a significant percentage of the total shoreline length of the Puget Sound basin had been impacted with some sort of land-filling or erosion-prevention armoring structure in the roughly 100 years of shoreline development prior to that date. Even with our efforts at no-net-loss of forage fish spawning habitats, certain classes of permitted shoreline armoring continue to this day. Forage fish spawning habitat distribution information, both in terms of egg occurrences and the annual seasons when the eggs are present, is critically important to those evaluating the potential impacts of proposals seeking a Hydraulic Permit for in-water shoreline activities from state agencies.

While the wholesale or piecemeal physical burial and destruction of the upper intertidal forage fish spawning habitat zone has been diminished by application of new regulations in the recent forage fish information era, habitat maintenance concerns continue. It is now generally recognized that widespread armoring of shorelines, resulting in the halting of local sediment

upper intertidal sand-gravel beaches for the benefit of the marine ecosystem. In our collective

inputs off the uplands, will cause "normal" upper intertidal and-gravel beaches to dwindle in geographical extent and coarsen in sediment texture over time, even if the habitat zone has not actually been buried within the initial design foot-print by the armoring structures. Fine-grained sediments of the type that generally characterize "preferred" forage fish spawning substrates are easily moved and re-distributed by the wind-wave action that runs the "long-shore drift" system in the Puget Sound near-shore zone. Without constant re-nourishment from upland sources, these fine sediments presumably cannot persist in zones of the breadth, length and thickness along the upper beach that we, and spawning forage fishes, presently find them. The feared result will be a diminution of the geographical extent of beaches supporting forage fish spawning activity in the long-term, presumably to the detriment of continued maintenance of these species at their existing biomass levels. It is estimated that once fine sediments have moved, by frequent re-suspension and gravity, down-beach from their original location to just a feet vertical feet below the extreme low-tide line, the material is essentially lost from the intertidal beach system and is destined for movement into deep water for foreseeable geological time.

The pace at which upper intertidal, mixed-sediment beaches will deflate and degrade after sediment sources have been diminished will depend upon the relative health of original sediment sources, local topography, wind-wave-action regime, and percentage of the local "drift cell" armored. In some areas, visible degradation (in terms of quality or forage fish spawning habitat) of the upper beach has reportedly been observable in the last 10-20 years. In other long-armored sites, effects seem to be apparent after 50-100 years. At other sites, cumulative impacts of armoring may take longer to be evidenced. The overriding point is, however, that armoring structures of the types proliferating in the Puget Sound basin are intended to be in place in perpetuity. Much additional research needs to be undertaken pertaining to the impacts of armoring on beaches, and the proper design of mitigation measures.

The need to document the existing conditions of beach sediment sources and thus management beaches more rationally, has led island County to initiate a survey of the status of all 'feeder bluffs" and other intertidal sediment sources along the county's shorelines. While much of the shoreline of the Puget Sound basin has been mapped to some extent for the boundaries and directions of net sediment movement in the various "drift cells", such current-status information is urgently needed in the face of increasing pressure for erosion-control measures to protect shoreline property. Applications of certain concepts and techniques of "soft-shore armoring", applied in part to conserve the character of the natural upper intertidal zone, including forage fish spawning habitats, are becoming more widespread in Puget Sound. Unfortunately, the continued application of hard-armoring (vertical seawalls and riprap slopes) still seems to dominate regional thinking and on-the-ground erosion-control designs.

Impetus for shoreline restoration/mitigation activities:

Recognition of the ecological importance of forage fish populations, and the maintenance of their critical habitats, is commonly part of particular initiatives to both restore degraded reaches of Puget Sound shoreline, and the design of rational mitigation concepts and projects that will in part consider the habitat needs of local forage fish populations in their design. It should be noted here that, in the writer's opinion, there are as yet no acceptable, proven mitigation measures that can be relied upon to assuredly replace existing natural forage fish spawning habitats, thus allowing for the routine, knowing destruction of documented natural

spawning sites in order to expedite shoreline development proposals of the scale that were routinely allowed before the modern era of environmental protection regulation measures.

Development interests should realize that the "bad old days" are, and should be, gone forever. The truism that "it is cheaper to preserve existing natural critical habitats now than try to replace them later" is certainly true for forage fish habitats. Toward that end, it may not be un-reasonable for certain lead-entities to consider littoral zone/shoreline beach reaches of particular natural significance for inclusion within local networks of "Marine Protected Areas" and other forms of aquatic reserve. It should be recognized, however, that the "no-net-loss" conservation of forage fish spawning sites in Washington State will always depend upon the imposition of governmental regulations upon land-use decisions on private property, since this state, of all on the US Pacific Coast, did not have the foresight to keep the marine tidelands in public hands from statehood. Preservation of only those forage fish spawning site that happen to occur on existing public property, or property that might be purchased in the future by any reasonable expectation of funding, will not suffice to conserve the stocks for the public good.

In response to the recognition that wholesale armoring of certain parts of Puget Sound has resulted in damage to upper intertidal beaches, a program is being developed by the non-profit Puget Sound Restoration Fund to investigate the possibilities of large-scale experimental restoration of such beaches on presently-armored shorelines where they no longer occur. In many proposed experimental sites, forage fish spawning habitat requirements will be considered within the projects' design. In some, the impetus for placing the project at a particular site will largely be to attempt to replace or enhance degraded forage fish spawning habitat. Evidence from several existing beach restoration projects in the Puget Sound basin indicates that surf smelt and sand lance will in fact spawn upon restored beaches. Counties, cities, and other entities are now also commonly considering beach restoration project among their public projects. Acre-for-acre, it may well be that marine beaches are amongst the most important, "culturally-interesting", and heavily-used classes of natural environment in the Puget Sound region, and it is virtually assured that restored beaches will be heavily-used and much-appreciated by the public..
Long-term re-establishment of "normally-functioning" upper intertidal sand-gravel beaches is still highly experimental, in the opinion of the writer. However, if experiments of this sort can be performed without damaging existing habitats and other marine resources, at the least they may yield design concepts and cost estimations that will serve to allow presently-degraded forage fish spawning habitats to be enhanced and maintained throughout their geographical ranges. It should be understood by restoration project supporters that "beach restoration" is an action that will likely require monitoring and periodic sediment nourishment activities, and budgets, in perpetuity.

The comments above may also apply to current work on the replacement and/or transplantation of native eelgrass beds in the Pacific Northwest. Given the acknowledged ecological importance of native eelgrass beds, and the degree to which eelgrass has been extirpated from many areas of Puget Sound prior to the modern era of environmental awareness, much work is being done to find expeditious methods for the mitigative replacement of eelgrass beds found to be within the destruction footprint of certain shoreline development proposals. In some cases, experimental transplantation projects have even been considered as mitigation for knowing destruction of documented herring spawning sites, in spite of "no-net-loss" policies. Although, fortunately, none of these particular herring-site projects have moved forward, it can be presumed that eventually, if there is any perceived success in the cost-effective, long-term replacement of significantly-sized eelgrass beds in non-herring-spawning areas, those same concepts will be proposed for eelgrass beds used by spawning herring. Then a societal decision will have to be made as to whether yet another critical natural habitat type, maintained for free to us by Gaia, can be sacrificed for a budgeted technological construct, however life-like in its appearance.

Enhancement of public shoreline access/recreation:

Included in the tasks assigned to the Island County forage fish spawning habitat inventory completion surveys has been the documentation of shoreline sites possibly amenable to both restoration and public acquisition. A number of potential project sites have been identified and forwarded to the MRC. While the human population of the Puget Sound basin continues to grow at a high rate, acquisition of additional public-access beaches and tidelands will not keep pace, particularly in the current economic climate.

Surf smelt are excellent table-fare, and surf smelt harvest by dipnet on the spawning beaches, has high recreational value for many people in certain parts of Puget Sound where there has been traditional fisheries since aboriginal times. Generally speaking, there is no agency concern over an increase in public opportunities for the harvest of surf smelt. As noted above, for virtually any sector of Puget Sound, the accessible percentage of surf smelt spawning habitat is very small, and will never be very large. It is presumed that surf smelt harvest could increase several-fold over the few tens of tons of roughly estimated annual catch without harming the resource. A completed inventory of all the existing surf smelt spawning beaches might reveal wholly new beaches that would afford smelt harvest opportunity if public access was developed and publicized. At least as likely is the discovery of seasonal surf smelt spawning on existing public beaches and park shorelines, where mere additional publicity will create an "instant" surf smelt harvest fishery where it did not previously exist, simply because the local populace did not notice the fish there before, and thus had no fishery tradition at the site.

As noted above, marine beaches may be among the most popular and heavily-used outdoor environment types found in the Pacific Northwest. We just seem to be drawn to the shore, captives of the sea-water coursing through our veins. Generally-speaking, development of a surf smelt fishing beach acquisition can automatically afford access to a reach of shoreline amenable to many other kinds of consumptive and non-consumptive public uses. A surf smelt beach is generally at least partially fine-to-moderately grained in character, suitable for walking and disabled access, picnicking, kid-play and non-trailered boat and kayak launching. Most smelt beaches include shellfish harvest potential lower in their intertidal zones, and opportunities for non-harvest marine-life observing and education.

Surf smelt spawning beaches might also afford sport anglers opportunities for hook-and-line harvest of salmonids (Dolly Vardens, cutthroat trout) that seasonally forage upon the spawning smelt schools in some parts of Puget Sound. – DEP

2.5 Biologists' Scope of Work – the interagency agreement

INTERAGENCY AGREEMENT: WDFW AND ISLAND COUNTY 10/4/02
Project Title: Regional Forage Fish Spawning Habitat Assessment

STATEMENT OF WORK:

The scope of work for WDFW staff to conduct forage fish spawning habitat surveys and document critical habitat for the WDFW/Island County Interagency Agreement includes the following elements:

1. Conduct surf smelt and sand lance substrate spawning habitat inventory surveys. WDFW staff will be the lead worker, with assistance from county volunteer residents as needed.
2. Complete laboratory analysis of substrate/spawn samples obtained from above surveys to document presence/absence of spawn deposition. WDFW staff will be lead worker, using the WDFW LaConner wet-lab.
3. Complete data entry in a timely manner as data is collected from on going field surveys. WDFW will process data in a manner compatible with existing protocols as previously developed during previous San Juan and Island County surveys.
4. Conduct public outreach and training. WDFW staff will be available to present summaries and reports of on-going survey findings and train interested county or local groups in the survey protocols on request.

Two full time Fish and Wildlife biologist positions will be funded by this work. Both will work under Dan Penttila's (WDFW, FW Biologist 3) supervision.

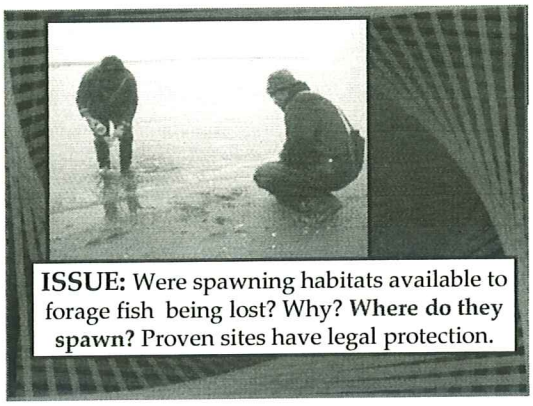
The first will be a Fish and Wildlife Biologist 2 position at an hourly rate of $27.60. The duties of the position include:

Organizes and conducts surf smelt and sand lance spawning habitat surveys on marine beaches in Whatcom, Skagit, and Snohomish Counties, using standardized protocols. Processes and analyzes substrate samples for spawn deposition using standard protocols. Prepare summaries, reports and recommendations based on results and findings. Coordinates survey activities with local field assistance volunteers. Conducts informational presentations related to spawning habitat survey findings and other outreach activities as required.

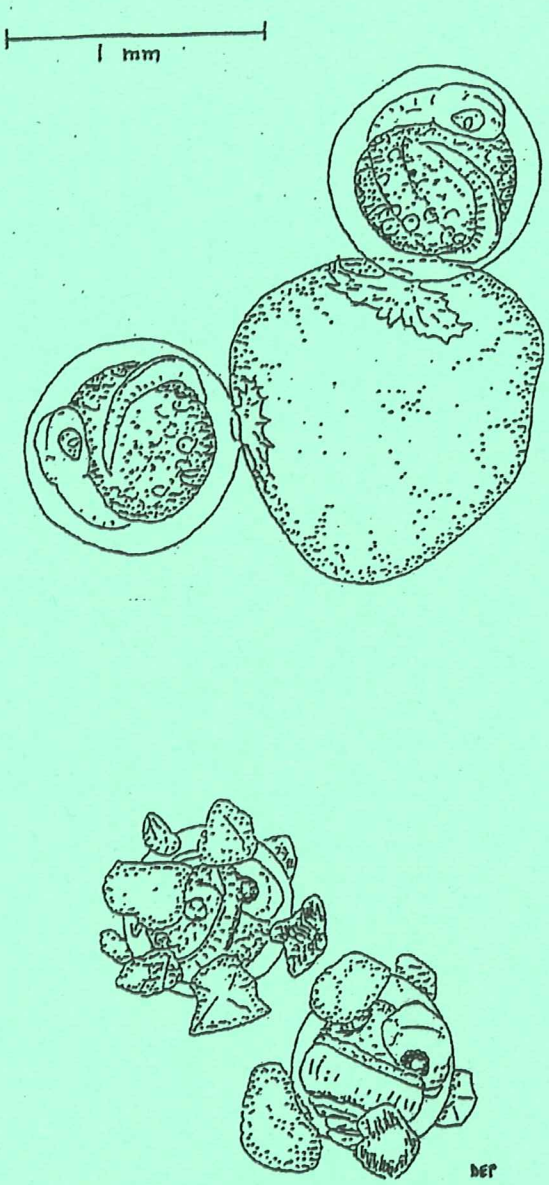
The second will be a Fish and Wildlife Biologist 1 position at an hourly rate of $23.14. The duties of the position will include:

Assist in conducting forage fish spawning habitat survey projects in the Puget Sound basin by collecting spawn substrate samples, recording sampling site habitat data, and preparing field reports documenting survey activities. Enter survey results utilizing current data entry formats as required for mapping and report writing. Communicate

and train with data entry specialists within WDFW and local governments as needed for data base continuity and data exchange. Convert past WDFW databases to current formats as needed.



ISSUE: Were spawning habitats available to forage fish being lost? Why? **Where do they spawn?** Proven sites have legal protection.



Credit: DAN PENTTILA, DFW

3.0 Methodology and Protocols

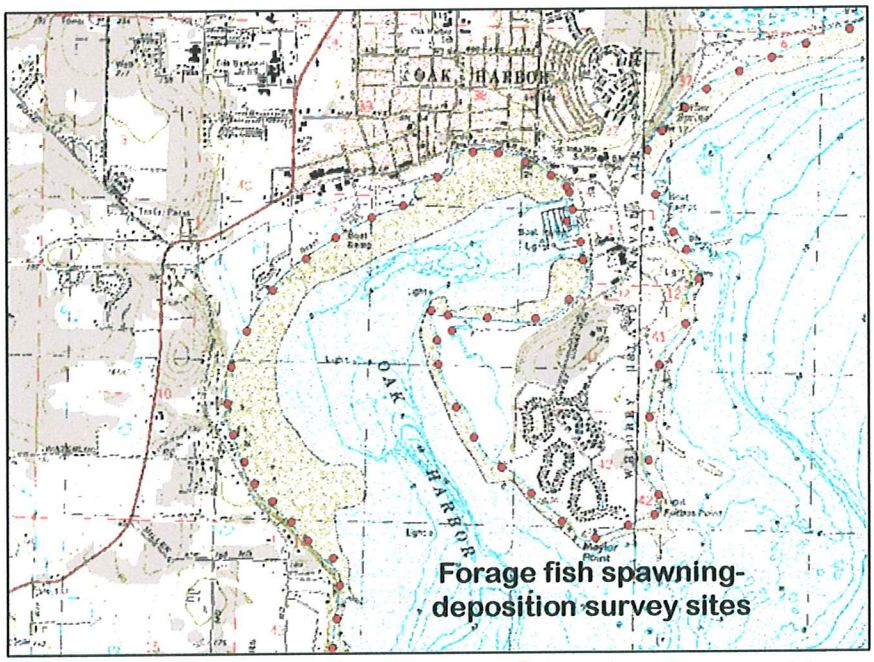
Cite **Protocols, materials and methods** in sections 3.1 through 3.9 as:
Moulton and Penttila, 2000

3.1 Surf smelt and sand lance spawn habitat assessment

Sampling for spawn deposition consists of 1) obtaining a bulk sample of mixed sand and gravel from the upper intertidal region of an appropriate beach; 2) condensing the bulk sample to a manageable volume; and 3) examining the condensed sample under a dissecting microscope to determine the presence or absence of eggs.

3.2 Site Selection

Not all beaches represent potential surf smelt/sand lance spawning habitat. Suitable sites are composed of a mixture of sand and small gravels. The spawning and incubation areas are normally in the +7 to +9 foot Mean Lower Low Water tidal zone. Areas that are shielded from direct sunlight by overhanging vegetation are often more heavily used than areas where vegetation is non-existent or has been removed. Potential spawning sites are identified with the use of aerial photographs, and personal communication with local residents possessing knowledge of forage fish.



For areas such as Oak Harbor, at right, the entire range is potentially spawning habitat, and regular stations are set out at equidistant interval

Once potential sites are identified, a sampling schedule is generated, taking into consideration that spawning times may differ between areas. Because the purpose of this investigation is to determine the extent to which spawning occurs, all selected beaches are sampled at least three times to ensure that spawn is not overlooked due to timing.

3.3 Field Equipment

Equipment needed for collecting bulk beach samples to assess surf smelt:

- □ 8 ounce plastic jar or scoop
- □ 1 gallon or larger plastic storage bag
- □ Waterproof labels

Equipment needed for condensing samples:

- □ Rack of sediment screens, sizes 2 and 0.5 mm
- □ One five gallon bucket modified to act as a drain for screen rack
- □ Wash bucket
- □ Plastic dishpan
- □ 8 ounce plastic sample jar
- □ Stockards Solution (preservative) 50 ml formalin(37% formaldehyde), 60 ml glycerin, 40 ml glacial acetic acid, 850 ml distilled water

3.4 Field Records

Certain physical characteristics of the sampled location are recorded to help analyze the results of the sampling. These records are entered on a field data sheet at the time of sampling. The data fields are as follows:

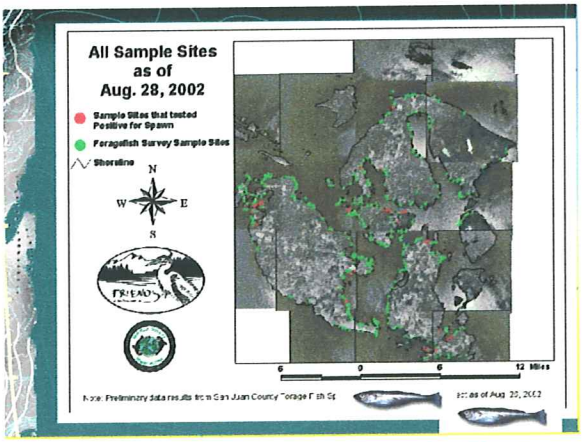
Date of Sampling
Station: Station number, starting with 1 each area, each day
Sample: Sample number.
Latitude/Longitude: Listed in degrees, minutes, seconds
Beach: Character of the upper beach:
0 = mud
1 = pure sand
2 = pea gravel (fine gravel) with sand base
3 = medium gravel with sand base
4 = coarse gravel with sand base
5 = cobble with sand base
6 = boulder with sand base
7 = gravel to boulders without sand base
8 = rock, no habitat
Uplands: Character of the uplands (to 1000 feet):
1 = natural, 0% impacted
2 = 25% impacted, 3 = 50% impacted, 4 = 75% impacted, 5 = 100% impacted
Sample Zone: Distance of collection parallel from a land mark in feet to the nearest ½
foot. Used to determine the tidal elevation of the spawn deposit
Land Mark: Land mark for the sample collection:
1 = down the beach from the last high tide mark
2 = up the beach from the last high tide mark
3 = down beach from second to last high tide mark
4 = down beach from upland toe
5 = up beach from waterline at time noted in comments
Tidal Elevation: This is determined in the office by using the data from "land mark", the
average beach slope for the sector, and the height of the tide on the previous tide.

3.5 Smelt, Sand Lance, Rock Sole, Herring: subjective field assessment of spawn intensity:

0 = no eggs in field
2 = light, observed in field
3 = light medium, observed in field
4 = medium, observed in field
5 = medium heavy, observed in field
6 = heavy, observed in field
7 = very heavy, observed in field
8 = eggs observed in the winnow
Width: Width of the potential spawning substrate to the nearest foot
Length: Length of the beach up to 1000 feet, or "C" if continuous.
Shading: Shading of the spawning substrate zone, averaging over the 1000 foot station and best interpretation for the entire day:
1 = fully exposed
2 = 25 % shaded
3 =50 % shaded
4 = 75 % shaded
5 = 100% shaded
Comments: additional observations, evaluated station by station

3.6 General Protocol for Collecting Bulk Beach Samples

Each beach is examined to determine the area(s) most likely to contain spawn. This zone is typically in the upper third of the beach, near the upper tidal limit. For surf smelt eggs, the zone is characterized by mixed sand and small gravel. Mud or muddy sand are not acceptable substrates. Larger gravel, cobble or solid rock are also unacceptable. The samples are composed of four scoops of gravel, evenly spaced along a 100 foot stretch of beach:



San Juan County Sample Sites

☐ Identify an approximately 100 foot of beach to be sampled

☐ Obtain location information from a GPS or map of area

☐ Prepare a label identifying location of sample

☐ Start at one end of the transect, fill scoop with sand from the top 0.5 inch of beach and dump into the plastic storage bag. The scooped area should be 3-4 feet long

☐ Move 10 paces along the transect, obtain another sample and place in the storage bag

☐ Repeat until the four scoops have been obtained. This constitutes a bulk sample for one location

3.7 Condensing Bulk Samples

Bulk egg samples can be processed in the field to remove most of the sand and reduce the volume of the sample. This separation is done by washing the eggs from the sand and discarding the barren sediment. The eggs are lighter than the sand and gravel, and will move upwards during this washing process, allowing them to be skimmed from the surface material. The washing procedure is as follows:

- Assemble the screens on top of the drain bucket, with the larger mesh on top.
- Remove the sample label and place it in the 8 ounce storage jar
- Add a portion of the sample to the top screen, thoroughly wash the sediment through the screen set with fresh water
- Discard the sediment in the top screen, retaining only the material in the lower (0.5mm) screen
- Dump the material retained in the smaller screen into the dishpan
- Add water until the material is covered by 1-2 inches of water
- Swirl the water around the pan, adding rocking and bouncing motions to allow the eggs to migrate to the top of the sediment
- After swirling for 1-2 minutes, work the lighter fraction of material to one corner of the pan. Carefully dry up the lighter fraction by tipping the pan so that the water drains away, and skim the lighter fraction from the surface of the sand with the sample jar.
- Repeat the winnowing process two more times
- Process the remainder of the sample in a similar fashion, each time adding the retained lighter fraction to the sample jar
- Fill the sample jar with Stockard's Solution to preserve the eggs. Seal the jar securely, invert carefully several times to ensure that the preservative reaches all the eggs .

3.8 Laboratory Examination

Final separation is performed under a dissecting microscope at 10-20x, where the eggs are quite visible. Once identified, eggs are separated. Embryology is conducted at this time, and recorded on the examination data sheet (Figure 16). Due to the relatively long incubation periods, it is common to see two or more different stages in the sample. If possible, a random sample of 100 eggs is selected for the embryological examination. A number of non-egg objects may be encountered in preserved upper intertidal substrate samples that may be misidentified as forage fish eggs or empty shells. These objects include certain invertebrate eggs, algal fruiting bodies, and flatworms and their egg cases.

3.9 Quality Assurance/Quality Control

The primary concerns for quality control are:

- Sampling the appropriate habitat
- Accurate identification of sample habitat
- Careful screening and winnowing of the bulk sample to retain the maximum number of eggs
- Accurate identification of the sampled eggs

Adequate training of the samplers may be the best way to ensure good data. To check accuracy, a sample known not to contain eggs may be seeded with a known number of eggs, and then processed to see how many of the eggs are detected.

4.0 Project Objectives

4.1 Expand the forage fish assessments to three additional counties

The primary purpose of the surveys was to locate, sample, and test intertidal substrates for the presence of forage fish spawn deposition on the beaches of Island, Whatcom, Skagit and Snohomish counties. Island County (joined by San Juan County) was the only jurisdiction among the four listed to have engaged in assessments and mapping of these resources, *prior to this program.*

DFW biologists were retained via two interlocal agreements [between Island County and the agency] that enabled the agency to resume the long-since 'defunded' field surveys and laboratory work paid for by the project.

Volunteers assisted in three years' of field surveys, sampling thousands of stations, led by the fisheries biologists. The initial field observations are confirmed via laboratory protocols developed by this project, and adopted statewide.

The data was collected in GPS-referenced format, which was then mapped using the state Department of Ecology's GIS protocols.

4.2 Collection and lab techniques regionally consistent

The measurable objectives of project expansion included economies of scale, minimized administrative costs, uniform protocols, centralized data management, consistent lab techniques and seamless GIS mapping.

The assessments' field-sample collection and lab protocols were developed by Dan Penttila and Larry Moulton at the outset of the project in 1999. Collections were made with the assistance of trained volunteers. A single regional coordinator oversaw scheduling and the individual training programs, acted as a liason with DFW to prepare Interlocal Agreements, and coordinated billing and timekeeping between DFW and the individual MRC, Tribal and NGO sponsors. The coordinator also managed billing to the master funding agencies on a costs-incurred basis, for payment in arrears. Lastly, the coordinator prepared the majority of grant proposals, and all reports for the project.

5.0 PROJECT SUCCESSES AND CHALLENGES: THE LESSONS LEARNED

5.1 Participants de-briefing

In October, 2004, the Northwest Straits Commission, led by Director Tom Cowan, organized a post-project one-day meeting to discuss outcomes and exchange ideas. This section is based on the notes/summary of those candid discussions by Sasha Horst, Project Specialist, Northwest Straits Commission.

FORAGE FISH SURVEY PROJECT MEETING

DATE: October 5, 2004
LOCATION: La Conner Country Inn

In attendance:

Gary	Wood	Island
Kim	Bredensteiner	Island
Kevin	Long	Jefferson/North Olympic Salmon Coalition
Neil	Harrington	Jefferson
Pat	Pearson	Jefferson
Ginny	Broadhurst	Northwest Straits Commission
Tom	Cowan	Northwest Straits Commission
Sasha	Horst	Northwest Straits Commission
John	Cambalik	Puget Sound Action Team
Tina	Whitman	San Juan
Jody	Kennedy	San Juan
Ivar	Dolph	Skagit
Ann	Bylin	Skagit
Sean	Edwards	Snohomish
Erika	Jensen	Snohomish
Mike	Ramsey	Salmon Recovery Funding Board
Dale	Gombert	WA Dept of Fish and Wildlife
Mary Lou	Mills	WA Dept of Fish and Wildlife
Dan	Penttila	WA Dept of Fish and Wildlife
Anne	Shaffer	WA Dept of Fish and Wildlife/Clallam
Erika	Stroebel	Whatcom

5.2 ISSUE: County Responsibility

- Where are data/maps housed?
- Which is responsible department? Who is the responsible person?
- How is information being used? Shoreline Master Program planning, permit review, MRCs, others? Are there barriers to using the data?

COMMENTS:

Clallam: Clallam data are available through WDFW's Priority Habitat and Species database (PHS) which is considered to be best available science in local policy. However, forage fish are not specifically mentioned in the county critical areas ordinance (CAO) and data are not used much.

Island: Housed by WSU extension, data are available in all departments but not aware of use. No revisions to Shoreline Master Program until 2009. Critical Areas Ordinance in 2005. Arguments are not about presence or absence of forage fish, but rather what their presence/absence means.

Jefferson: Data go to GIS staff then accessed by Planning staff.

San Juan: working hard to be sure that forage fish data are included in new Critical Areas Ordinance. Held a workshop in January 2004 for county planners and managers. Approximately 50 people attended. Required significant investment of time to organize and follow-up continues. Development review relies on WDFW HPA approval/denial rather than internal county review of data.

Skagit: Barriers to use include others collecting data and battles over "best available science". Josh Greenberg is the contact person for data use. It is used in permit review process. Map portfolio does include forage fish map (does not have newest data). SMP update will occur in 2012.

Snohomish: An early adopter of a Shoreline Master Program. Forage fish data are available in the county GIS department. However, it is not linked well with planning department and not yet used for any planning purposes. There is a disconnect between planning/permits.

Whatcom: Housed by Water Resources within Public Works. Trying to make connections with public works and the planning department but the timeline is very short for the upcoming SMP adoption in 2005. Whatcom is using data, and Dan Penttila is involved in the technical advisory committee for Whatcom's SMP process.

General Concerns/Questions:

- Many counties are deferring to WDFW's HPA approval (which extends only to the ordinary high water mark) rather than making the permitting decisions themselves based on their local authorities. WDFW will almost always approve a project "with conditions" rather than deny it because of forage fish spawning.
- Many counties still are not using forage fish data and there needs to be diligent efforts to be sure that the data are used. Each county has its own system to figure out. Educating planning commissions, elected officials and planning staff about the utility of forage fish data is important. Also need to be sure that the data are being referenced in all shoreline master program updates and critical areas updates. HB 1933 states that counties are required to identify and protect forage fish beaches in their critical areas ordinances until a shoreline master program is updated. Puget Sound Action Team may be able to help pull some education efforts together and will be commenting on ordinance updates.
- Dealing with urbanized shoreline is really difficult. There are huge disincentives for property owners to pull back their armoring. Lot sizes are small and heavily developed.
- Next steps needed include efficacy of shade, forage fish eating insects from trees, different buffer needs based on shoreline type.
- Struggle with communicating correctly about the health of the nearshore. A bulkheaded area can be fully functioning ecologically depending on where it is in a drift cell.

WDFW is now writing a marine waters model Critical Areas Ordinances. Steve Penland is the lead.

5.3 ISSUE: Future needs?

- What's left to do? More beaches? Resurvey beaches?
- Are there plans for continuing surf smelt and sandlance inventories? What about herring? Role for the NWSC?
- Are there plans for forage fish beach restorations?
- Budget requirements?

COMMENTS:
Clallam: Future needs include winter sandlance, outer coast, river sampling and community outreach.

San Juan: looking for new funding to continue at sites with a lot of history and answer other questions about change over time. There are also many one-egg sites that they would like to return to and monitoring of restoration sites. Recommend if planting on shoreline plant in fall and spend considerable time planning. Also, restoration should be considered as a buffer, bank stabilization and forage fish shading. (Rather than just forage fish shading,) Ecological impact of restoration projects has been low – mainly an education program.

WDFW: there is a lot left to do, including revisiting King county, east Kitsap, Pierce and north Mason, as well as outer coast and estuaries. Ideally all one-egg sites could be revisited. Forage fish is not part of the current WDFW budget. $350,000 in budget request for next biennium for forage fish work. Dan is working to convert old data forms to new forms that can then be entered in digital database. This data transcription is a priority. $100,000 needed to complete and convert old data.

Jefferson: not completed. Need more money for additional sampling.

General Questions/Concerns/Suggestions:
Who is responsible for using the data? It is unclear in some situations.

- All counties should do a "blueprint" project.
- Coastal Training Program or shoreline planners group maybe could help put together a program focused on using the forage fish data
- WDFW support is necessary for continued forage fish work, but staff time may not be available.
- Future projects should lead to direct protection/restoration.
- SMP process looks for partnerships and restoration opportunities.

Washington Department of Fish and Wildlife

- How is information being used?
- Plans for continuing inventories?
- Budget for additional work?

Challenge to get data publicly available as it requires a philosophical change at the agency. Current system requires an application form and payment. Concern over how much data to make available because of potential for misleading or out of date information. WDFW is a management agency, not research oriented. Eventual concept is for a web-based system, but not expected soon.

Questions/Concerns:

- Counties depend on WDFW, what if WDFW doesn't have all the data?
  - QA/QC for PHS is important
  - Counties should have the same data.
  - Example: no HPA denied to date in San Juan county due to forage fish presence.
  - PHA request is a time issues.
- When will data point maps be available?
  - Depends on budget and Dan's time to transcribe older data.
  - Dale can distribute current data which is positive data points. Still needs data from Clallam. Island is complete. Most is complete for Whatcom, Snohomish and Skagit. Jefferson to be done by end of 2004. Need point data from San Juan.
  - PSAT will facilitate development of criteria to prioritize action to use forage fish data. One model is blueprint.

5.4 ISSUE: Lessons Learned

- What worked?
- What didn't work?
- Role of regional coordination?
- Ideas for improvements?

COMMENTS:

- Regional project should be managed/coordinated directly by the NWSC, not one MRC.
- Dan Penttila responsible for Quality Control worked well
- Landowner permission meant good education
- Protocol transfer was efficient/effective
- Pre-project, mid-point and post-project meetings were needed.
- NWSC holding the meeting brings a level of importance that wouldn't otherwise.
- Early meeting was focused on funding, not technical aspects.
- Difficult to understand the role of each MRC.
- Counties connecting to each other is inefficient compared to a regional coordination.
- Needed to know status of project earlier in order to seek funding for continued work –the data lag provided no incentive for continued funding.
- Overall property owners were very receptive in all counties when asked. Mostly non-responses for mailouts. Personal contacts were best and most likely to lead to behavior change.
- Periodic training on protocols is needed to ensure no protocol drift.
- Greatest potential for difficulty and changes is in lab work.
- NWSC should be the lead and define roles, but capacity of NWSC staff is recognized.
- Bookkeeping: better grasp of who is tracking budget when there are multiple funding sources.

Summary and conclusions

Life history questions are not known for sand lance and smelt. It is not known where they live outside of their juvenile state. They don't show up in salmon tow nets or trawls. We do know that the juveniles use kelp beds.
It's helpful to have the NWSC as a coordinator.

It may take much effort to be sure that data are used for permitting decisions and are referenced in SMPs and CAO updates. MRCs should play a role in this and help communication flow within county government.

5.5 The necessity of regional coordination

By sheer coincidence, eight unrelated grants were awarded by three funding sources to six local "forage fish" projects in late 2000. To the sponsors' dismay, the projects posed wholly inconsistent survey approaches, with no two protocols alike. A potential hodge-podge of non-uniform, inconsistent surveys had been launched.

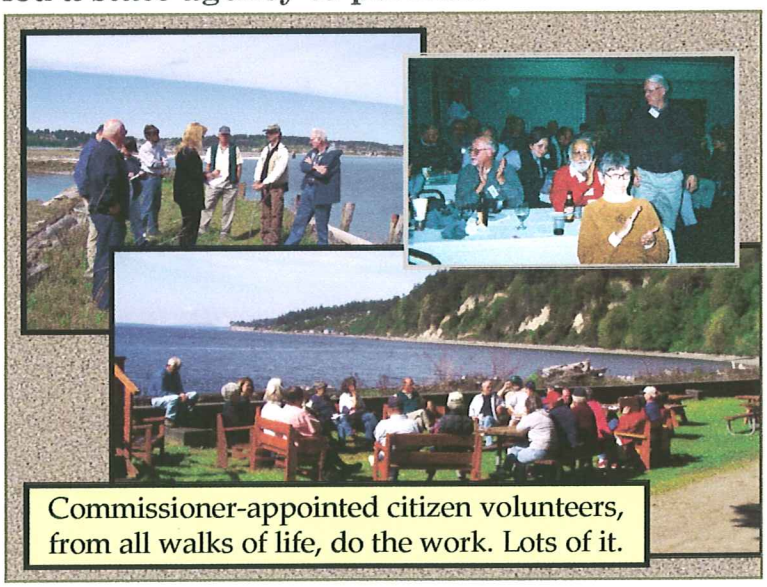
To avoid this unhappy, inefficient and expensive result the SRFB underwrote two years of regional coordination (via annual contracts with Island County extending from June, 2001 – May, 2002) to ensure uniformity of project deliverables, QA/QC and assessment techniques. Island County then contracted with this report's author (Gary Wood JD dba Intertidal Consulting) to perform the coordination tasks enumerated in the SRFB contracts.

5.6 Citizen-based volunteers enabled a state agency to perform

The Island County MRC and each of the seven cooperating MRCs cin the congressionally-adopted **Northwest Straits Initiative** www.nwstraits.org was a primary sponsor of the forage fish assessments.

Not only is the MRC itself comprised of citizen volunteers appointed by their County Commissioners, all MRCs were involved in recruiting volunteers for the field surveys.

Over two hundred citizens volunteered and joined the biologists for a day.



Commissioner-appointed citizen volunteers, from all walks of life, do the work. Lots of it.

5.7 Short vs. Long Term outcomes

Short-term outcomes (inventories & maps) vs. long-term goals identified at the outset (species & habitat protection)

Near term: The newly-discovered spawning habitats are measurable in miles (or fractions thereof); a wholly original database has been built re collections; the data is used in GIS maps; will also be available as website content; a great teaching aide -- a 30 minute project video was also completed and was previously submitted. {See "Tiny Fish Tails"}

Local planning departments and the DFW have agreed in advance to use project data in official resource maps, and to initiate "no less loss" legal permitting protections per the WA Hydraulic Code's HPA process.

Long-range: Forage fish have suffered a precipitous decline in the region, despite fisheries closures. **Mapping their spawning beaches will curb loss of these habitats to nearshore construction and hardening by effecting 'no net loss' legal protections and by alerting permitting agencies to their locations.**

Research / management implications –

The discovery of new spawning habitats is a product of the project's extensive field research. In a sense, the entire project is founded on hard-core, on-the-beaches sampling and research. The methods of site selection, the timing of sites visited, and the unusually high percentage of "finds" of recent spawning deposition are the results of Dan Penttila's 30 years of expertise in this particular endeavor.

The project's management implications are direct: planners and permitters will use the acquired information to enlist 'no net loss' habitat protections that do not come into play unless and until the habitats have been mapped to this degree of scientific certainty.

Presentations and Poster sessions about the Regional Forage Fish Assessments were made at over a dozen conferences, and it was awarded recognition by *Shared Strategy* in 2004.

6.0 DATABASE – CD-ROM

6.1 CD-Rom Content

Extensive post-processing of the field data by Doug Kelly has produced a single-source disk for the four-county surveys (Island, Whatcom, Skagit & Snohomish). The Database CD-Rom for this project – available at cost from the Island County MRC -- is entitled:

THE REGIONAL FORAGE FISH HABITAT ASSESSMENTS (2001-2003)

Sponsored by grants from the SALMON RECOVERY FUNDING BOARD, the National Fish and Wildlife Foundation and the NORTHWEST STRAITS COMMISSION in partnership with the Washington Department of Fish and Wildlife, Dan Penttila, lead biologist. Project coordination by the Island County, Whatcom County, Skagit County and Snohomish County *Marine Resources Committees* and Gary Wood.

The following files are contained on the **Regional Forage Fish Habitat Assessment Data CD:**

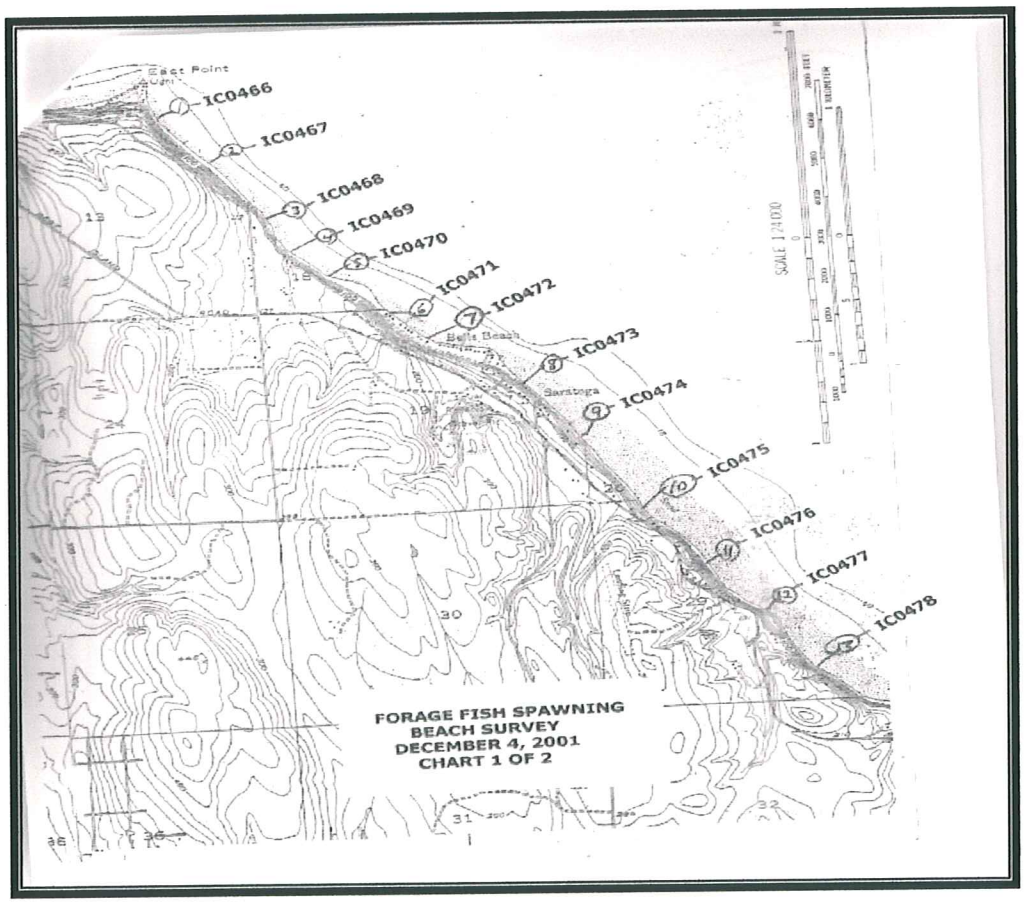
Filename Description Location
ForageFish.mdb Primary data set for forage fish data x:\
ForageFish.mxd GIS Document containing presence /absence datalayers x:\gis
***.lyr** Presence / absence data layers x:\gis
CountyX*.pdf Presence / absence maps, by species, Season and county x:\Pdf Maps
icfm-*.tif Scanned field maps x:\FieldMaps
icfs-*.tif Scanned field sheets x:\FieldSheets
icls-*.tif Scanned lab sheets x:\LabSheets
1972to1983.mdb Historical Forage Fish Data x:\Historic
Readme.pdf This file x:\

Technical notes: As noted above, the primary data collection is contained in the ForageFish.mdb file, which is an MsAccess 2000 database. There are two primary tables contained in the database, [Main] and [LabAnalysis]. The [Main] table is linked to the [LabAnalysis] table with multiple keys: SampleNumber, SubCode, and County. Initially when the database was designed the only key implemented was SampleNumber. However, once data from multiple counties was encorporated, this was no longer sufficient. Field staff collecting the forage fish data occasionally re-used or duplicated sample numbers, resulting in the need for the subcodes which are sequenced A, B, C, etc.

6.2 Field maps & notes

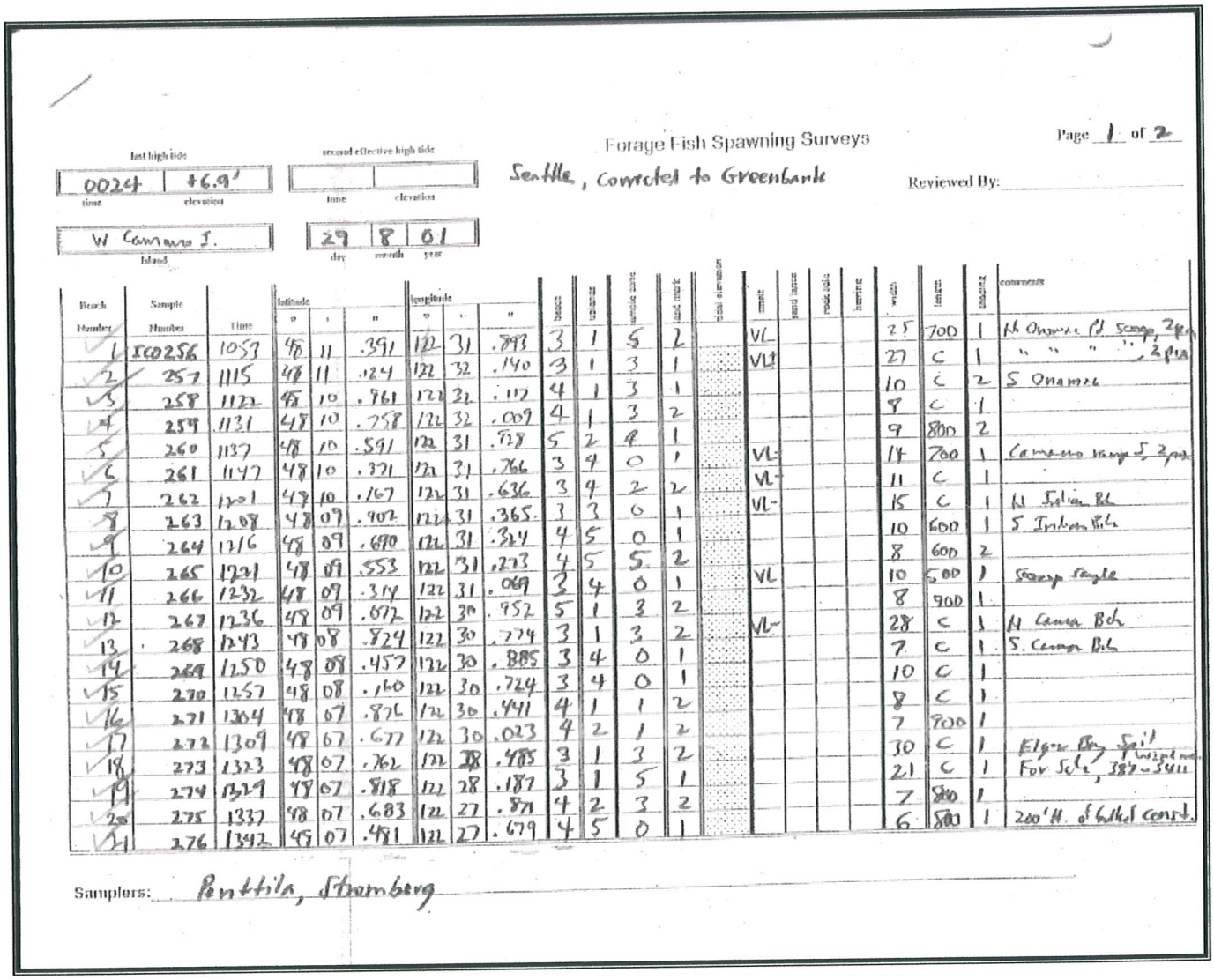
In addition to the GIS datalayers that can only be used with MSAccess, there are non-GIS records made available, that enable a microscopic examination of the work performed and data gathered.

A. Sample field map - one of over 287 field maps available on the CD; **icfm-*.tif** Scanned field maps x:\FieldMaps), detail of USGS sectional, with numbered sampling sites indicated:



B. Sample field report:

The eleven-odd parameters noted in the field at the time of sampling, e.g., substrate material, beach geology descriptions, vegetation, bluffs, etc. are all entered into the database for use in future research. This sample is one of 224 reports on the CD.



Forage Fish Spawning Surveys — Page 1 of 2

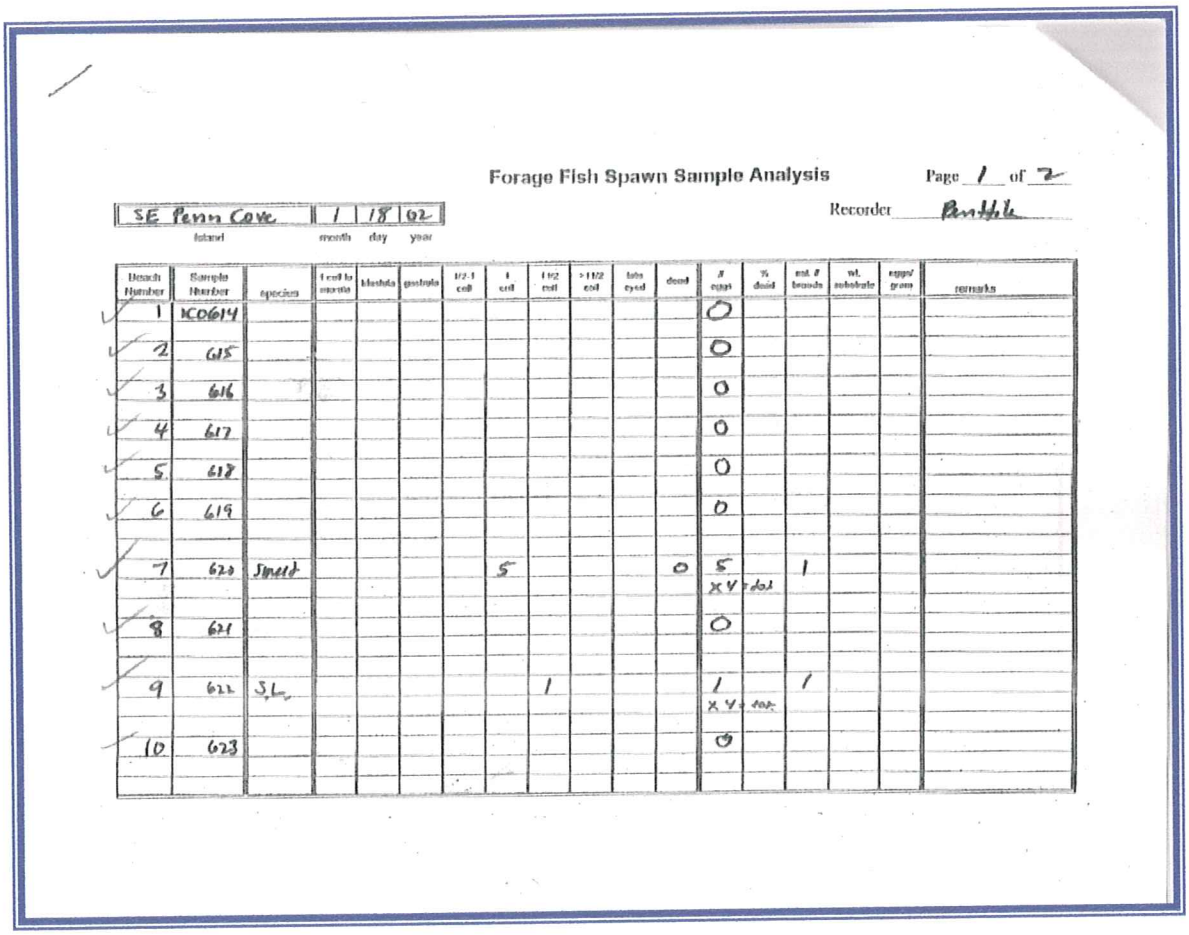
first high tide: time 0024, elevation +6.9' — second effective high tide: time, elevation — Seattle, Corrected to Greenbank — Reviewed By:

Island: W Camano I. — day 29, month 8, year 01

Beach Number	Sample Number	Time	Latitude °	'	"	Longitude °	'	"	beach	substrate	sample date	seed mark	total elevation	smelt	sand lance	rock sole	herring	width	length	depth	comments
1	1C0256	1053	48	11	.391	122	31	.893	3	1	5	2		VL				25	700	1	N Onamac Pt Scoop, 2 pts
2	257	1115	48	11	.124	122	32	.140	3	1	3	1		VL				27	C	1	" " " " 2 pts
3	258	1122	48	10	.761	122	32	.117	4	1	3	1						10	C	2	S Onamac
4	259	1131	48	10	.758	122	32	.009	4	1	3	2						8	C	1	
5	260	1137	48	10	.591	122	31	.728	5	2	4	1						9	800	2	
6	261	1147	48	10	.321	122	31	.766	3	4	0	1		VL				14	700	1	Camano Island S 2 pts
7	262	1201	48	10	.167	122	31	.636	3	4	2	2		VL				11	C	1	
8	263	1208	48	09	.902	122	31	.365	3	3	0	1		VL				15	C	1	N Iselin Bch
9	264	1216	48	09	.690	122	31	.324	4	5	0	1						10	600	1	S Iselin Bch
10	265	1231	48	09	.553	122	31	.223	4	5	5	2						8	600	2	
11	266	1232	48	09	.319	122	31	.069	3	4	0	1		VL				10	500	1	Scoop Eagle
12	267	1236	48	09	.072	122	30	.952	5	1	3	2						8	900	1	
13	268	1243	48	08	.824	122	30	.774	3	1	3	2		VL				28	C	1	N Camp Bch
14	269	1250	48	08	.457	122	30	.885	3	4	0	1						7	C	1	S. Camp Bch
15	270	1257	48	08	.160	122	30	.724	3	4	0	1						10	C	1	
16	271	1304	48	07	.876	122	30	.441	4	1	1	2						8	C	1	
17	272	1309	48	07	.677	122	30	.023	4	2	1	2						7	700	1	
18	273	1323	48	07	.762	122	28	.485	3	1	3	2						30	C	1	Elger Bay Spit
19	274	1329	48	07	.818	122	28	.187	3	1	5	1						21	C	1	For Sale, 387-3411
20	275	1337	48	07	.683	122	27	.871	4	2	3	2						7	800	1	
21	276	1342	48	07	.481	122	27	.679	4	5	0	1						6	800	1	200' N. of bulkhead const.

Samplers: Penttila, Stromberg

c. Sample lab notes:



Forage Fish Spawn Sample Analysis Page 1 of 2

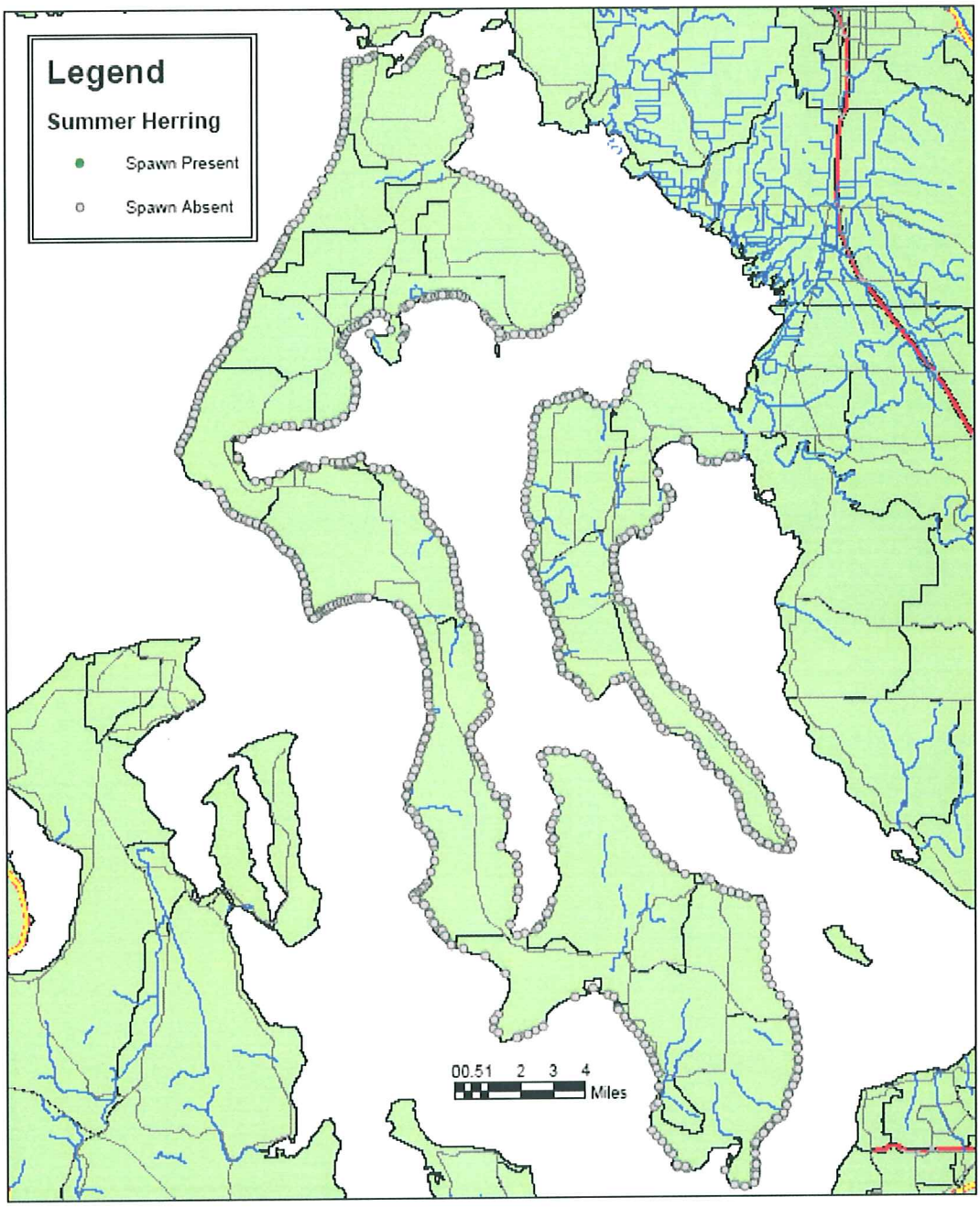
SE Penn Cove | 1 | 18 | 02 (Island | month | day | year) Recorder Penn Lab

Beach Number	Sample Number	species	1 cell to morula	blastula	gastrula	1/2-1 cell	1 cell	1/2 cell	>1/2 cell	late eyed	dead	# eggs	% dead	est. # beads	wt. substrate	eggs/ gram	remarks
1	KC0614											0					
2	615											0					
3	616											0					
4	617											0					
5	618											0					
6	619											0					
7	620	Smelt					5				0	5 X 4 = 20		1			
8	621											0					
9	622	SL						1				1 X 4 = 4		1			
10	623											0					

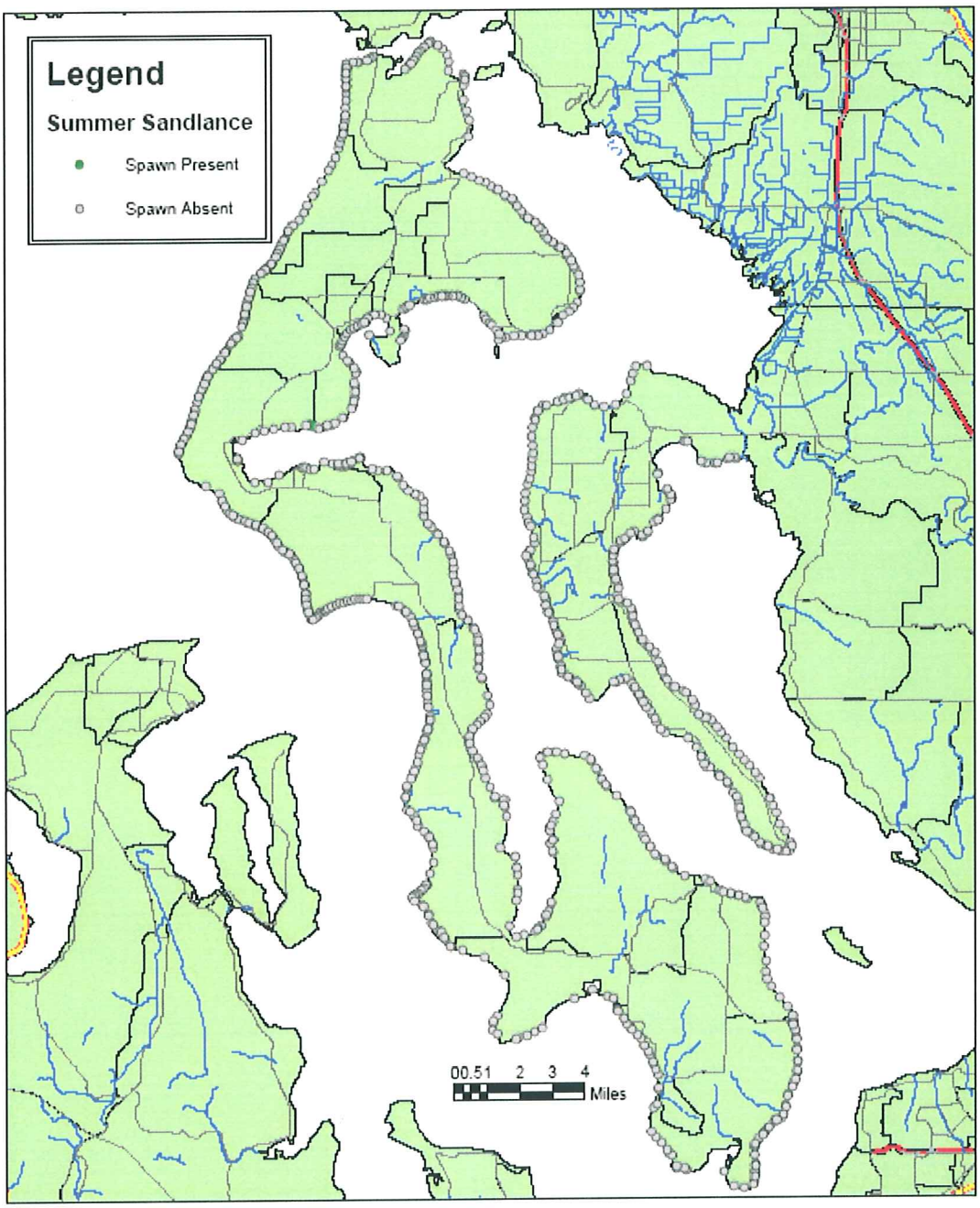
6.3 COUNTY SHORELINE MAPS, by species & season

For convenience, the following 32 pages contain one copy each of the **Island/Whatcom/Skagit/Snohomish** .pdf maps, reprinted here from **CountyX*.pdf Presence / absence maps, by species, Season and county x:\Pdf Maps.**

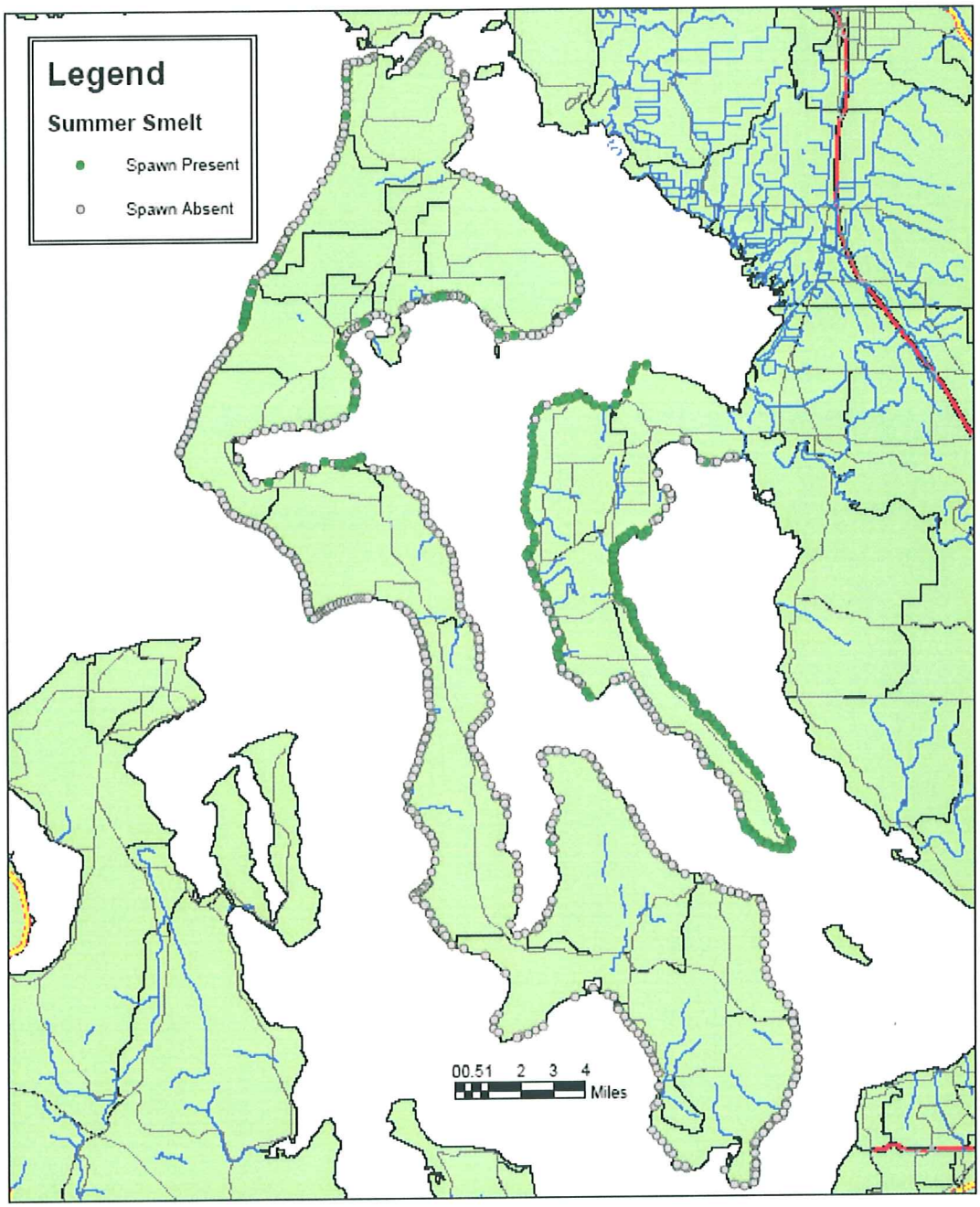
These indicate in simple "presence or absence" notation the surveyed species by runs (winter smelt, summer sand lance, etc.) along the four-county shorelines.



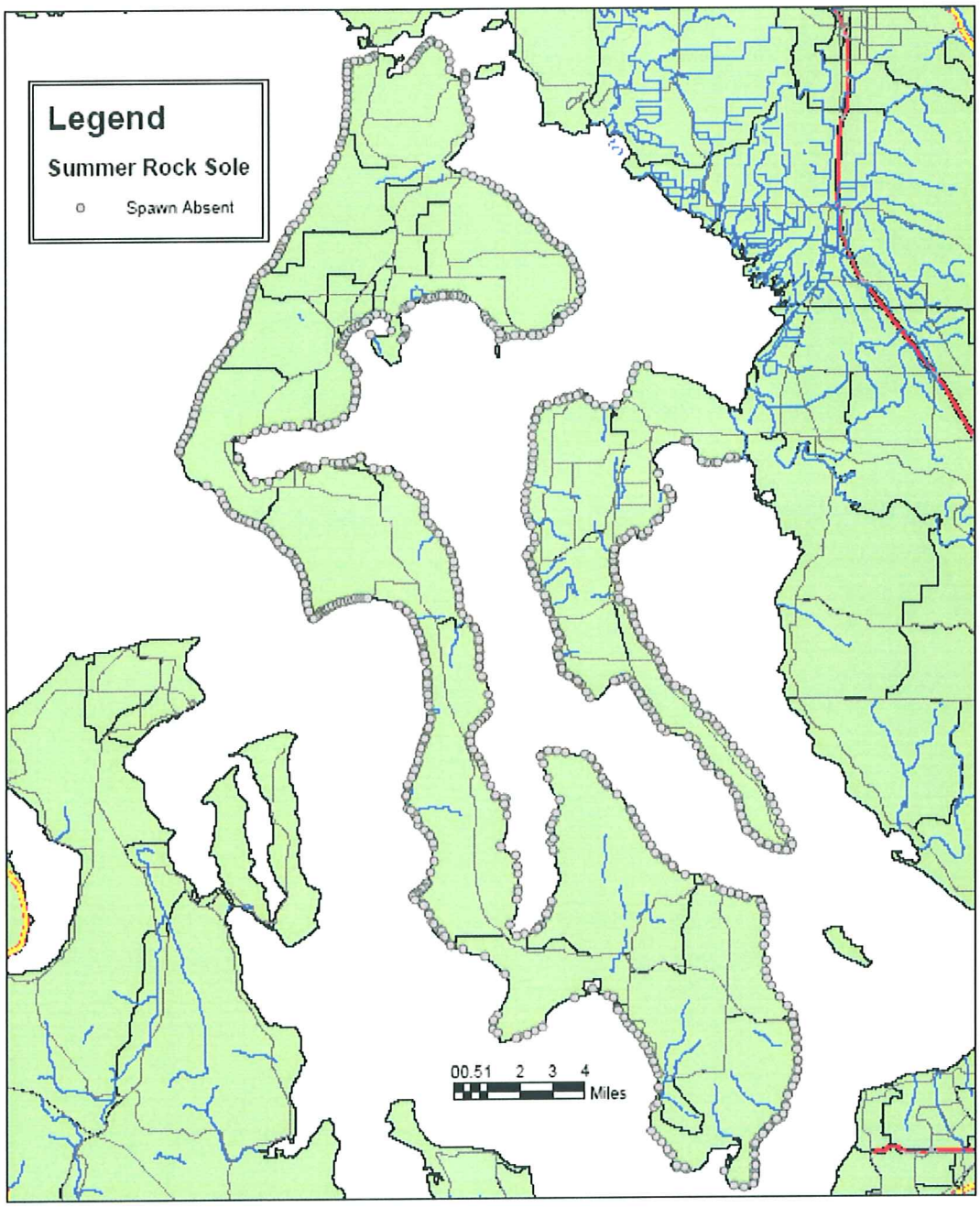
Island County Forage Fish



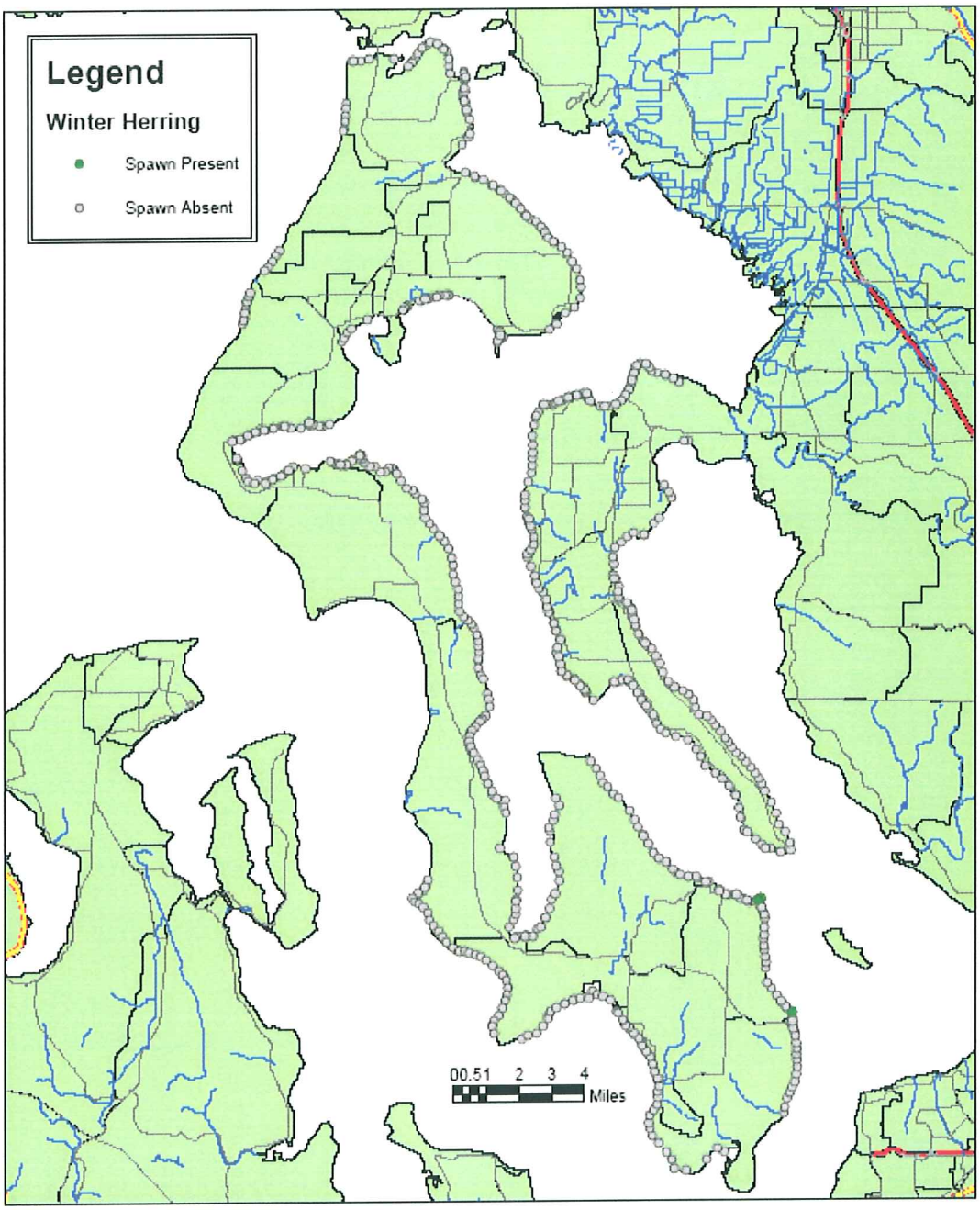
Island County Forage Fish



Island County Forage Fish



Island County Forage Fish



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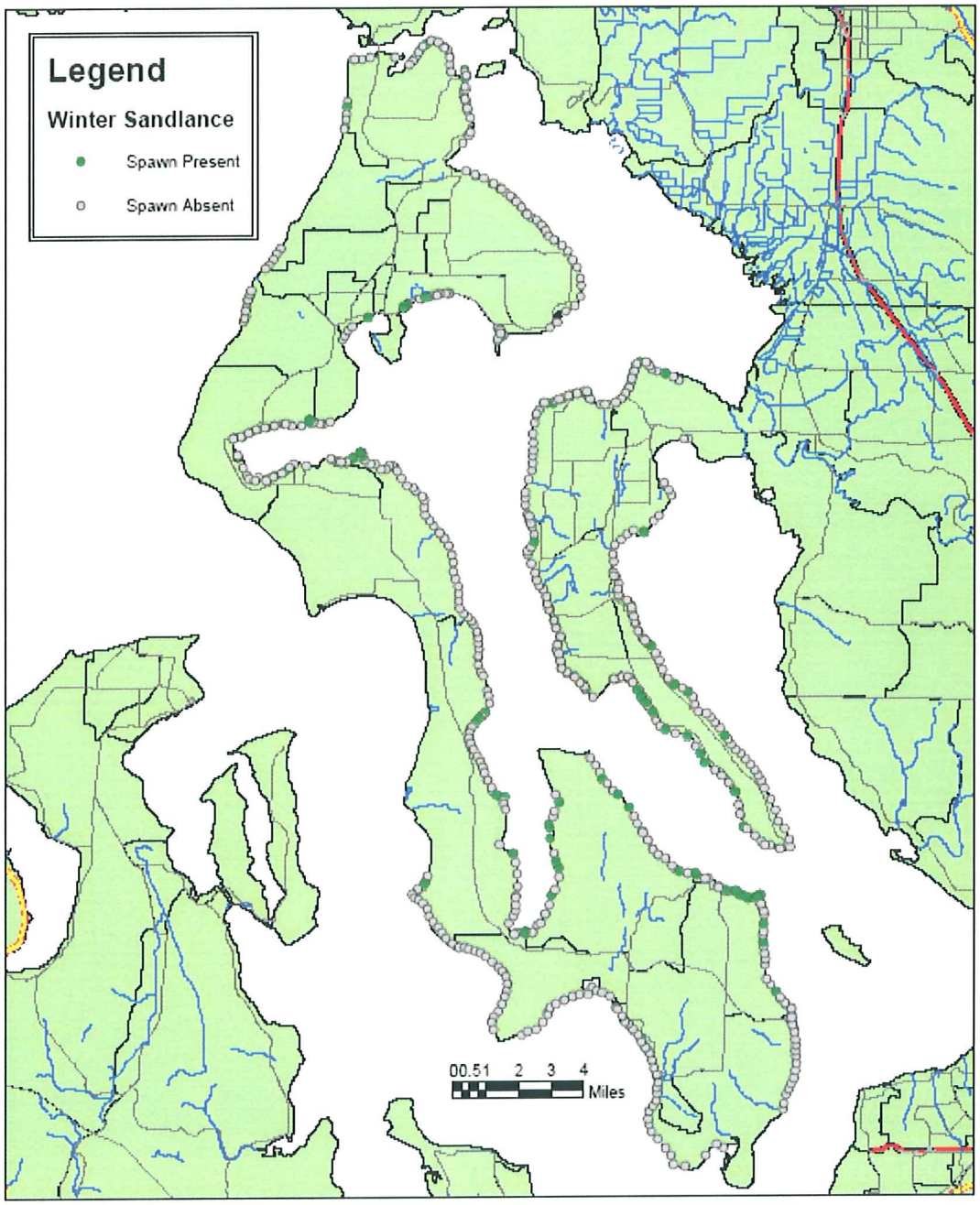

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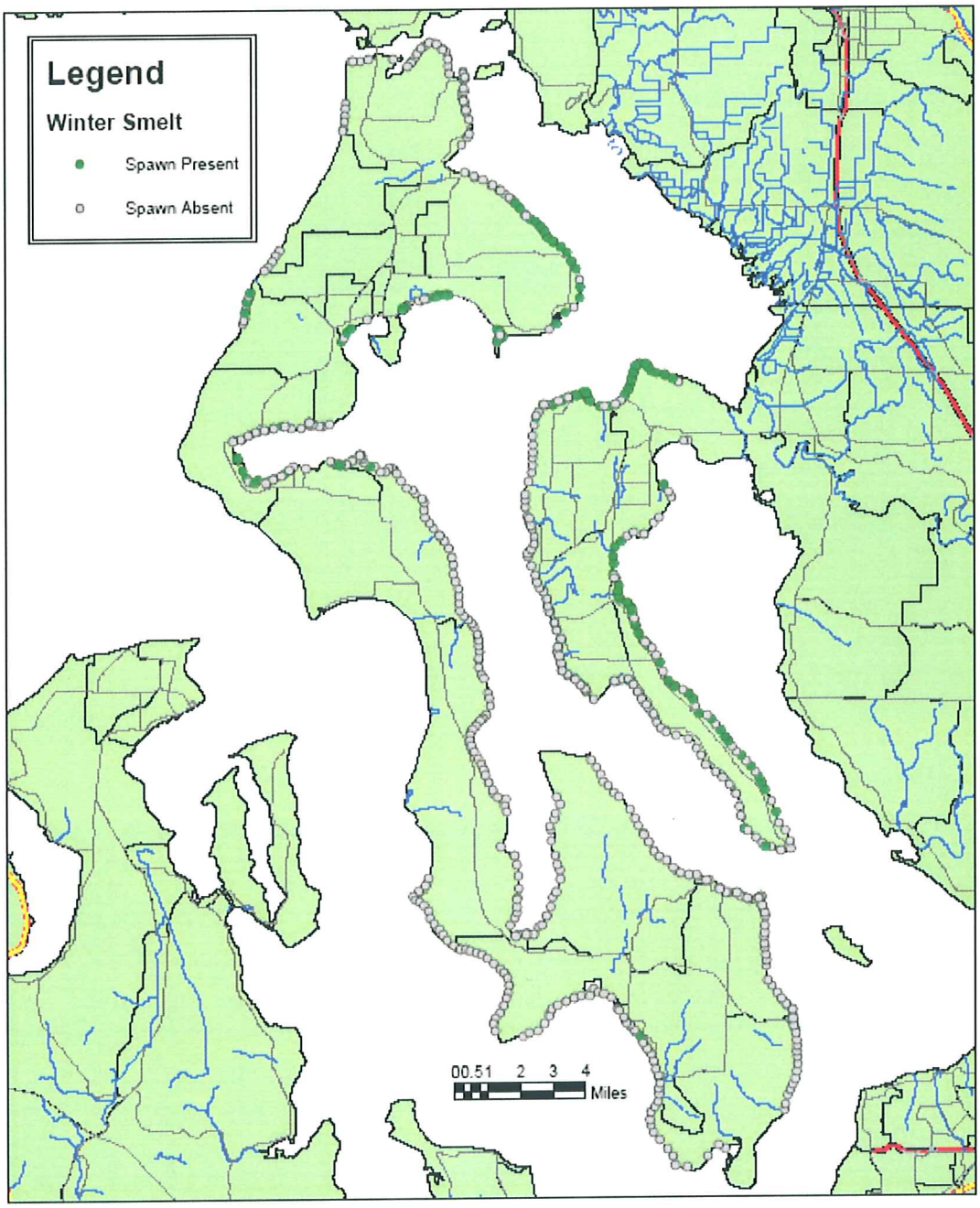

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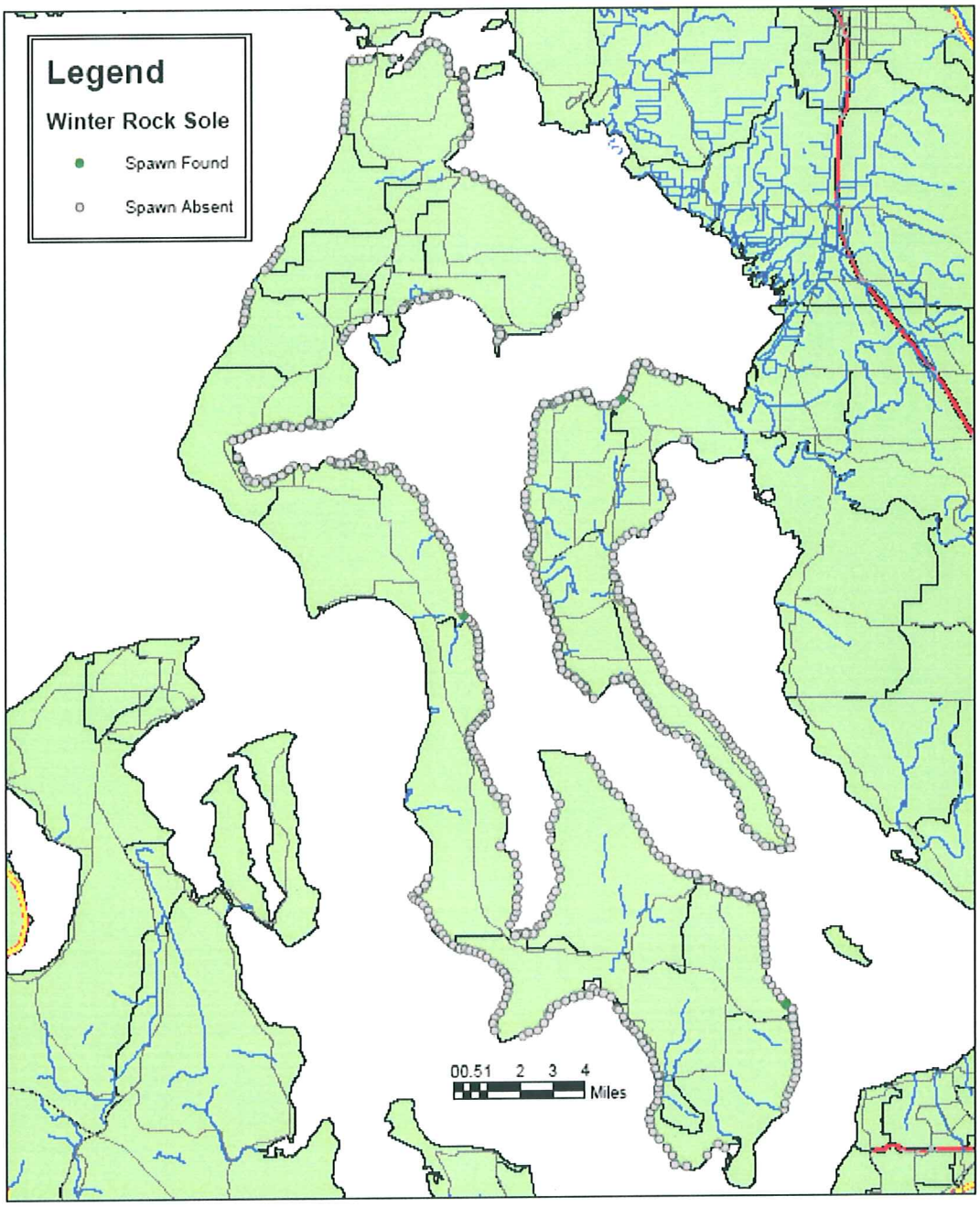
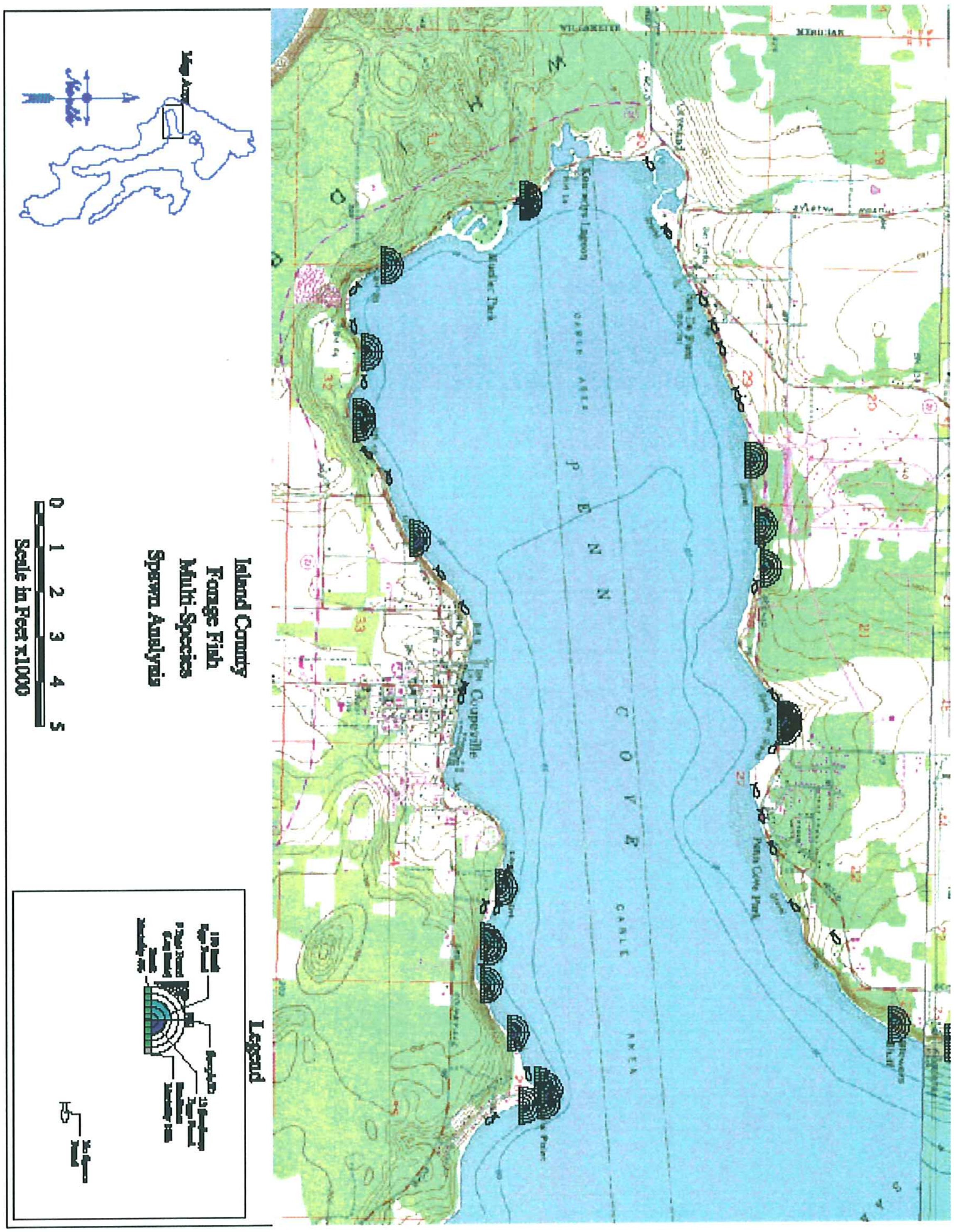
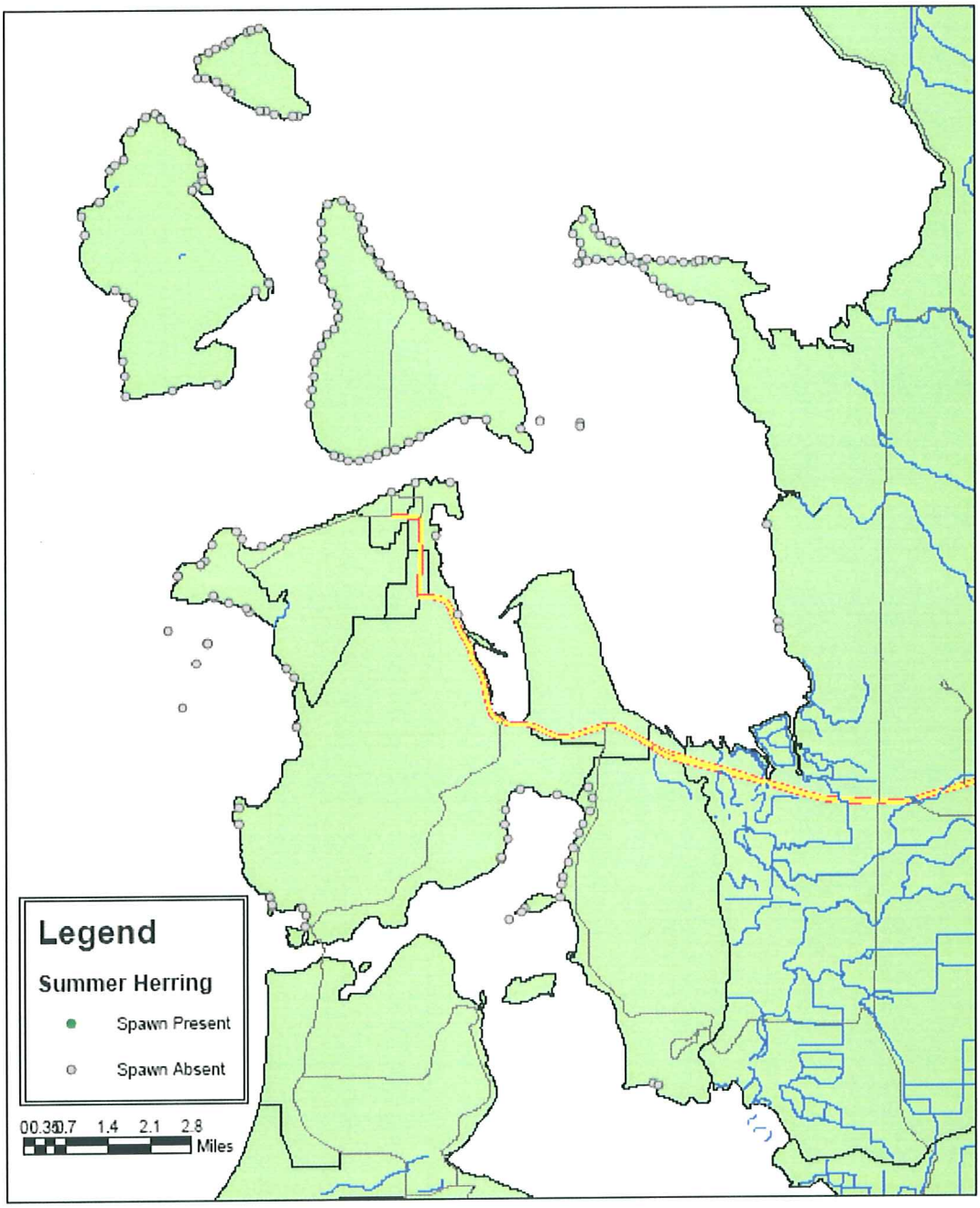
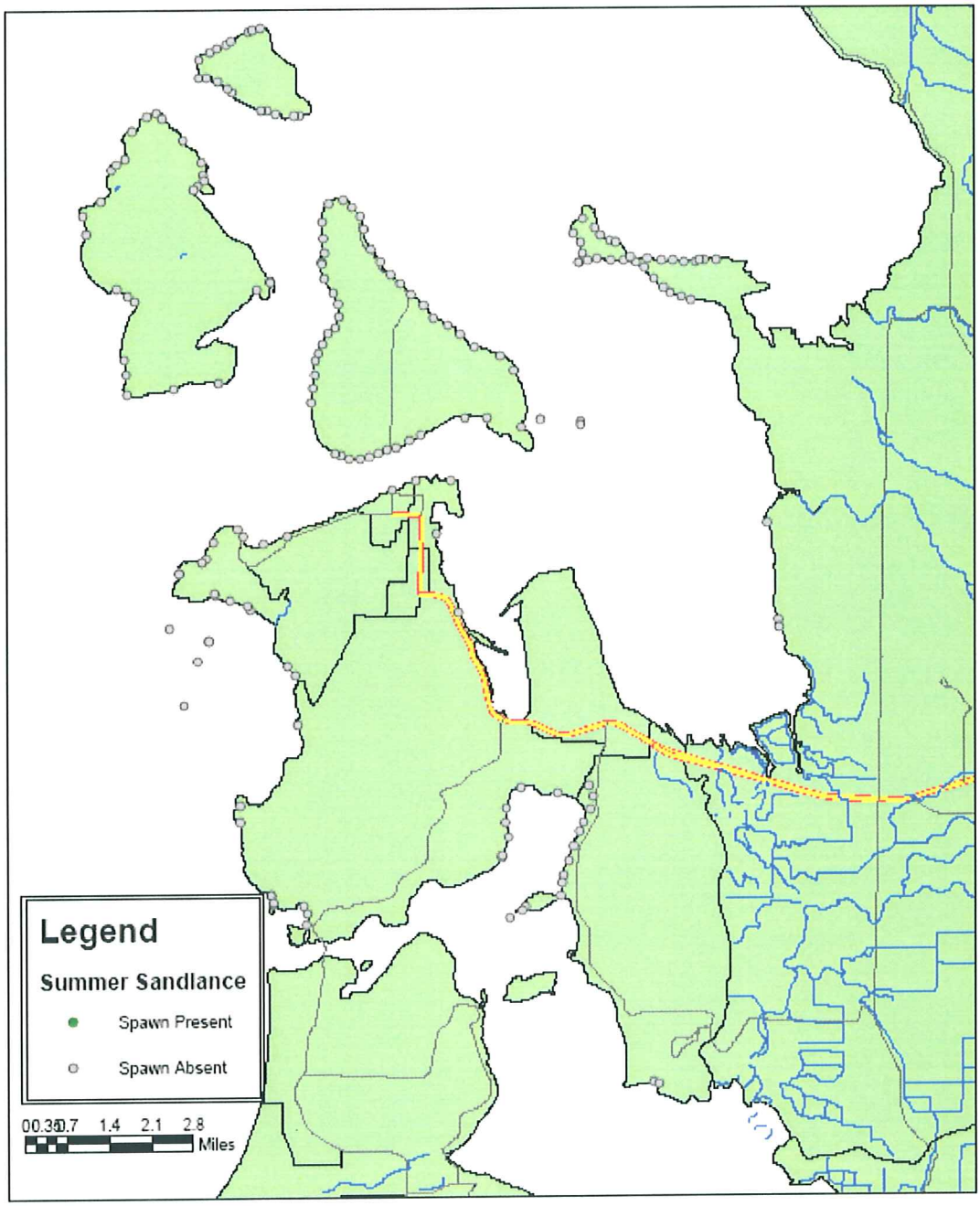


Island County Forage Fish

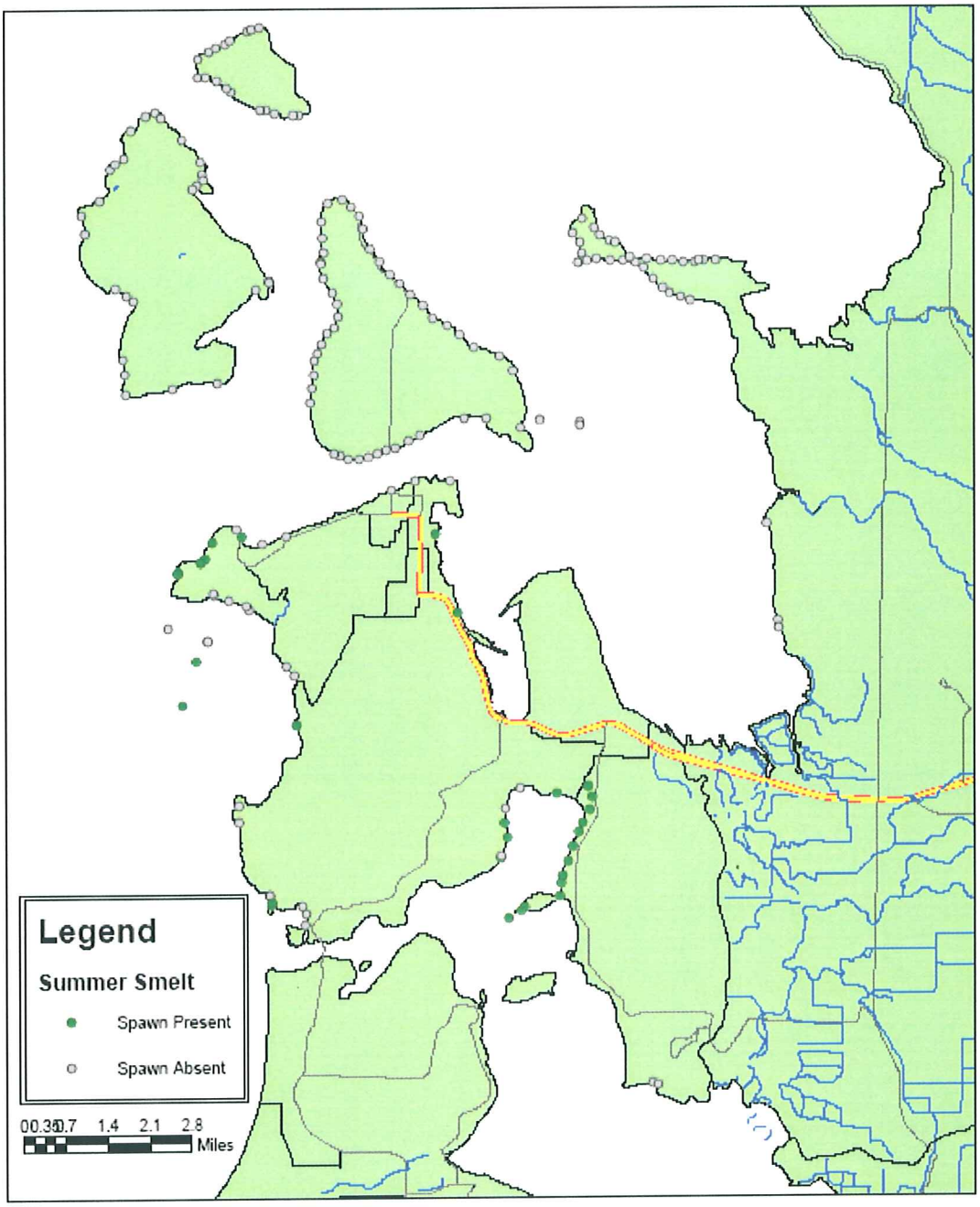

Island County
Forage Fish
Multi-Species
Spawn Analysis
0 1 2 3 4 5
Scale in Feet x1000
Legend
P E N N C O V E
Coupeville
Penn Cove Park



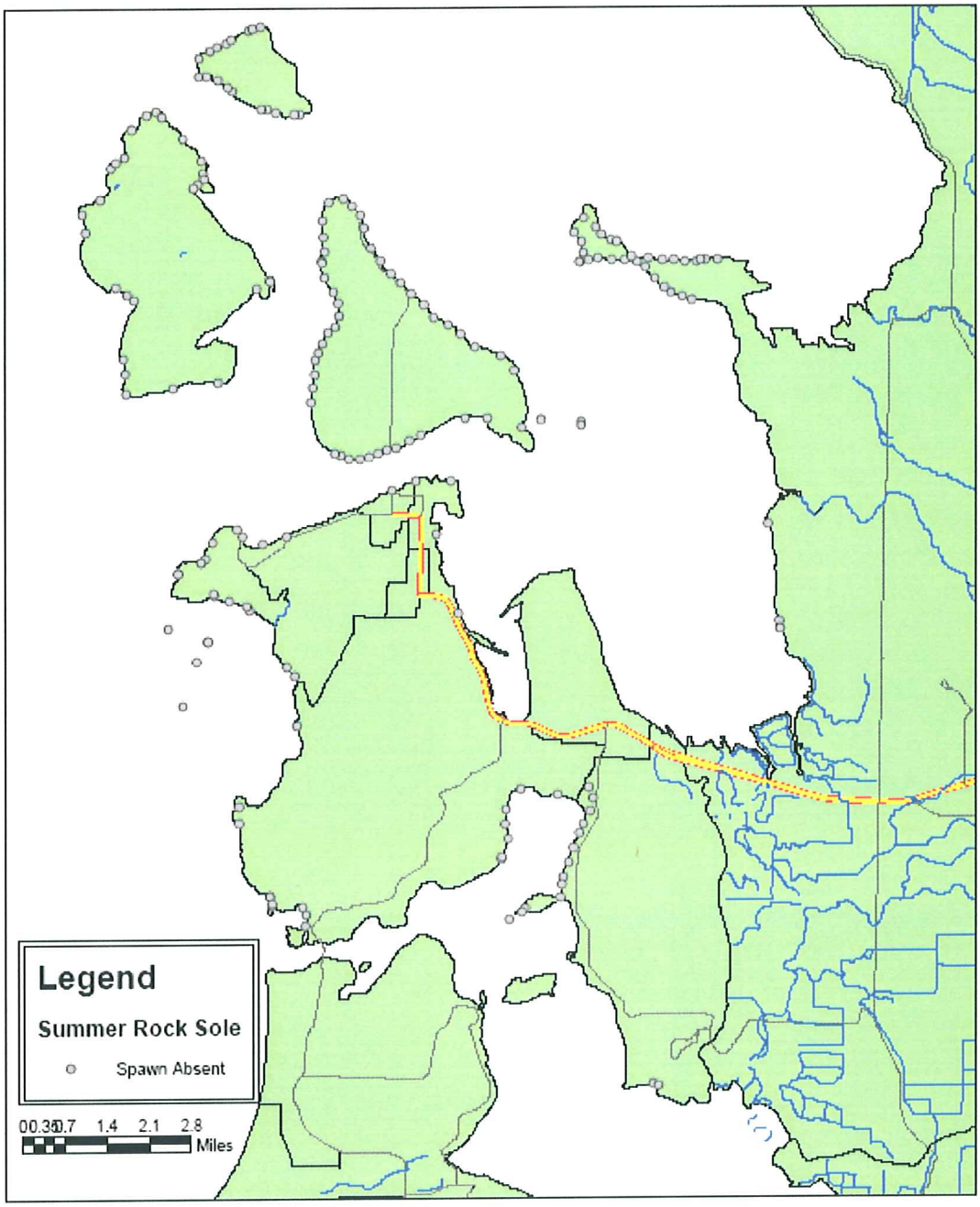
Skagit County Forage Fish



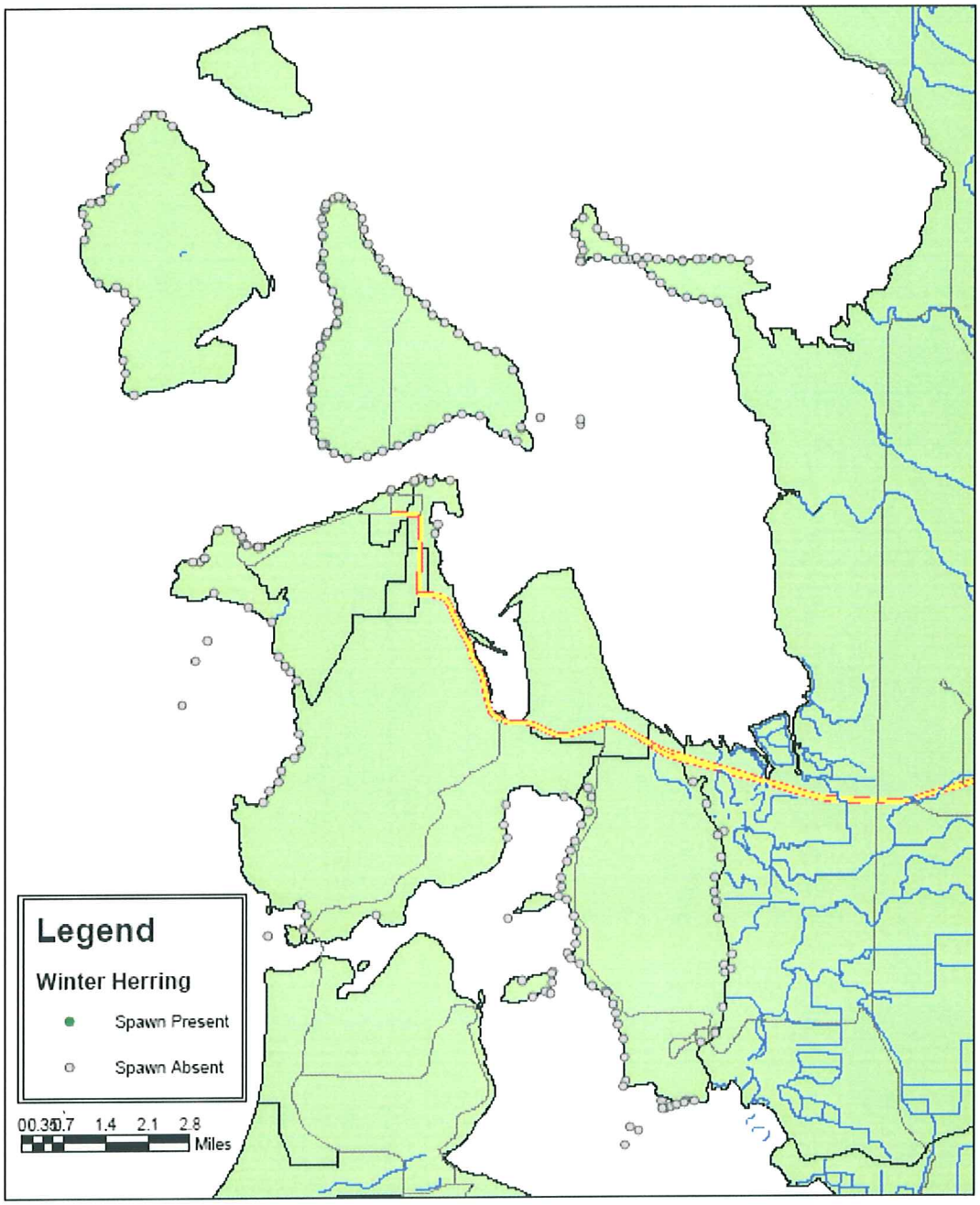
Skagit County Forage Fish



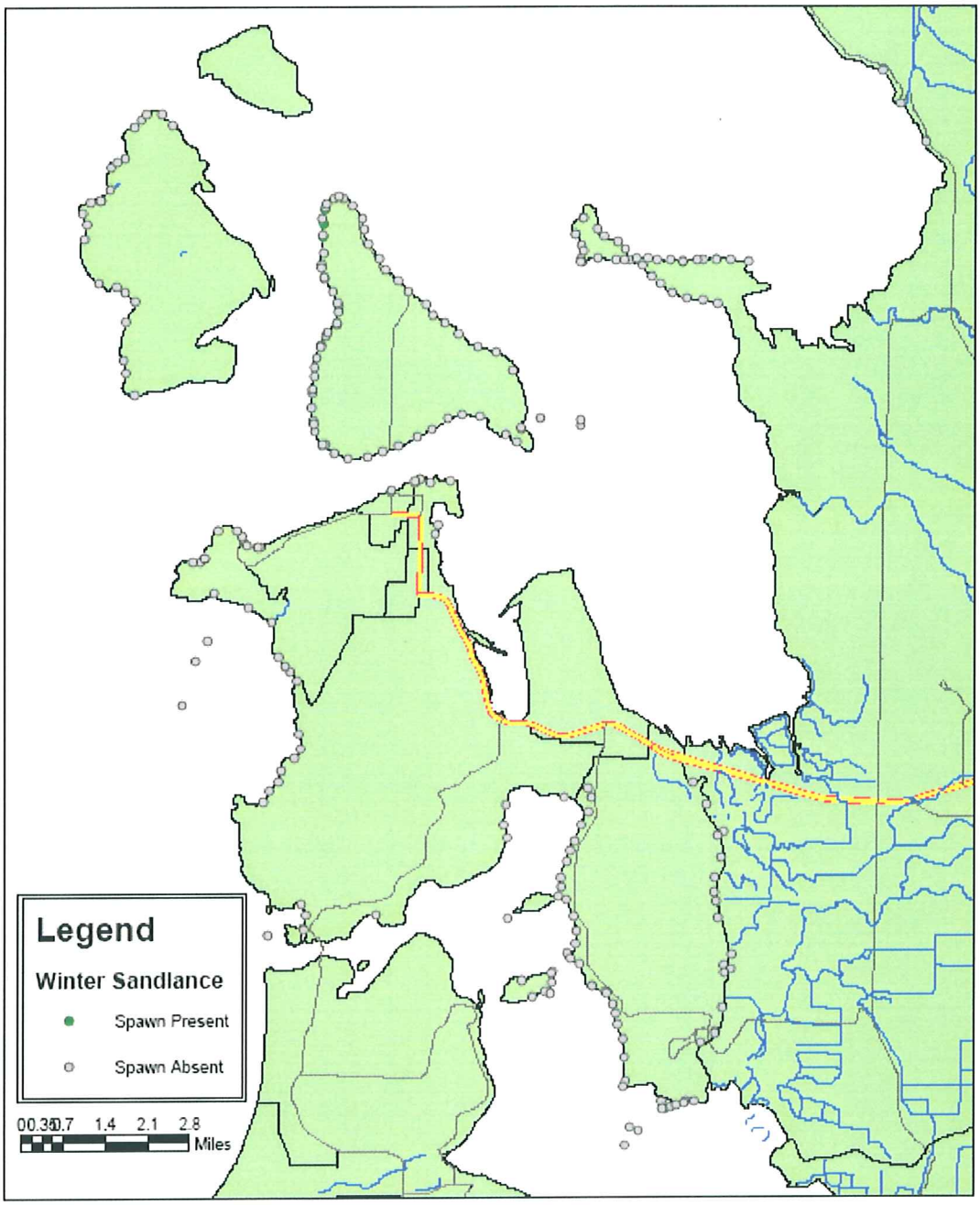
Skagit County Forage Fish



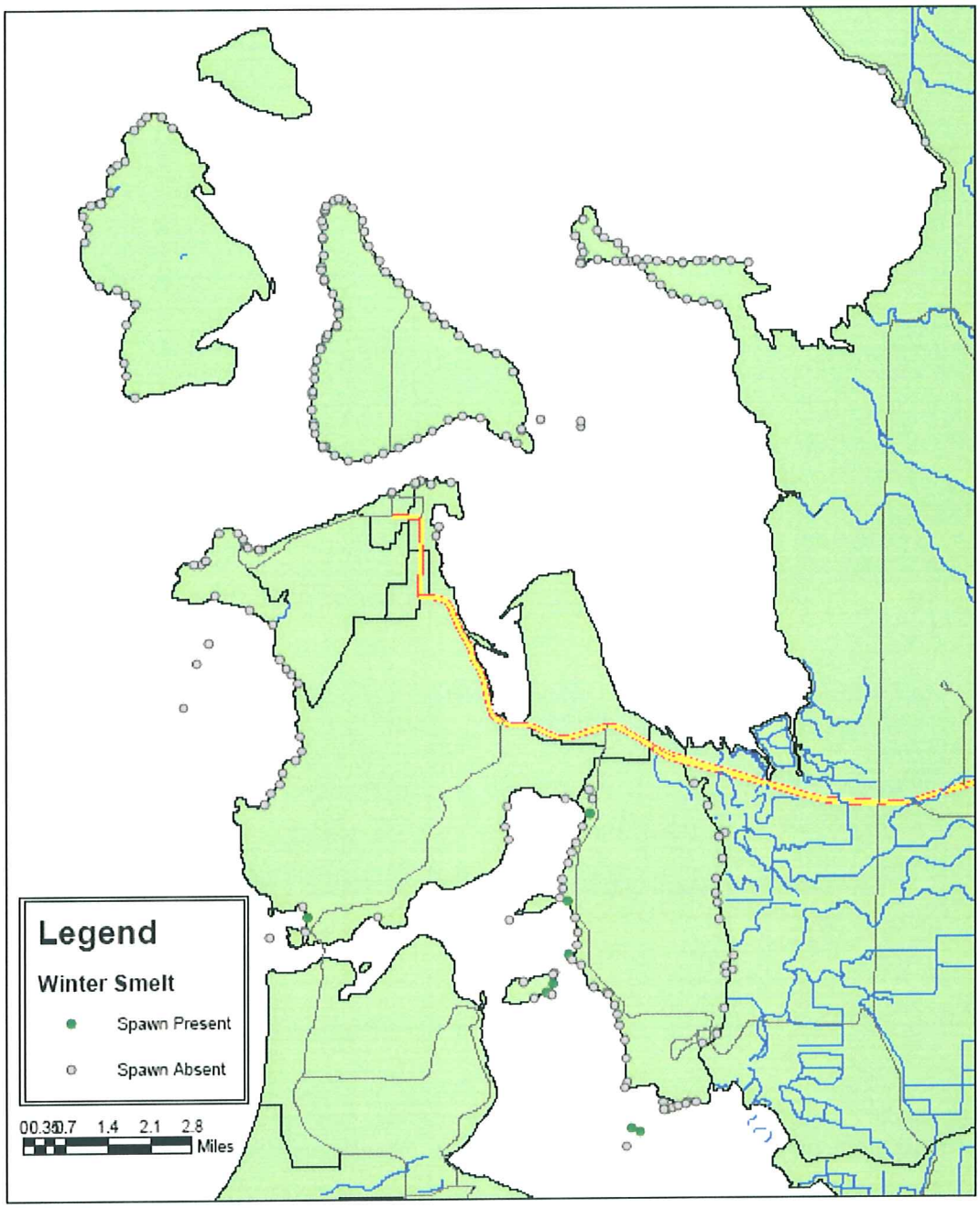
Skagit County Forage Fish



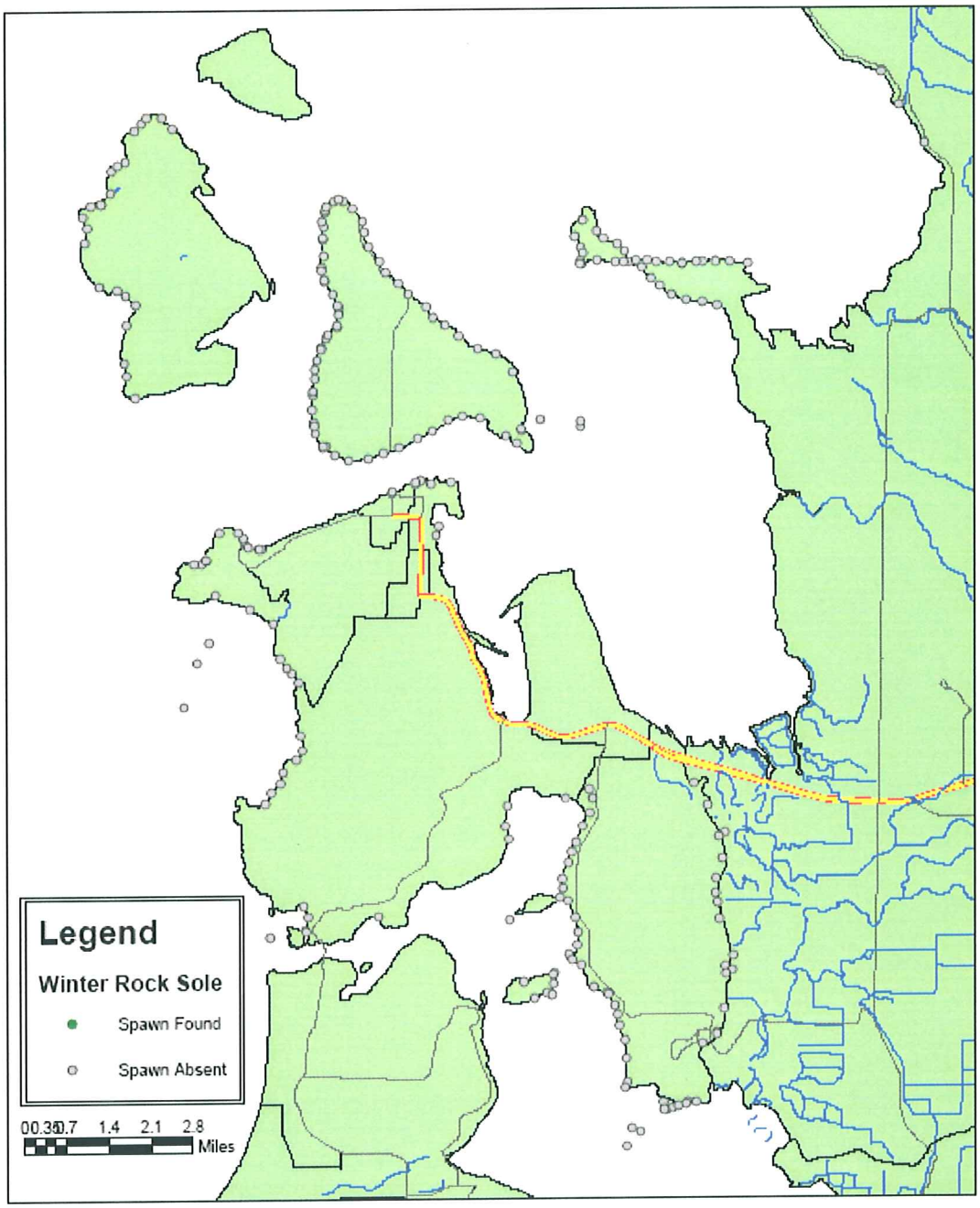
Skagit County Forage Fish



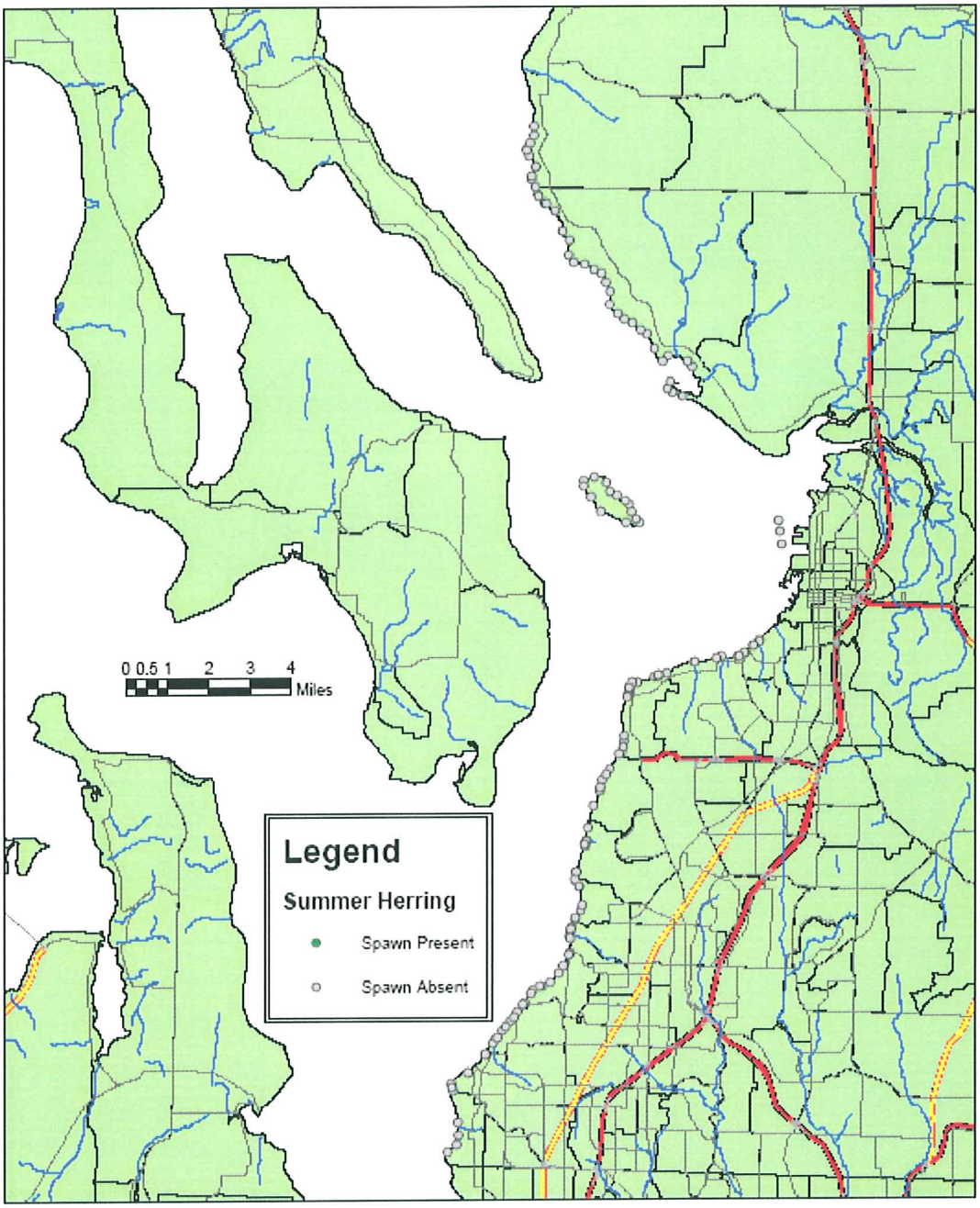
Skagit County Forage Fish



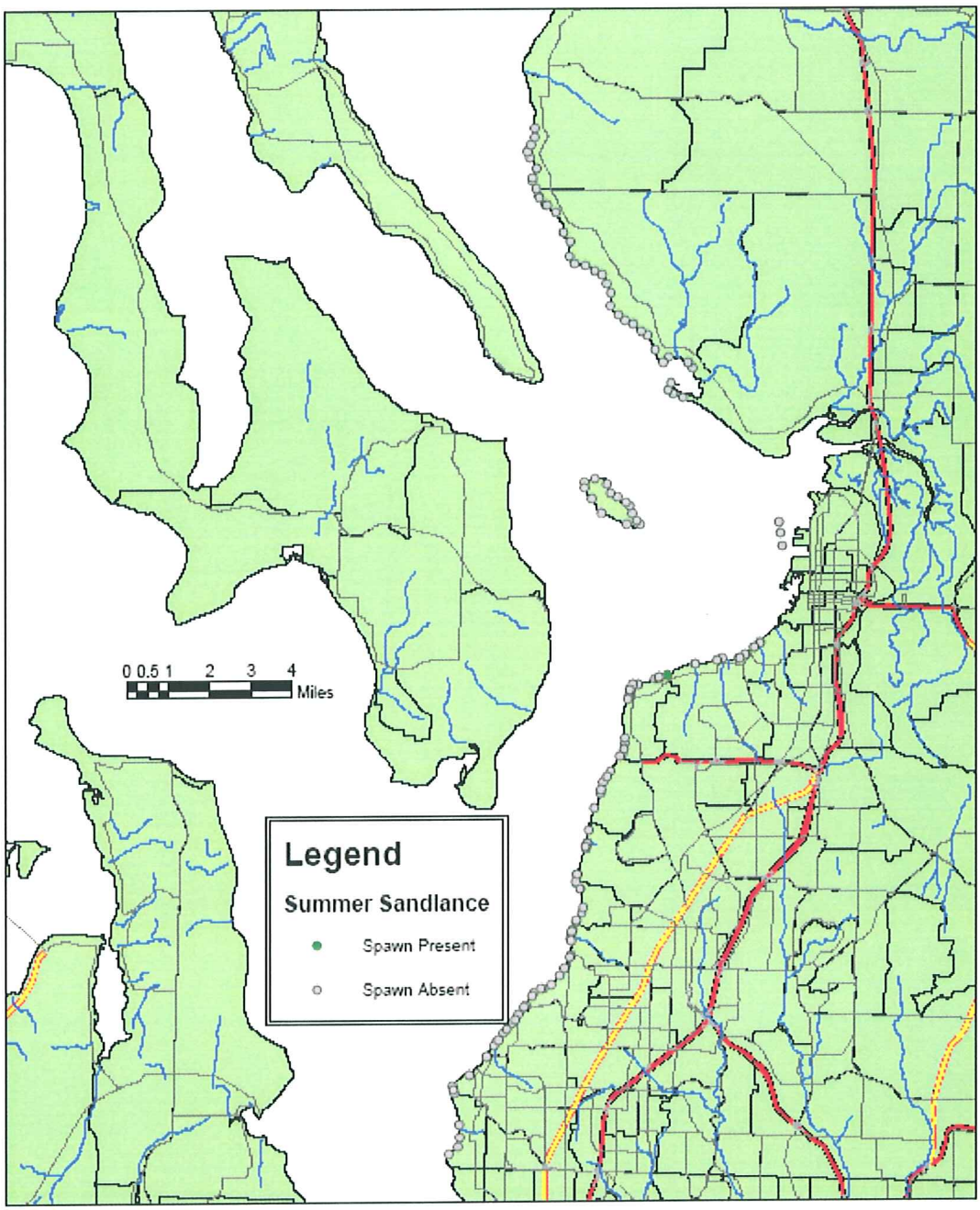
Skagit County Forage Fish



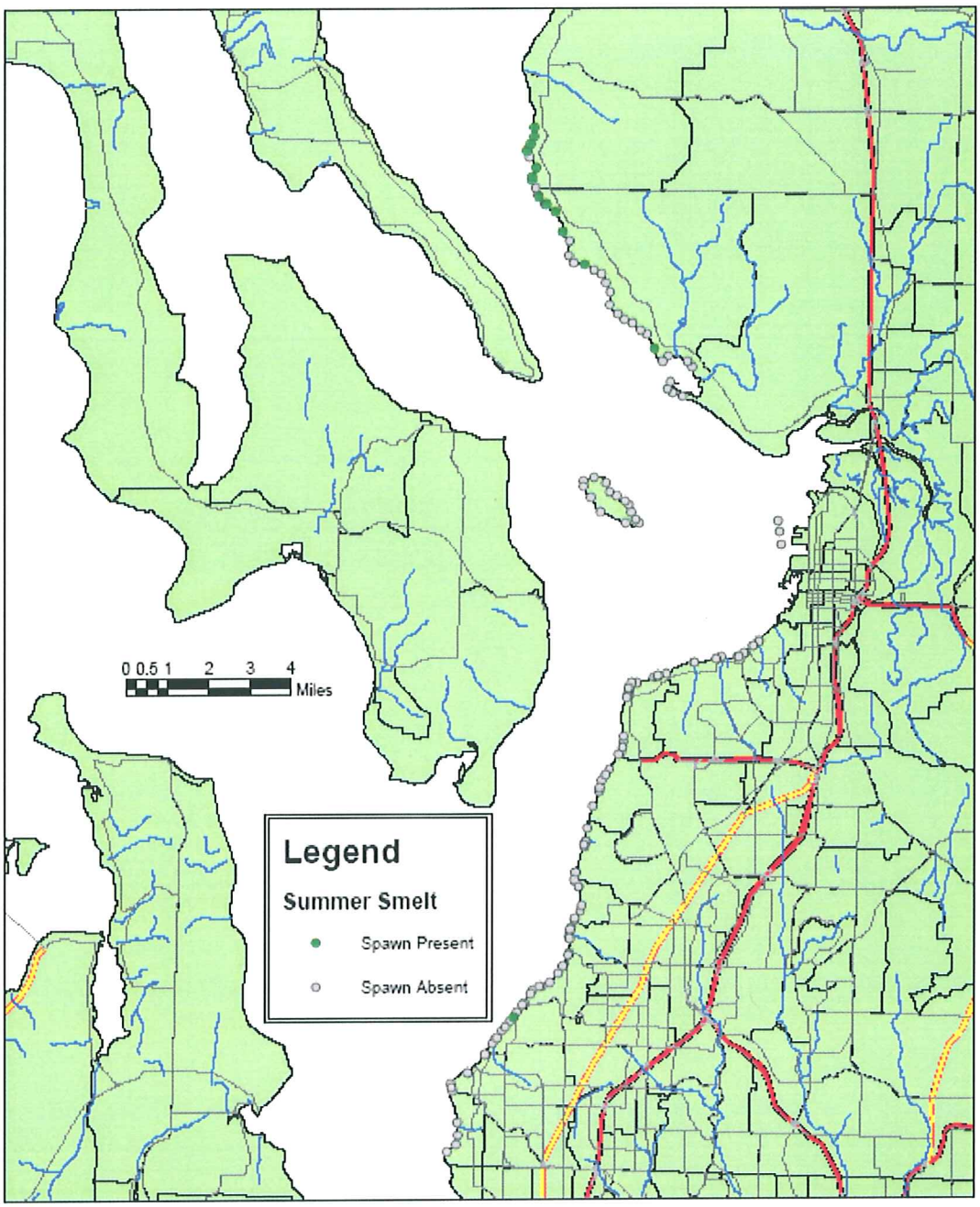
Skagit County Forage Fish



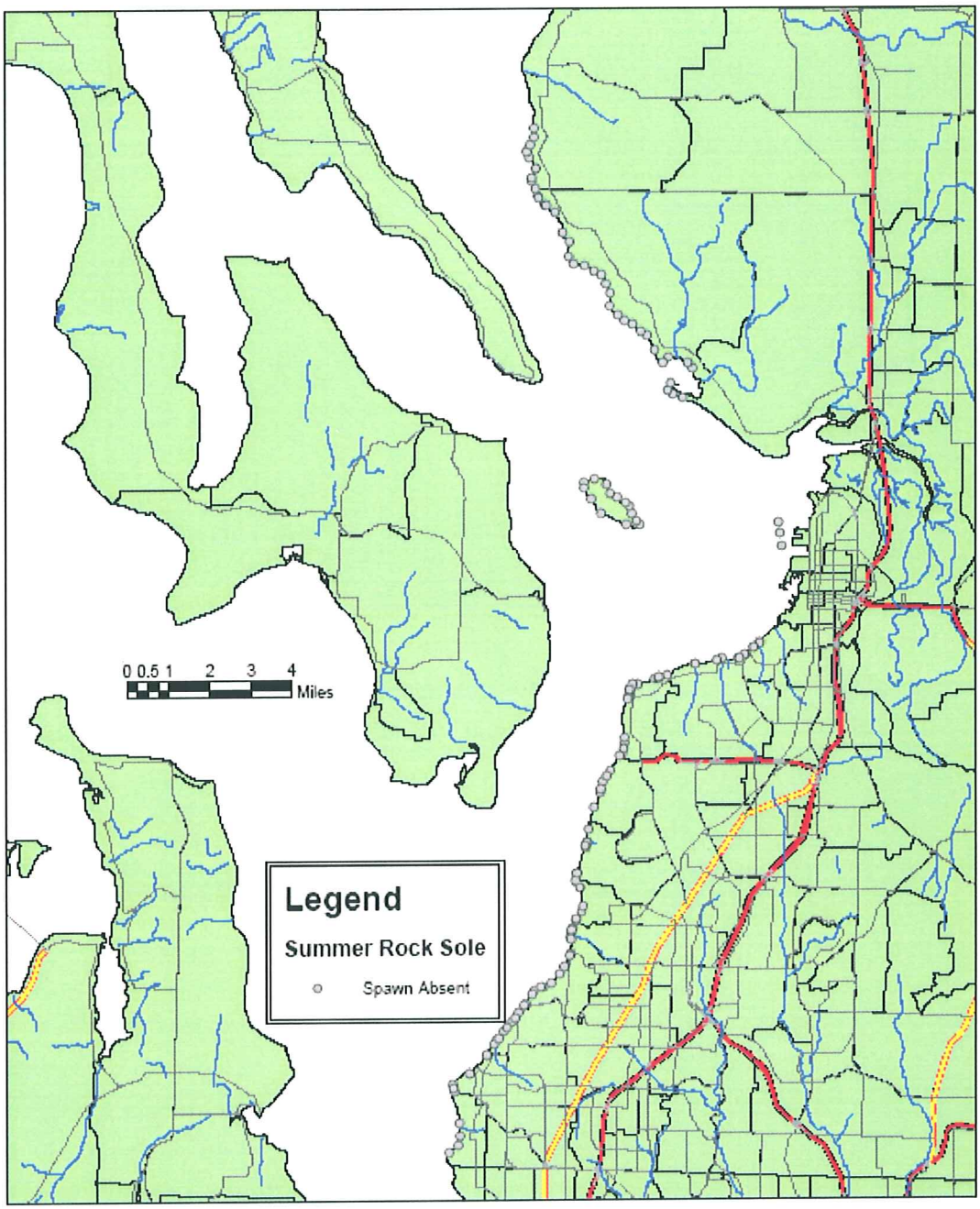
Snohomish County Forage Fish



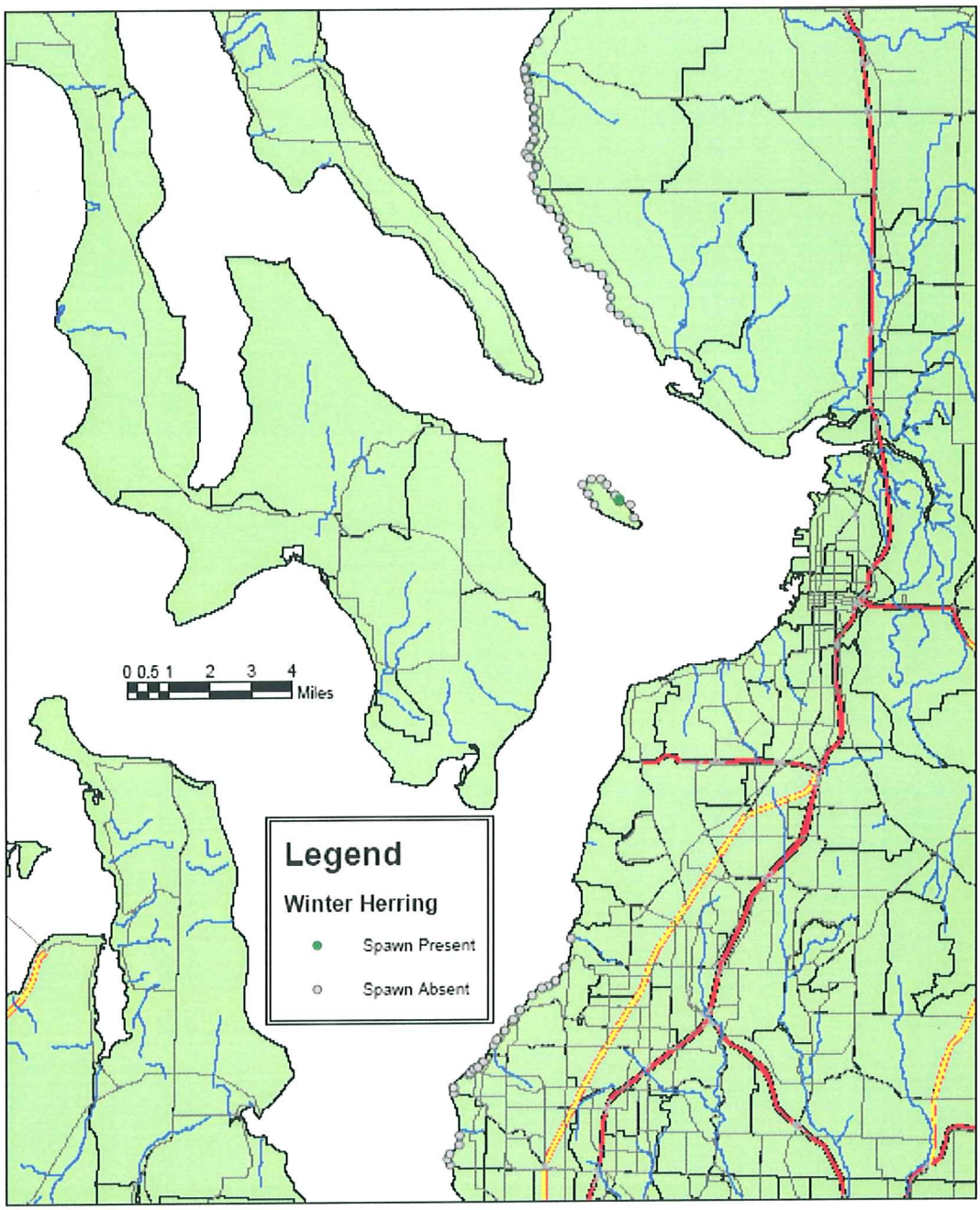
Snohomish County Forage Fish



Snohomish County Forage Fish



Snohomish County Forage Fish



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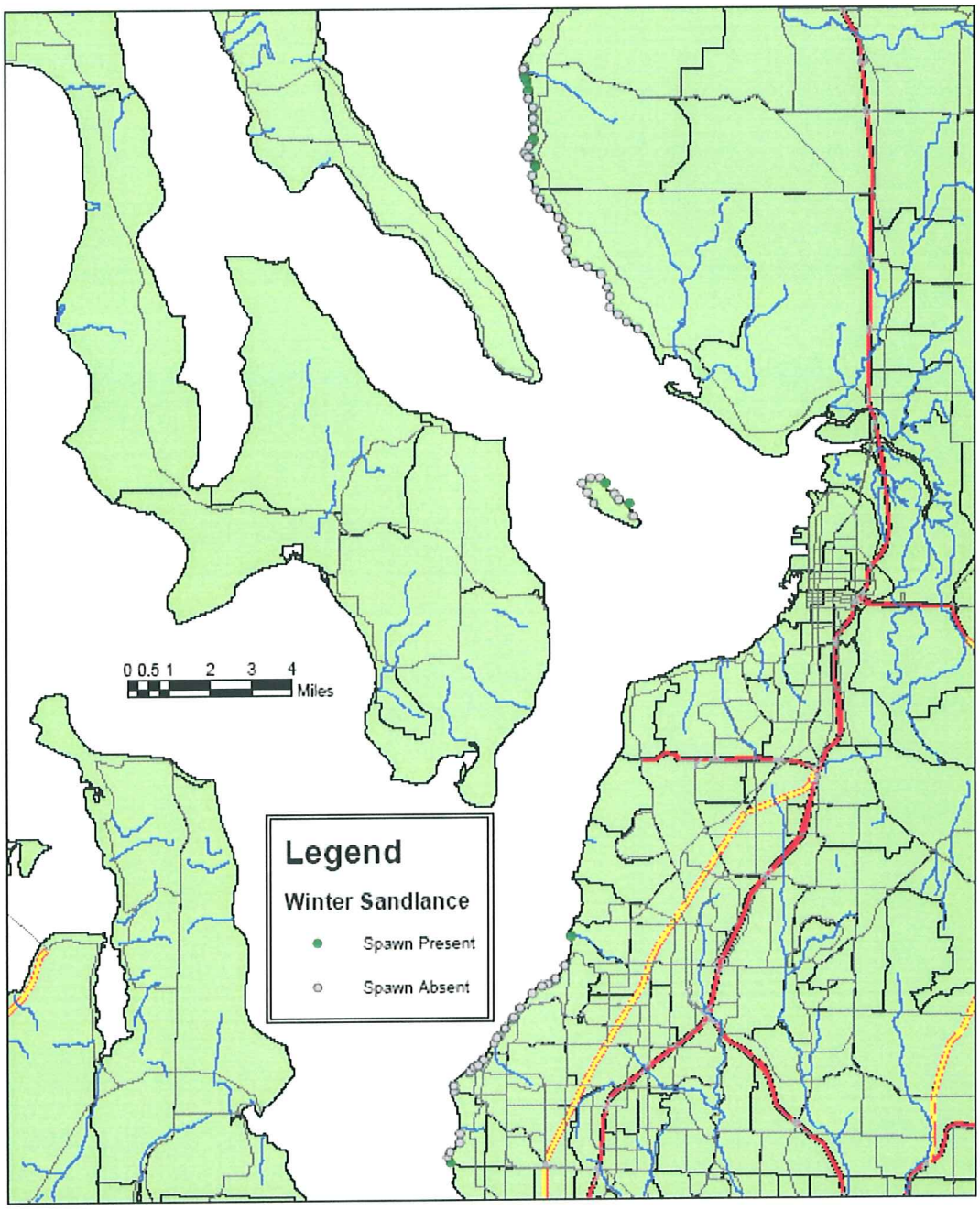
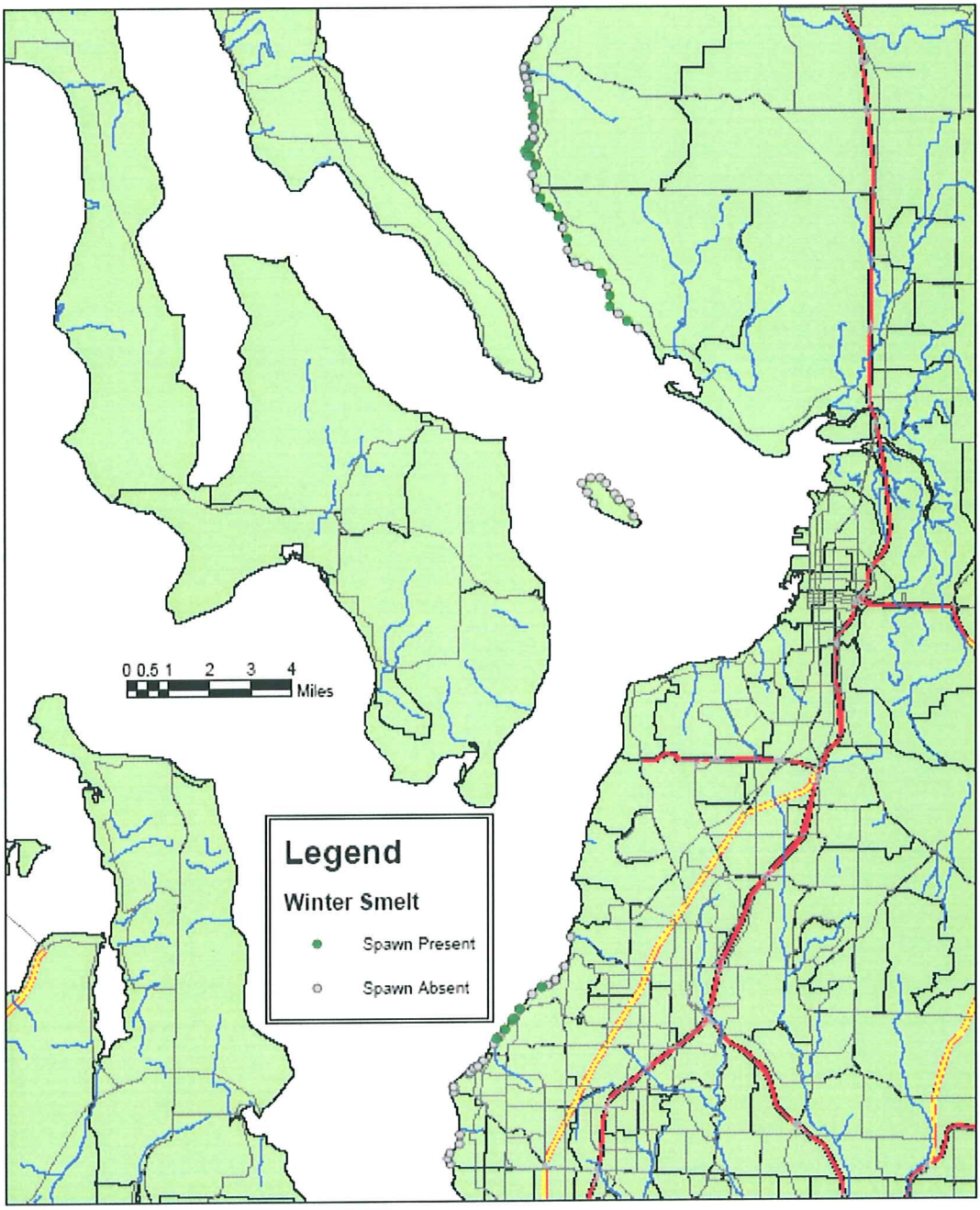
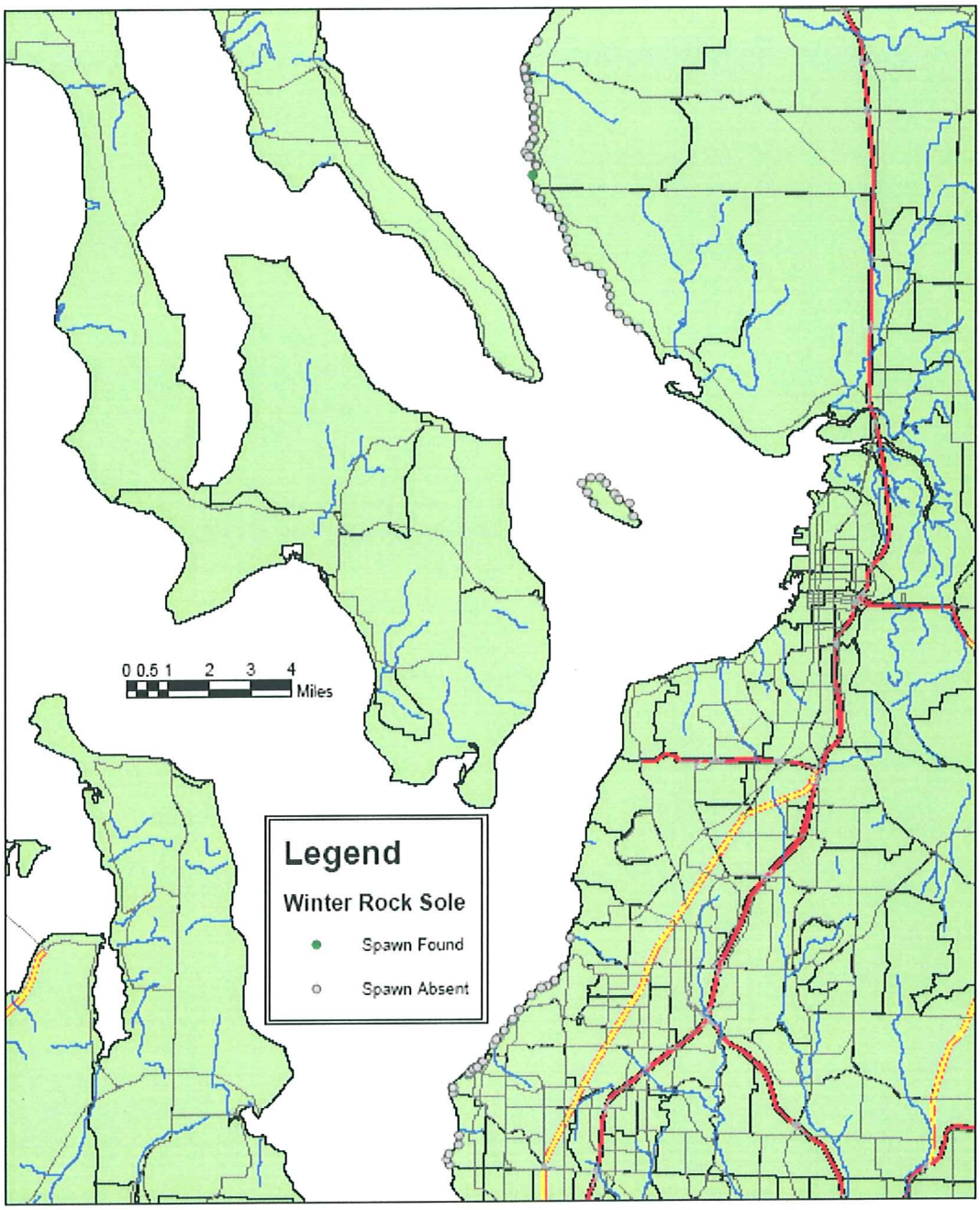


Snohomish County Forage Fish



Snohomish County Forage Fish



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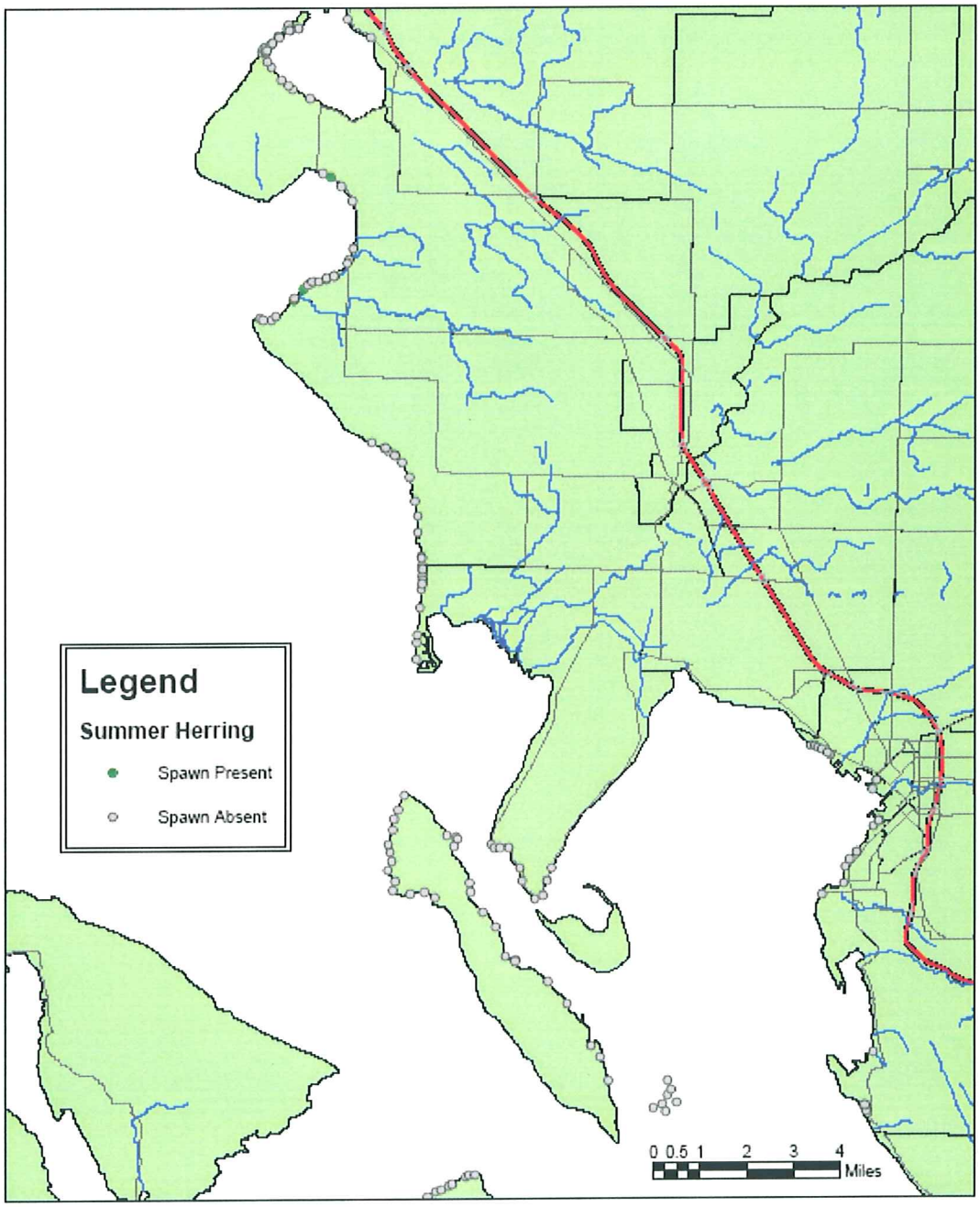

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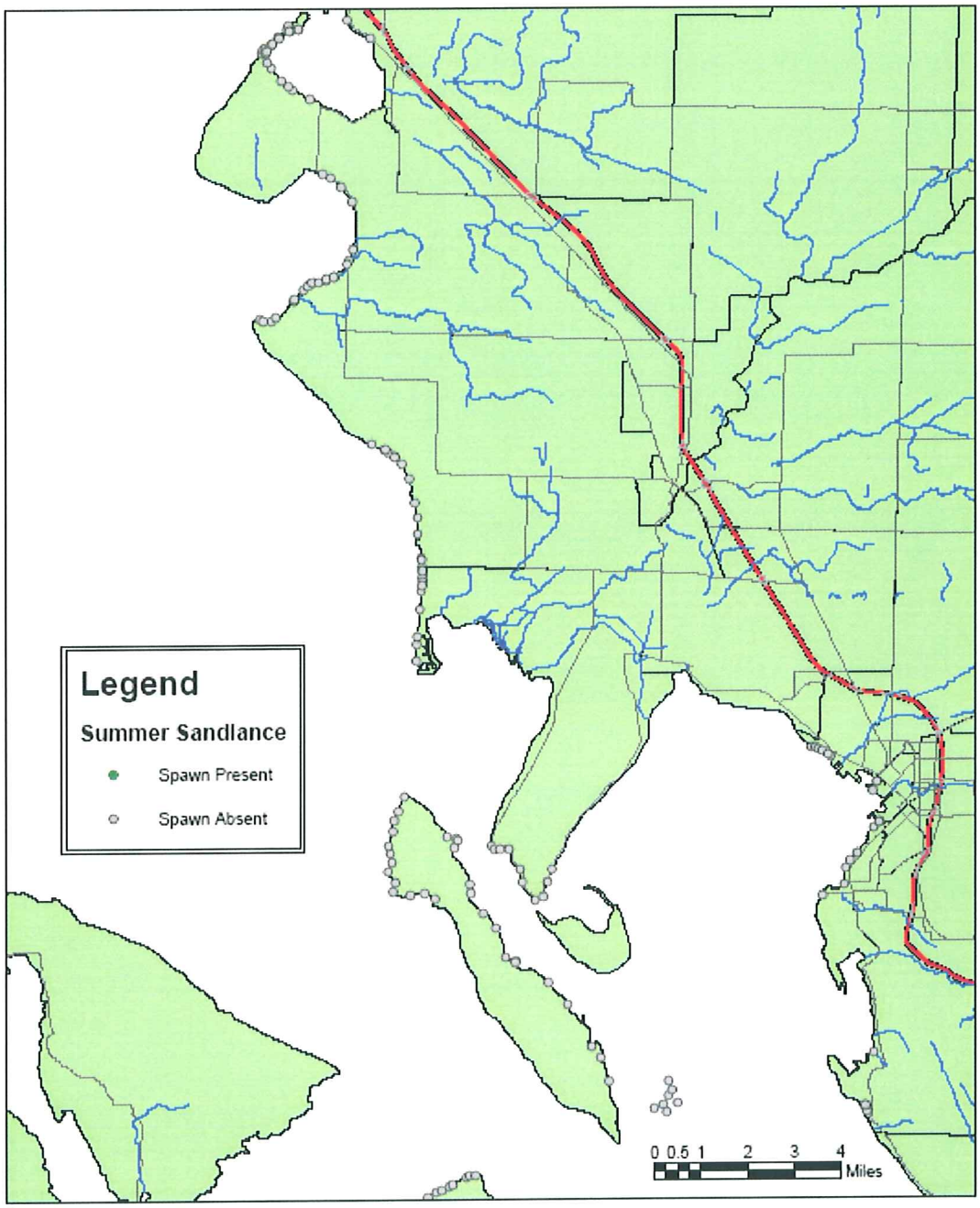

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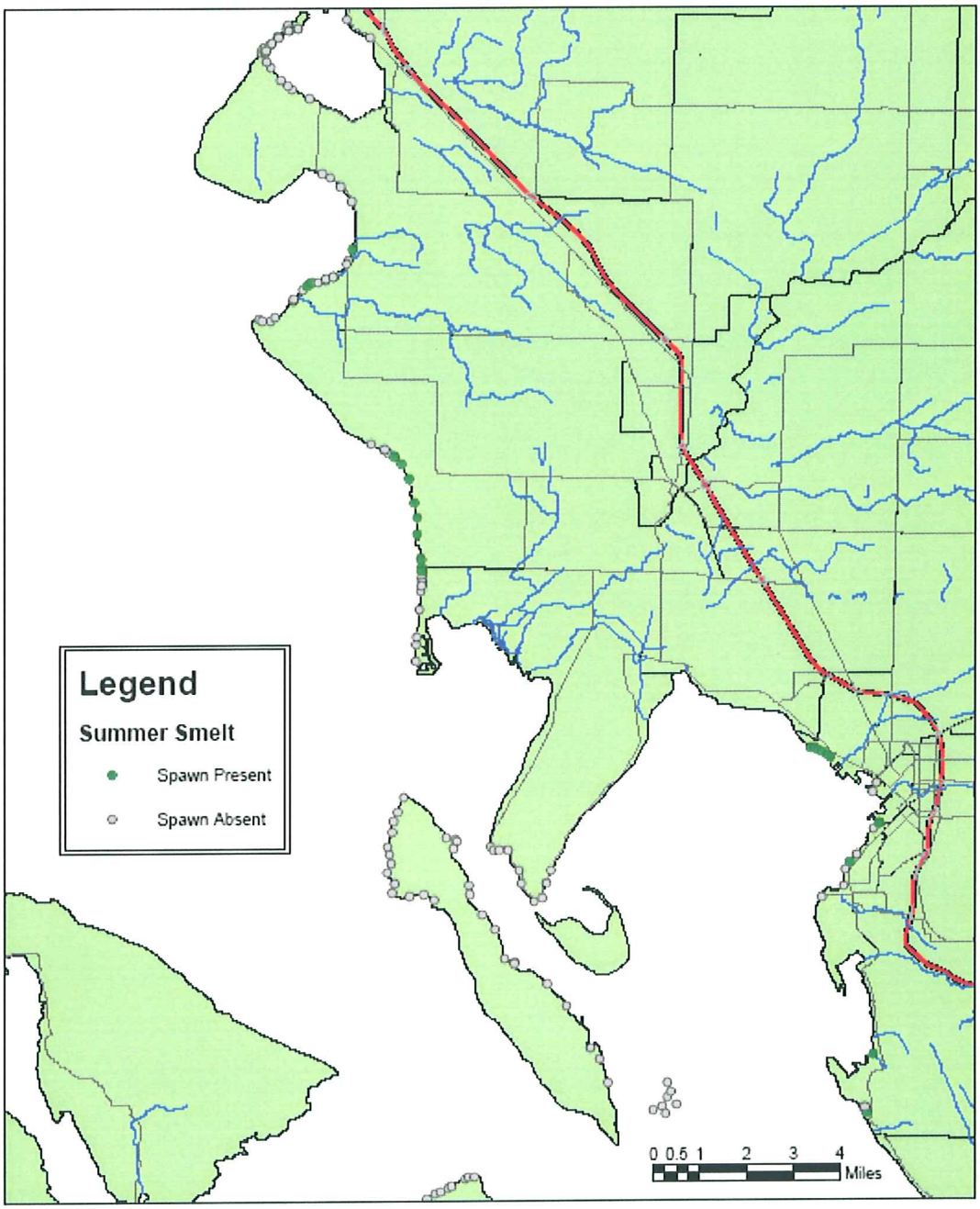

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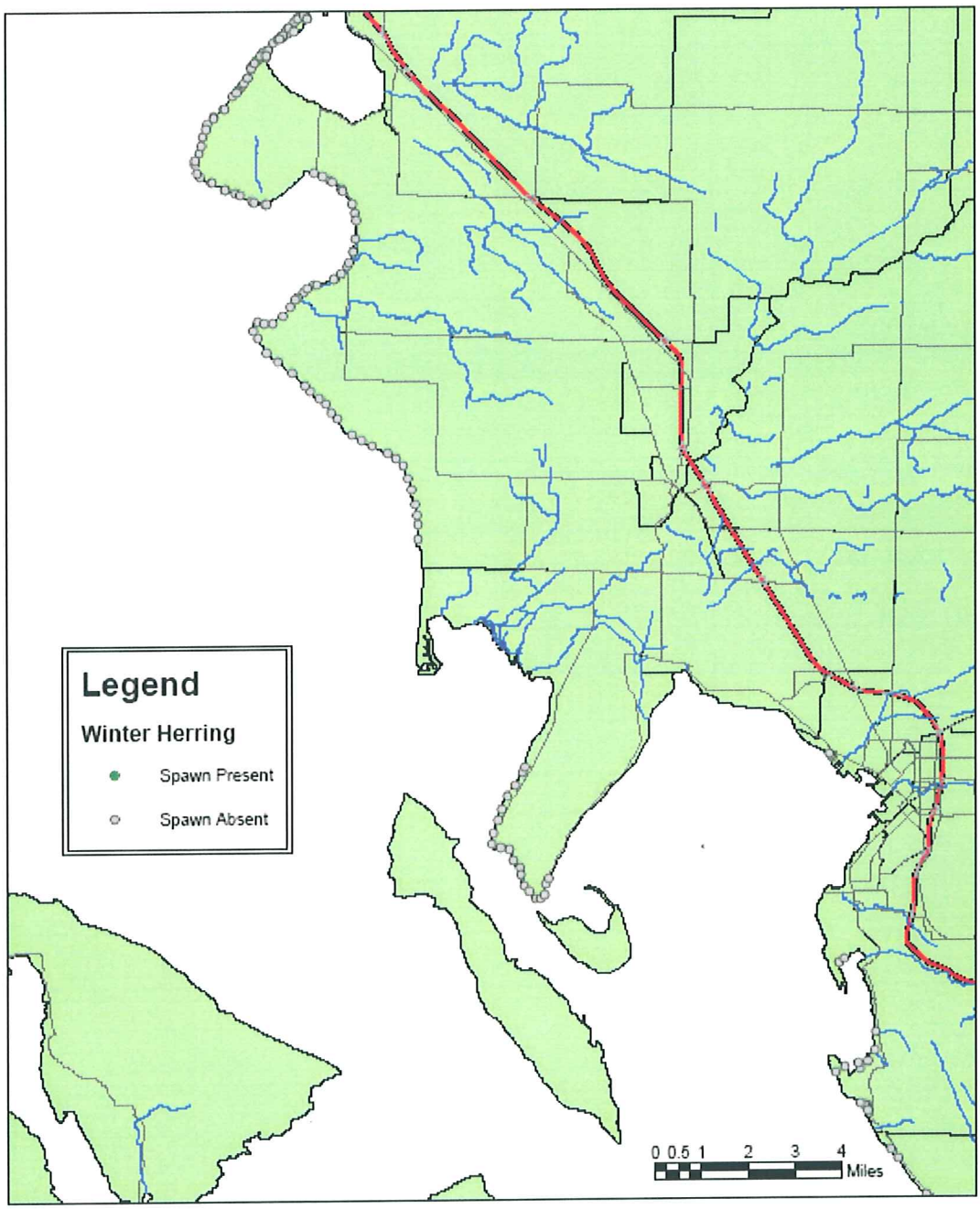

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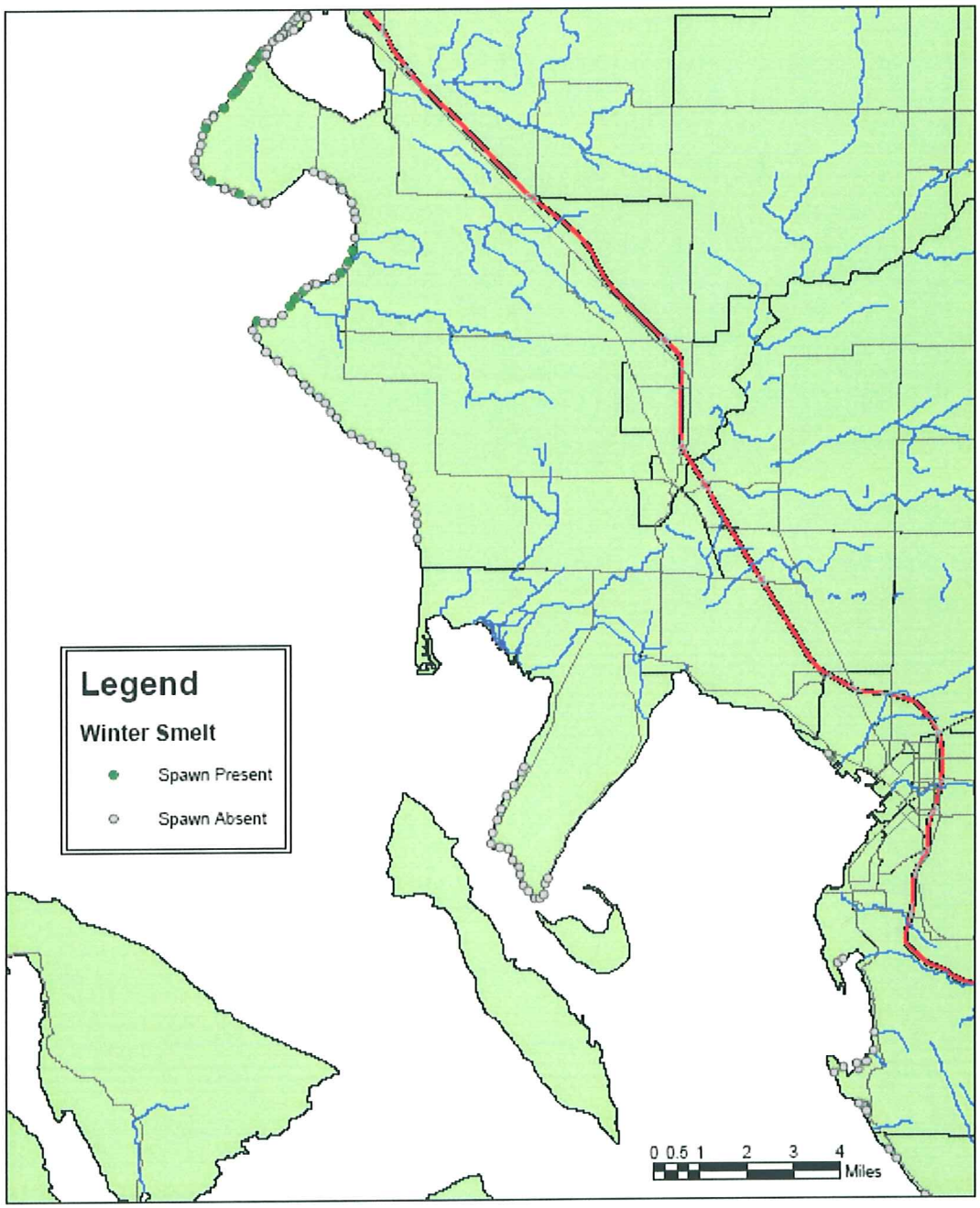

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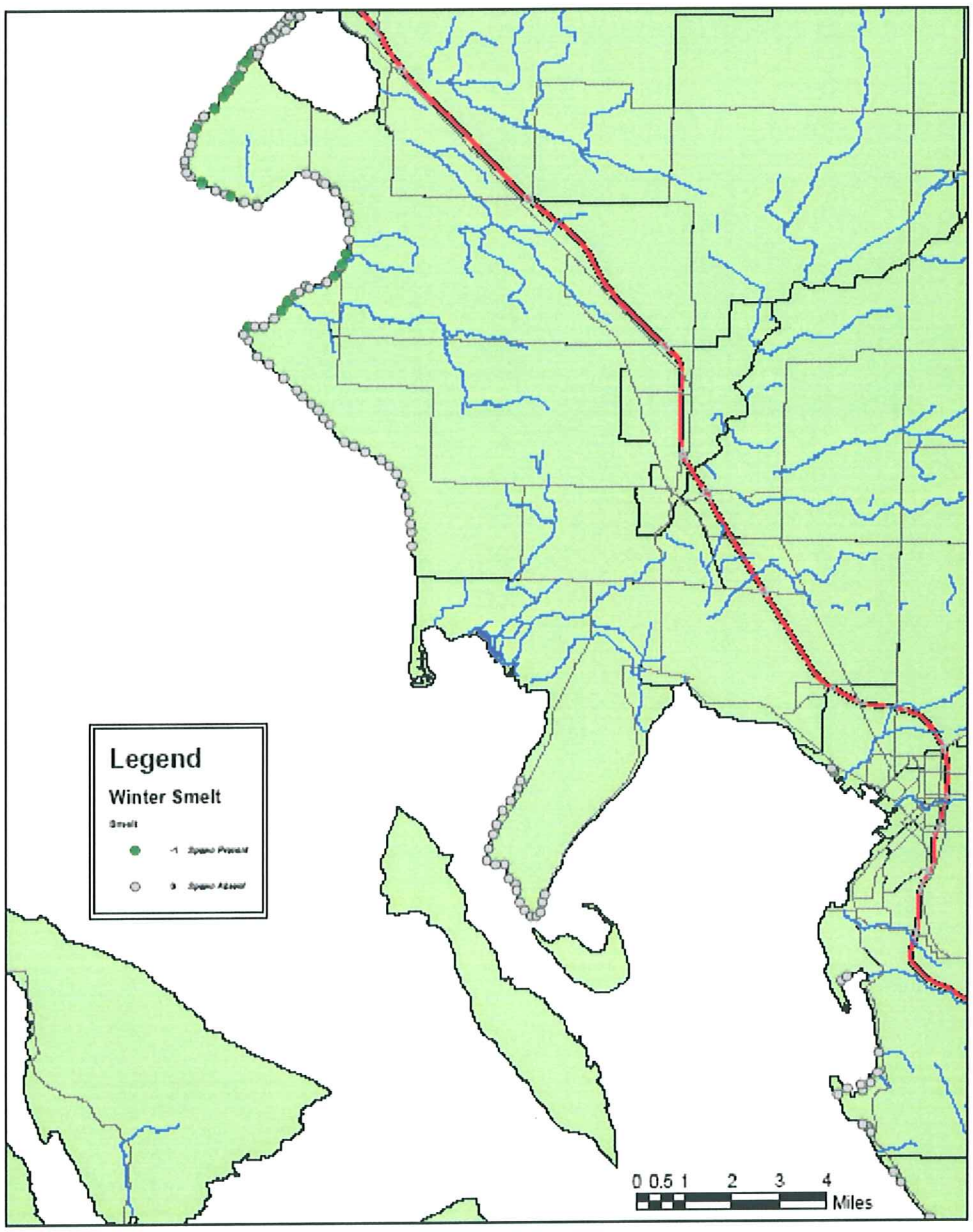

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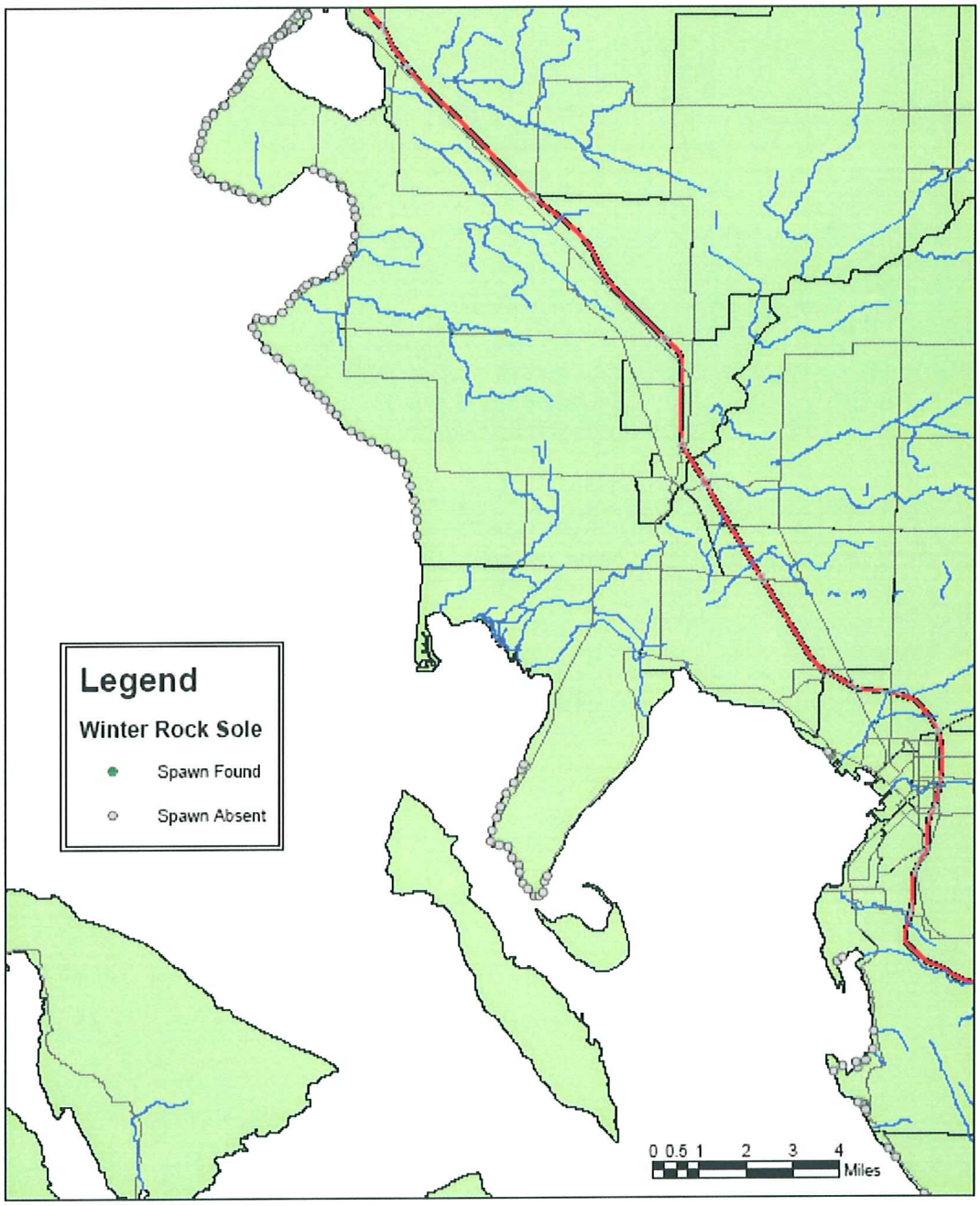

Whatcom County Forage Fish

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Assessment of Shoreline Spawning Habitats in the Northwest Straits (2001 - 2004)

Credits and Notes

Many people contributed to this project and deserve shared credit for these results: Doug Kelly for his GIS datasets and maps; Andrea Copping and **Washington Sea Grant** for the remarkable project poster (after page ten) displayed at the RAE and Puget Sound/Georgia Basin Research conferences; and Tom Cowan, **Northwest Straits Commission** director, for organizing the October, 2004, de-briefing; and Sasha Horst for her excellent summary.

Rep. Rick Larsen and Senator Patty Murphy are remembered for their steadfast support of the project's many grant applications. Mike Ramsey, Tara Galuska and the **Salmon Recovery Funding Board** are thanked for that panel's courage and leadership in funding these assessments; together with Krystyna Wolniakowski, **National Fish and Wildlife Foundation**; and the **SeaDoc Society**.

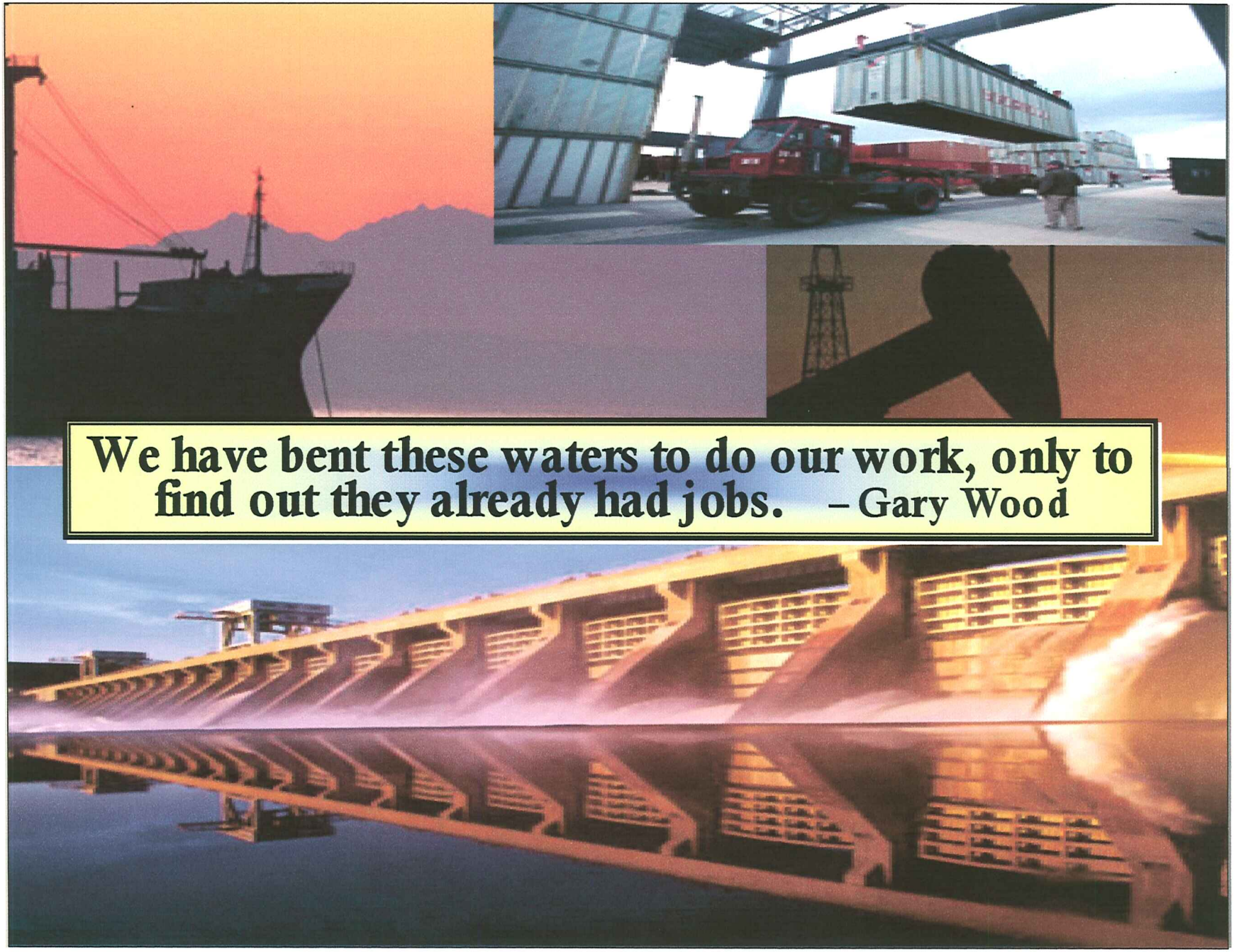
Over the years, Kevin Ranker, Stephanie Buffum and Tina Whitman of **Friends of the San Juans** were instrumental, assisted by Jim Slocomb in that county's effort. Norm Lemberg, then head of the **Washington Department of Fish and Wildlife's** LaConner office, was a critical partner in the complex agency-civilian partnership that this became.

The **WSU Beach Watchers** are thanked for their days and days of volunteered sample collection. Don Meehan's **WSU Extension** office provided constant support and staff assistance. The Whatcom County MRC deserves special recognition for the excellent video they had **Black Dog Productions** film about the project. All the MRCs played roles in this fine collaboration.

This final report was produced by the Island County MRC; cover design and report content by Gary Wood; protocols and final assessment narratives contributed by Dan Penttila. But the whole effort depended upon those hundreds of one-day sampling trips made by individual volunteers in many counties, just to get the science right.

Thank you all – look what you made possible.

February, 2005


We have bent these waters to do our work, only to find out they already had jobs. – Gary Wood