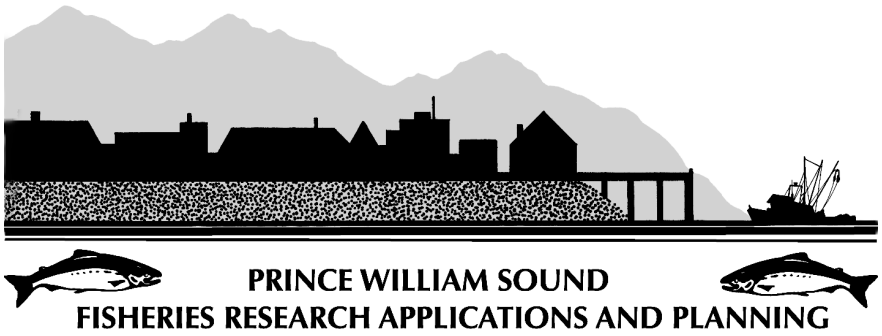

Annual Report

EVOS Project #060784
Ongoing Synthesis and Modeling Activites Restoring Injured Commercial Fisheries Services

NOAA Contract 50ABNF200060 mod 6
Implementing the Pink Salmon Survival Model: Phase 2

February 3, 2006 through January 15, 2007

prepared

September 2006

for

Exxon Valdez Oil Spill Trustee Council
and
Contracting Officer, Western Regional Acquisition Div., NOAA

by the Project Principal Investigators and the Collaborators of
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ANNUAL REPORT FY 2006 EVOS Project 060784

Project Data

Project Number:	060784
Project Title (EVOSTC):	Ongoing Synthesis and Modeling Activites Restoring Injured Commercial Fisheries Services
Project Title (NOAA):	Implementing the Pink Salmon Survival Model: Phase 2
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Report prepared by:	K. M. Adams C. R. Mullins E. V. Patrick

Project website:	`www.pwsfrap.org`
	For contractual and support information for this and prior years, select the link Status&Records or go to URL
	`http://www.pwsfrap.org/pwsfrap/records/`

1. Work Performed

The work to be performed in this project is a revised continuation of the work begun under the predecessor project, EVOS Project 050757. The objective of both has been to bring together (coordinate) the monitoring and modeling infrastructure currently sustained and in service in Prince William Sound with the previously developed, independently maintained, but locally unutilized capabilities for the representation and numerical simulation of pink salmon fry during outmigration. Although the representation and numerical simulations describe diets, consumption, growth, and dispersal of fry and coupled species, it is the output scalar "fry survival" that gets most attention and hence the widely used nomenclature "pink salmon fry survival model."

There have always been multiple motivations for this project. While all are jointly compatible, each is largely distinct. We note three that have gotten the most attention.

The first of the three is one instance of a larger and older topic in ecology. The method of representation used for the juvenile pink salmon ecosystem was an adaptation of the methods used for coupled, distributed physical systems and in recent years for planktonic systems. This moved the use of such methods one level higher in the trophic web. If effective, this use contributes to the goal of ecology more like other sciences, one based on testable theory. (See page 11 of the revised proposal [AM05]; see page 2 of the Introduction [PMW$^+$06][`www.cfims.org/psfrybksmplr/Intro.pdf`].)

The second motivation is the manner in which this model and any model functions as a synthesis of empirical observations, synthesis in the sense that a weather model provides a synthesis of data from a network of meteorological monitoring stations. If effective, the model "lifts" isolated observations into a system context. This is one way to make precise the meaning of "monitor recovery" identified as a part common to every one of the three and four part restoration strategies of the 1994 Restoration Plan [EVO94][p36–37], the monitoring of the consequences of an active or a natural recovery strategy.

The third motivation is the use of the model to improve the effectiveness or efficiency of the pink salmon fishery. Because there were effectively only two fisheries in Prince William Sound (PWS), the avenues to address commercial fishing in PWS as an injured service were primarily restoration of Pacific herring and enhancement where possible of the one surviving fishery. In this context, the model, if combined with an adequately robust observing infrastructure and marking program, offered the potential for an end-of-season estimate of outmigration survival of pink salmon fry.

The initial design of the project had been based on the first two motivations as priorities, with the third a supporting factor. By mid-year, it was clear that a change was needed, that the programmatic emphasis was on the second and third motivations with the first largely irrelevant. For a period during 2005, the effort lost focus. The collaborators are indebted to the Science and Technology Advisory Committee (STAC), the Public Advisory Committee (PAC), the Council, and especially the staff for their guidance and assistance in constructing the revised course of the current project. This assistance had consequences beyond the immediate questions of that period. The results described in this report would not have been achieved without the revisions and additions that were created through the dialogue, reviews, and responses that began in June and concluded with the submission of the revised proposal on September 14, 2005.

The revisions were two-fold. First, the objectives were refocused. Performance evaluation would be in terms of *a*) contributions to synthesis of past and present data and *b*) contributions to improved capabilities or resources for commercial fishing as an injured service. Second, the methods were revised to have the work done in-region. Three task areas—*1) coordination with operational*

observing programs, *2) revival and recovery of the pink salmon fry technology*, and *3) fusion of the two*—became five with the addition of *4) relocation of collaborating expertise to Cordova* and *5) addition of infrastructure needed to conduct the work locally*.

In §1.1 Tasks, the work performed is described chronologically. A review of the results from that effort appears in §1.2 Results. Because of the nature of the project, activities addressing coordination and collaboration, community involvement, and information transfer were integral rather than supplemental. Consequently, these will be covered in this section as well as in separate sections of this report.

This is a mid-course report. It describes work completed and also work scheduled for the remaining 3.5 months of the project.

1.1 Tasks

The revised proposal was approved for funding by the Trustee Council in November 2005. Shortly thereafter, the project was advised that a loss of staff in the contracting office precluded award of the contract until sometime in 2006.[1] This notice brought to the forefront one aspect of the revised proposal that had not been fully appreciated. The revised design involved initial, up-front financial expenditures by the project. The absence of an award placed the requisite expenditures beyond previously planned resources for the project. As a consequence, in early December the decision was made to suspend all activities regarding relocation. Project tasks and schedules were reconfigured to accommodate continuing for several months in place and with existing off-site resources and additional infrastructure ordered and arriving prior to the notice of the delayed award.

At the time of the approval of funding, the Council and the Public Advisory Committee made note of the science plan that had shortly before been released by the North Pacific Research Board (NPRB) and of the pending deadline for submissions of papers and posters for the symposium Marine Science in Alaska 2006. We reviewed the new science plan and found that two of its primary features were things about which we had significant prior experience. The NPRB's concept of an Integrated Ecosystem Research Plan was close to that of the Sound Ecosystem Assessment plan and the NPRB's focus on post-program relevance, utility, and benefits to a region as the motivation, justification and assessment criteria for the program had been the focus of PWSFRAP from the beginning. However, the NPRP science plan did not address the question of how successful research was to deliver or the post-program outcomes that were the stated criteria for programmatic success. We developed and submitted a poster that defined this "post-IERP problem" and the need to include solutions within the science plan itself and within the plan and budget of the research program. (See Appendix 2.) In addition, we completed a significant fraction of what was to be a project proposal to NPRB on this topic. There was much that had been learned on this topic over a period of more than five years, and an effort was made to describe a project whereby that experience could be used to further develop the IERP concept. Although the task proved too much for the time available, the effort was a valuable preview for similar requirements that we addressed during 2006.

During December, a plan for the requisite infrastructure was developed and put into motion. The scope of the project objectives—one that ranges from simulation codes to requirements for the use of proprietary digital formats, from document exchanges across a large collaborative network to online graphic displays and information retrieval, all at minimum cost—was most readily addressed with

[1] The award date for the contract modification for this work is February 3, 2006.

multiple platforms. One platform would address the related requirements for compatibility with defacto standards and for compatibility with preferences among collaborators and stakeholders. Other platforms would be used for development and problem-solving. For this latter, the choices were driven by the goal of minimizing the introduction of overhead (systems administration time and costs, the need for duplication of past investments due to lost compatibility) associated with major changes from the resources used presently and from the resources used previously to produce the existing codes for the numerical solutions and simulations.

The starting point in the fall of 2005 was the pre-2006 on-site resources and the pre-2006 off-site resources. The second of these is described in some detail in the retrospective review in Appendix 1. The two tables below present a summary of the starting point defined by each.

TABLE 1.1.1

PRE-2006 ON-SITE INFRASTRUCTURE — UNION HALL OFFICE

item	primary function	service period	sponsor's cost & date
Apple imac, OS 9.1	documents, accounting, workshop transcripts, reports	2002–present	init. acq., 2002
Epson 5700i	laser printer (non-PostScript)	2002–present	init. acq., 2002

TABLE 1.1.2

PRE-2006 OFF-SITE INFRASTRUCTURE — INST. SYSTEMS RES., UMCP

item	primary function	service period	sponsor's cost & date
Sun UltraSPARC 10, Solaris 8	programming, shell scripts, technical documents (TEX), simulations, image manipulation, mapping (GMT), project management (AutoPLAN), file server, webserver (cfims.org)	1998–present	none indefinite loan by R. Kulkarni
PC, Redhat Linux	file server for project collaboration resources, for PWS research archives, back-ups	2000–present	none indefinite loan by R. Kulkarni
Sun SparcStation 10, Solaris 8	webserver (pwsfrap.org)	1993–present	none status changed during 2006, see text

The design objective for infrastructure and the status as of August 2006 is shown in Table 1.1.3.

The Apple platform was acquired to address the first class of requirements noted at the outset. This acquisition benefitted from Apple's planned but then unannounced switch from the PowerPC chip to Intel processors: at the time of purchase, Apply hardware was offered at near fire-sale prices. Multiple factors determined the choice: greatly reduced costs (capital and human resources) for security; greatly reduced security-related risks for the project (e.g., system corruption, loss of service, loss of data); the UNIX-variant operating system (OSX 10.4) has much greater inherent compatibility with current and past resources; the graphical interface is in part X11 compatible; and the advantages due to vendor-consistency relative to past acquisitions and existing infrastructure.

TABLE 1.1.3

ADDED INFRASTRUCTURE — UNION HALL OFFICE — AUGUST 2006

Power Mac G5 2.5GHz PowerPC G5 Mac OSX Server 10.4 oem 250GB HD + non-oem 250GB HD 0.5GB oem SDRAM + 2GB non-oem SDRAM Cinima HD Display (23" flat panel) on-site & "up": late Dec 2005	iMac G5 2.1GHz PowerPC G5 Mac OSX 10.4 flat panel (1-piece display & computer) on-site & "up": late Dec 2005
LAN hub Wireless 802.11 + 10/100 Base-T Ethernet Apple "AirPort Extreme" on-site & "up": late Dec 2005	ink-jet color printer HP Deskjet 6840 (non-PostScript) on-site & "up": late Dec 2005
Sun UltraSPARC 10 440 MHz SUNW,UltraSPARC-IIi Solaris 9 524MB memory 300GB HD (ST3) 126GB accessible due to ATA limits on-site June 17; "up" mid-July 2006	i686 PC, tower on-site June 17, 2006

Because this was new equipment, it was readily configured to provide (at additional but discounted cost) the necessary "industry standard" office automation software and the several media and data exchange technologies that today are necessities—USB interface, write as well as read interfaces for CD and DVD media, wireless LAN, and digital display interface. Because of Apple's long-running emphasis on graphics, it was possible to include functions such as vendor-integrated, large format flat-panel displays at nominal added cost.

The solution for the second half of the infrastructure restoration emerged in December with the discovery that the Institute for Systems Research (ISR)[2] was in the midst of a major upgrade of its Sun Microsystems infrastructure. In particular, all existing UltraSPARC hardware was being replaced. Ms. Margaret Jayant, Senior Systems Administrator for ISR, suggested using one of the salvaged machines with the highest speed UtraSPARC processor, filling its memory slots from salvage, and purchasing a contemporary-technology hard drive. Sun Microsystems had previously made its Solaris operating system, Sun's version of System V UNIX, open source: Solaris 8, 9, and 10 are each on line and free. Ms. Jayant offered to collect the pieces and assemble the box. By this solution, the project acquires locally, with minimum capital outlay (specifically, shipping), hardware that is a maximum-performance, end-of-model configuration of the hardware in use remotely. To minimize any potential institutional confusion arising from the fact that this box remains on ISR inventory, all costs other than shipping were paid by private support for the project.

[2] University of Maryland College Park; see the discussion of the past and present contributions of ISR to this project in §3.

The entries in the pre-2006 "off-site" table (Table 1.1.2) reflect the use of both Solaris on Sun hardware and Linux on i686 PC. While Solaris remains a reliable, stable workhorse, it is, of course, Linux on commodity-priced hardware that is the focus of the blooming open-source movement. On-site Linux is the way to be part of the process and make best use of it. This effort had available a second i686 platform, one that had been left for its use by Ravi Kulkarni at the time of the close of the Advanced Visualization Laboratory (AVL). It was decided to make this box part of the restored on-site infrastructure. The cost to the project is the shipping and systems administration required to install and set-up Linux.

The relocation of personnel was completed in January. The timing gave priority to Dr. Patrick's attendance with Mr. Adams at Marine Science in Alaska 2006 despite the fact that things were not in place for relocation. Since then, Dr. Patrick has maintained full-time residency in Cordova.

Initially, coordination, collaboration, and consultation tasks got the greatest attention. The work began at the symposium. Every opportunity to confer, whether an agenda event or independently arranged, was exploited, including events scheduled "adjacent to" the symposium such as the post-symposium PAC meeting. The symposium helped get coordination up to full speed quickly. It also provided a rapid, first hand introduction to the very large investment in the retrospective synthesis of the other PWS fishery, Pacific herring, and the opportunity to confer with the senior scientists and officers of the consulting firm conducting that synthesis.

Our poster itself had coordination as the central theme—the post-program, region-scale, inter-organizational management, protection, and utilization of program-derived intellectual properties, in-region infrastructure and expertise. (See Appendix 2.) We were disappointed by the mild reactions to our "caution flag" despite the fact that the presenter of the posters grabbed the most compelling line from the abstract to describe its message. The issue deserves to be revisited, possibly in a forum more oriented to stakeholders. The investigators sought out the Executive Director of NPRB and conferred further.

For purposes here, it is relevant to note that the poster for the 2006 symposium is a product of the high-end graphics capabilities of the newly acquired computing infrastructure.[3]

Upon return to Cordova, investigators attended and spoke at pre-scheduled organizational meetings or arranged special meetings. By the end of February they had conferred at least once with essentially every entity in Cordova having some involvement in fisheries ecosystems, save processors. Discussions covered this project, especially the status of observing programs, and a report on the Anchorage symposium, in particular, the specially scheduled presentation and side-sessions by the consultants retained for herring and other syntheses and on those from government and academic to whom the consultants referred "under-the-hood" questions regarding herring.

This first phase of coordination was one of discovery. The finding were factors for the future course of the project, primarily in three areas. The first was that the coordination even within our small community was not all it could be. This meant, unfortunately, that this rationale for PWSFRAP was still intact. The second was illustrative of the first. The investigators quite literally discovered a campaign of about two-years by a coalition of local, state and national conservation groups that sought an open, complete, vigorous, scientifically rigorous pursuit of claims by the state and federal governments under the clause "Reopener for Unanticipated Injuries" of the Spill Settlement Agreement. (See `www.exxonreopener.org` for coalition history, archived documents,

[3] It is also a product of PI Mullins "other life," that of a published photo-journalist with a degree in Fine Arts.

and monitoring of the progress of the reopener claims.) The third finding was the extent of losses in the area of operational observing programs that had taken place between August 2005 and January 2006. The losses undermined key working assumptions used in the determination of how to get the greatest benefits for commercial fishing from the recall and application of fry dynamics.

The objectives of the "reopener" coalition for herring were obviously compatible with those of PWSFRAP. Moreover, the coalition lacked any access to or even awareness of the diaspora of non-government expertise in the relevant scientific disciplines, a problem PWSFRAP exists to solve. Given the need in the community and the means to meet that need, PWSFRAP signed on to the herring part of the work of the coalition. But there were separate operational and technical factors in favor of this decision. There was the possibility of support for the work, an important consideration because of the very tight budgeting for this project. Second, there was a lot of overlap, especially in the area of existing, operational observing programs. While co-funding never materialized, the dual-use and dual-benefits for all coordination tasks definitely did.

As discussed in §VI of the proposal [AM05][p14-15, esp. Table 1], the project design is built around the coordination and synthesis of four observational resources—thermal marks, summer fry surveys by ADF&G in southwest PWS, the PWS circulation model of the Alaska Ocean Observing System/PWS Observing System (AOOS/PWSOS) programs, and annual hydroacoustic surveys of large zooplankton in PWS during spring. The loss of net-group resolution of fry releases associated with the switch to thermal marks from coded wire-tags and the in-season objectives of the project dictated addressing releases from all four hatcheries rather than a single hatchery. On the other hand, the 100% marking with thermal marks made it possible to examine the use of data from summer fry surveys for data assimilation in support of an in-season assessment of fry survival during outmigration. The extension to multiple hatcheries instead of one necessitated determinations of in-season forcing conditions along multiple outmigration paths as well as the "forecasts" and observations of what those outmigration paths in fact were.

In addition to the foregoing, the project had hoped to be able to pursue the "Reggiani conjecture," an important conjecture presented at one of the PWSFRAP workshops during 2005 by Dave Reggiani, Director of Prince William Sound Aquaculture Corporation (PWSAC):

> *The survival outcomes for a pink salmon hatchery in PWS is significantly affected by the outmigration route used by its fry, and the specific route used by the fry is significantly determined by the currents encountered by the fry following release.*

With multiple hatcheries and hence multiple routes, there could not be reliance upon west shoreline observations of zooplankton nor reliance on a coarse, local estimate of predation as had been possible with a single hatchery source. Not only was a zooplankton survey needed, the circulation model was needed to extend and interpolate that survey via an advection model. In addition, there was a need to include in any hydroacoustic survey at least a nominal assessment of predators.

Somewhere between September 2005 and March 2006, the status of the AOOS/PWSOS program and the status of the annual zooplankton survey changed and continued to change thereafter.

- Dr. Carl Schoch, the creator of the reformulated modeling programs for PWS, was no longer the Director of the Oil Spill Recovery Institute (OSRI) in Cordova. He had relocated himself and the program management offices for the atmospheric and ocean models to Anchorage.
- The OSRI budgets for 2007 and beyond had zeroed out support for the hydroacoustic zooplankton surveys.
- The model development had expanded organizationally; NOAA entities and the University of Alaska Fairbanks had been added to JPL, UCLA, Texas A&M, University of Maine, OSRI,

University of Miami and AOOS.
- The modeling priority for 2007 was drifter experiments during July and August. An inquiry regarding the possibility of model support for similar, independently funded experiments during the spring of 2007 led to the report that the models would not be ready that early in 2007.
- To participate in planning for the model development for PWS, one needed to travel to Seattle, October 11–12.
- Around June, EVOSTC advised AOOS that it was withdrawing from the consortium pursuing establishment of AOOS as one of the recognized IOOS entities.

This situation was a coordination and synthesis challenge that was beyond the scope of this project. It was, however, an issue at the heart of the purposes of this project—protecting, sustaining and utilizing the region's knowledge and infrastructure resources, especially those created as a consequence of the oil spill. Although the situation had deteriorated such that it was beyond the scope of this project, it was not beyond the scope of an initiative for herring restoration. The tasks required to address this coordination challenge were made part of proposal for herring restoration for fy2007. The demonstration tasks associated with the model and infrastructure restoration in Cordova were reconfigured to work around these findings; the adjustments are described later in this section.

During the same first three months of the current contract when coordination tasks were turning up lost or unavailable community capacity, the opportunities to impact the second of the project objectives—contributions to commercial fishing as an injured service—turned up in areas and at a level of impact unimagined in 2005. Section VI of the proposal [AM05][p9–15] is one of the results of a major effort to make more transparent the three distinct results and services provided by the *SEA* model development for pink salmon:

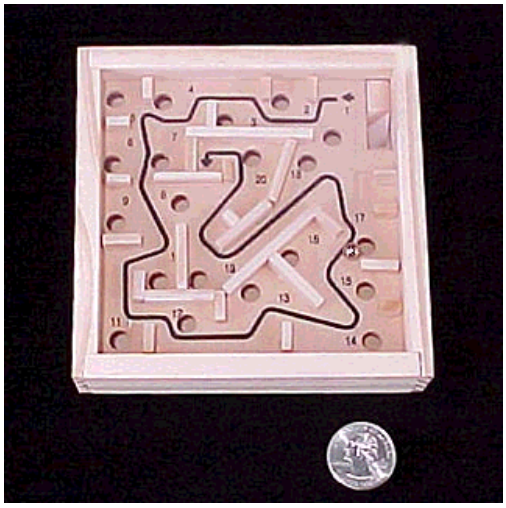
1 representation — in this case, a system of evolution equations;
2 a numerical analysis and a numerical solution for the equations plus a code by which the solution becomes a computer program with the capacity to run "simulations";
3 qualitative analyses of the equations — properties of the system of equations and hence properties of the ecosystem they describe.

One goal was to get past confusion of the fry model with a statistical model, this latter being one in which there is a service similar to 2 but which is based on a statistical analysis of past observations. Except for this common service — numerical simulations — there is no common ground whatsoever between the fry model and a statistical model.

The reason models like the fry model were pursued in the *SEA* program was because of item 3. Whenever one talks about "understanding" natural processes, in nearly all cases one is talking about the properties of the mathematical representation of those processes. If all we needed were the equations, science books would be one page long. The rest of the book is always about the properties of the equations and whether these properties do or do not adequately describe the real-world phenomena they seek to represent.

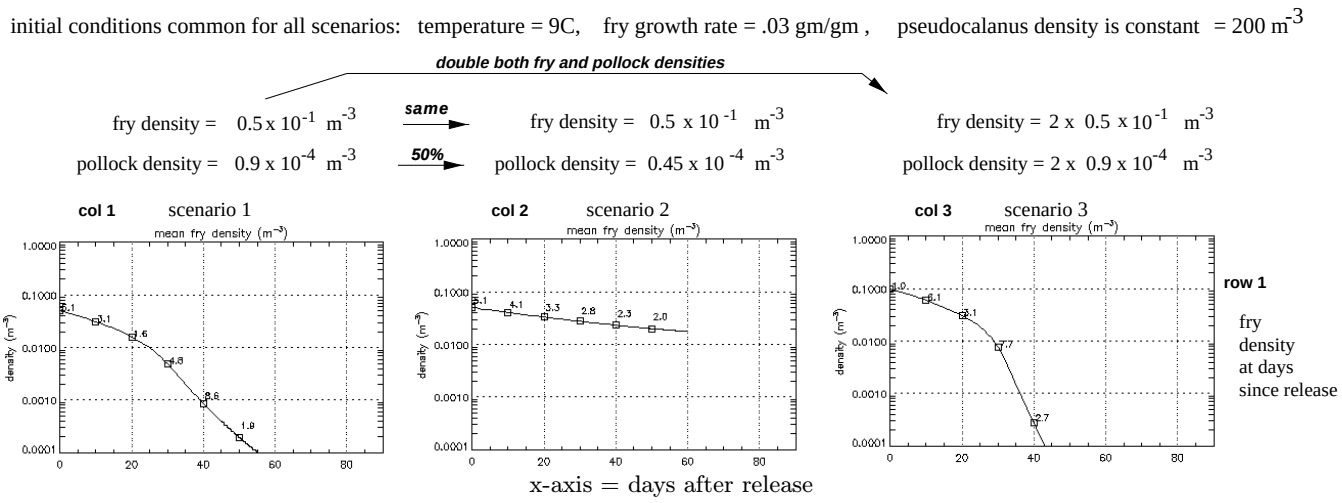
One of the properties of the fry system was that it operated as if "on rails," or rather, running along one of two rails. The findings from the model showed how the coded wire tag survival by pen group was either the product of successful predator swamping (upper rail) or its failure (lower rail). This property is not derived from data. It is a consequence of analyses of the equations in 1. The simulations in 2 were at times the motivation to undertake the analysis, at times demonstrations of a property identified in an analysis, and at other times demonstrations of the how all the properties acting simultaneously reproduced real-world observations.

There have been many efforts to communicate the nature of the fry model and more recently efforts to highlight the "two-rail" property that the equations exhibit. One of the latter was the use of the now forgotten analog version of "Pac-Man," the "labyrinth" game shown below.



In contrast to Pac-Man, a child could learn geometry from the game. One navigates the labyrinth by use of the dimension reducing boundaries with careful, hopeful, and rapid transitions from one boundary to another across the 2-dimensional space in which the position of ball is unstable.

The juvenile fry system does something similar, a property that first turned up in the simulation below.

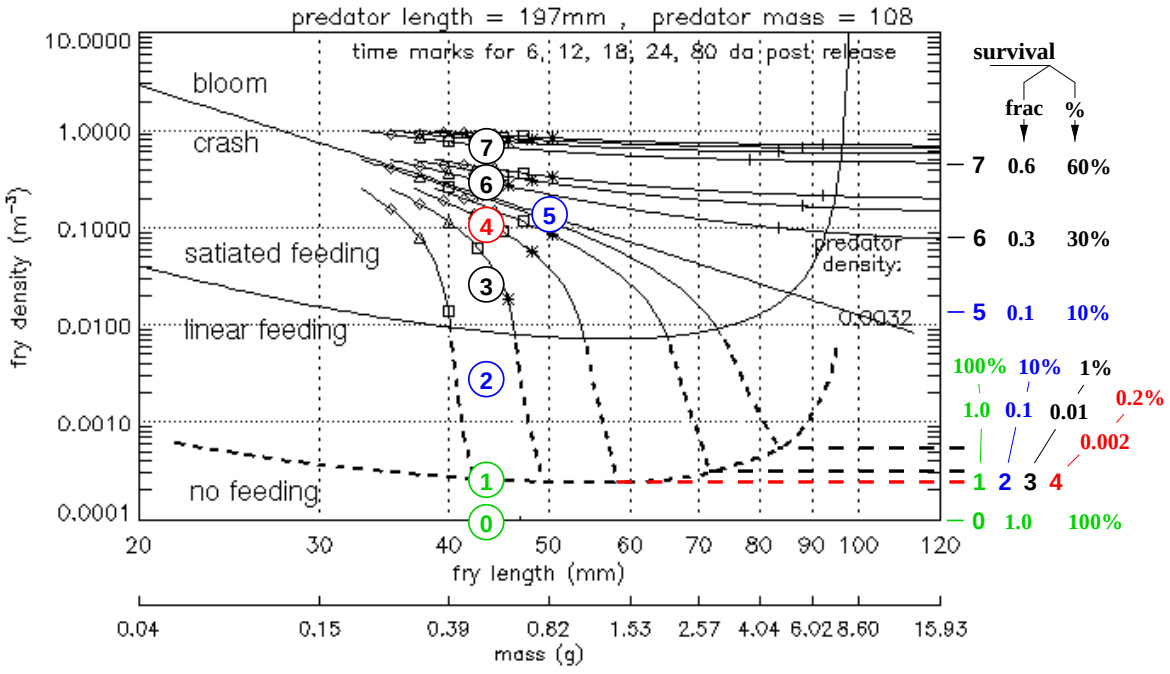


The slow, concave-up decline of fry density in the center panel, with endpoint around 30% survival, is characteristic of the outcome for predator swamping. The first and third panels show the consequence of falling below the threshold needed for predator swamping. Like the ball in the labyrinth game, once off the upper rail, things change fast and do not stop until encountering another rail. The simulation shown above is from the archives, from a period when the equations in 1 were not yet capable of representation of the processes that produce the lower rail, so there was no stopping of the decline.

The labyrinth game was first used to describe fry dynamics at the PWSFRAP planning workshop of October 2004. The graphic above was used in the full-day series of presentations for the general public on the opening day of the workshop. In the subsequent technical lectures, the focus turned to the theory and qualitative analyses that were the basis for the labyrinth analogy. In preparation for the current year, in particular, to address questions posed by the STAC and PAC, the lectures developed for the October 2004 workshop were upgraded and formatted for use online. The properties of the upper rail, predator swamping, are described in Session 15 of the online lectures at `www.cfims.org/psfrybklecture/cfimslec.html`. The key part of that session is three pages from Chapter 6 of the fry book `www.cfims.org/psfrybklecture/ch6_crashbloom.pdf`.

The representation and subsequent qualitative analysis of the "lower rail" was far more challenging and subtle. The technical description is found in Session 18 of the online lecture. A third part of the effort to provide an accessible description of the fry model was the development and publishing of javascript animations of the outputs from prior simulations, outputs that illustrate the workings of the two-rail properties. The link to the animations is in Session 19 of the online lecture and also at the very beginning of the opening page at `www.pwsfrap.org`.

Whether the efforts above for technology transfer were ever useful to those who were the original motivation is not known. However, it is being used by the re-engaged diaspora of herring researchers and some of those who have joined the network. The first realization of potential relevance of the fry model to the reopener questions regarding herring was a consequence of the formal statement of the obvious — the persistent low population for Pacific herring was functionally a stable state. When the analysis turned to intervention for enhancement of the numbers to move back to the original high population state, the question arises about why this does not happen naturally and whether there is some threshold that must be exceeded to get to the pre-spill state. It does not require much more to bring to mind the descriptions above. To that end, a summary of the two-rails was submitted as part of the Herring Summit April 24–25. An enhanced version of the figure used in that original submission is shown below.



During this same period, PWSFRAP collaborator Evelyn D. Brown had received a pre-publication copy of Andrew Bakun's paper [Bak06] in which he infers from data analysis of global fish populations for low-trophic level species like sardines and anchovy the two-rail property described above. Brown realized long before PWSFRAP that the fry model and Bakun's results described the same phenomena. She in turn passed the information to Dale Keifer at University of Southern California. Kiefer was a colleague of Bakun at Rosenstiel University of Miami and had worked with fishery managers on systems whose unexplained demise were addressed by Bakun's explanation. As a consequence, Keifer and Brown extended to PWSFRAP an offer to collaborate on herring and more generally on the applicability of the mathematical treatment behind the fry model to the classes of species considered likely candidates for having systems whose dynamics exhibit the two-rail properties for exactly the same reasons juvenile fry do. The offer was accepted. Formal acknowledgements of this dialog and these intentions appear in recent proposals submitted by Keifer's group and collaborators and by PWSFRAP.

1.2 Results

The most significant result from the project to date is the fact the long-range, high-impact goal of the project—major consequences for commercial fishing from the restoration of the model, infrastructure and expertise—is fully realized at levels not imagined at the outset. Conversely, the more straightforward goal of utilization of in-region resources in conjunction with model simulations ran into serious roadblocks.

The success is first and foremost the contribution of the fry model to herring restoration. The model provides the theoretical underpinings needed to formulate well-posed, fully precautionary test scenarios. It sets out what to expect and how to detect it with available, affordable marking technology.

Second, the success accomplishes the economic integration goal of the project. The fry model now has a range of relevance such that there is the real possibility of the technology and the infrastructure being sustained in a manner sufficient for its continued contribution to the fishing economy of the region, a contribution now that is not limited to pink salmon.

Because the model has jumped from being a minor player with over dependence on high resolution marking of hatchery fry to having global relevance, it should be possible for the ensemble of results and capabilities to find a home somewhere and not be so fully dependent on the unpredictable, high-overhead support available for restoration. It should be able to contribute to the region despite the fact that the region's economy is still so thoroughly crippled by the oil spill that expertise and infrastructure on its ecosystem is an unthinkable luxury.

2. Future Work

The project is at the end of the eighth month of the formal contract period of 11.5 months. As indicated herein, the goals of the project have been realized with outcomes significantly greater and more far-reaching than the ones envisioned in the proposal. However, there are some housekeeping tasks we plan to address during the remaining 3.5 months of the contract.

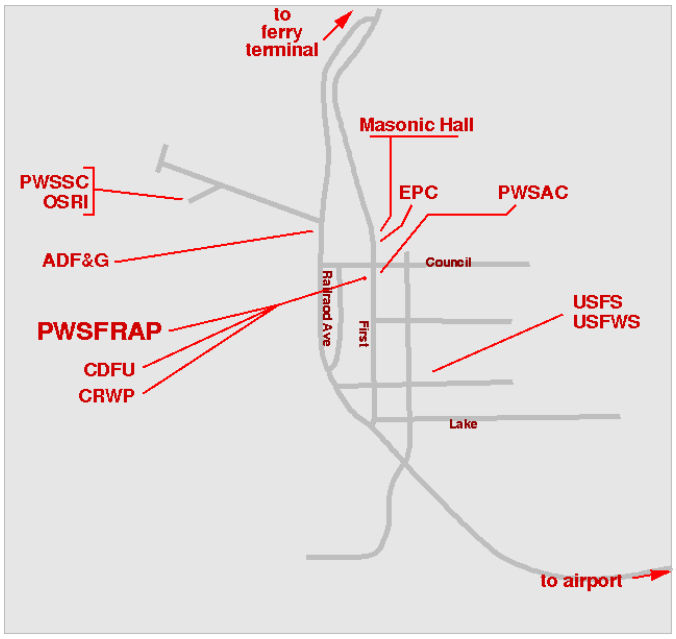
First, there remains some desireable systems integration tasks with the new computing infrastructure.

Second, once the most important of the systems tasks are completed, we intend to exercise the restored infrastructure through some model simulations with reformulated objectives, simulations which work around the loss of capacity in the community by exploiting to advantage the high quality data obtained during the *SEA* program. The goal is to exhibit examples that illustrate the qualitative analyses in a form such that numbers can be run regarding economic and ecological impact. However, the environment in which the project works is highly dynamic; this goal could easily be superceded by applications of the fry model and the restored resources to issues with greater benefits for commercial fishing as an injured service.

3. Coordination/Collaboration

3.1 Union Hall

The map at the right is from the "Contact" page of the PWSFRAP website `www.pwsfrap.org/pwsfrap/contact.html`. One of the first graphics created for the new website (original page of 07 June 2005 still used), the map helps answer the question posed by this section. The map highlights the fact that PWSFRAP's physical location could not possibly be better relative to its mission objective of faster and wider pathways between research and development on the one hand and relevance and restoration on the other.



The map is overdue for corrections and updates. It omits the offices of the Native Village of Eyak (NVE)—in the lower level of the building shared by PWSFRAP, CDFU, and CRWP—and the Cordova office of the Sea Grant Marine Advisory Program (MAP)—on the south, streetside corner of the PWSAC complex. It identifies a non-existent presence for USF&WS in the newly renovated Old Post Office Building of the USFS.

The office used by the project has a special historical significance for Cordova fishermen. The building, 509 First Street, is one of Cordova's historic buildings. Street-side signage with two-foot letters declares its identity—UNION HALL. It has been the site of Cordova District Fishermen United (CDFU) since the days when it was Cordova District Fishermen's Union. The spacious, well appointed office of CDFU today is a relatively recent configuration. Originally, the small, modest office at the back (west) of the streetside "meeting hall" was where CDFU took care of business. And this is where one finds PWSFRAP. The history and the ghosts of the office are motivating companions and an invisible fuel that helps keep the fires burning. Indeed, this project is responsible for what is being added to the history.

3.2 *Baker-Marquette Catalog of Research & Management Projects in PWS*

In March 2006, `www.pwsfrap.org` became something just a bit more than the online presence of a single project or a single group. On March 23, the site become the online "publisher" of the just completed *Catalog of Research and Management Projects for the Copper River and Prince William Sound in Cordova*. During the winter, Torie Baker, Sea Grant Marine Advisor in Cordova, and Allen Marquette, Education Coordinator for the Prince William Sound Science Center, were jointly interested in "seeing everything going on" in Cordova relative to research and management of natural resources, both terrestrail and marine. No such inventory existed, so they created one. They found 110 projects currently in-progress in Cordova.

In February, Torie Baker asked whether PWSFRAP was interested in providing online access to the catalog, and, of course, the answer was yes.

Comment on the emphasis on open standards and open source for the infrastructure build-up conducted through this project and the use of open source software for generation of the HTML version of the catalog. Open Office is an open source alternative to Microsoft Office; it was used to produce the HTML version of the catalog found online from the source Excel. Open Office Calc produces a clean, small HTML file, one which is easily edited and maintained. The figure below shows the opening half-page of the 110-item catalog.

Cordova Science and Research Project List

a spreadsheet listing of local and regional marine, freshwater, wildlife, and ecosystem research and management projects with local contact information

For updates to listings, contact:
Torie Baker torie@sfos.uaf.edu Alaska Sea Grant Marine Advisory Program
or
Allen Marquette allen@pwssc.gen.ak.us PWS Science Center

Overview
Last updated: 04/12/2006

Sea Grant
PWSAC
CR Watershed
Ecotrust
USFS
PWSSC
NVE
PWSFRAP
ADFG

download the catalog in a spreadsheet format:
Microsoft® Excel® 2004
OpenOffice 2.0

Sea Grant

2005 - 2006 CR/PWS Marine/Terrestrial/Wildlife Research Projects

A: salmon B: herring C: other marine fishes D: freshwater fishes E: fresh water fish habitat F: other wildlife G: other

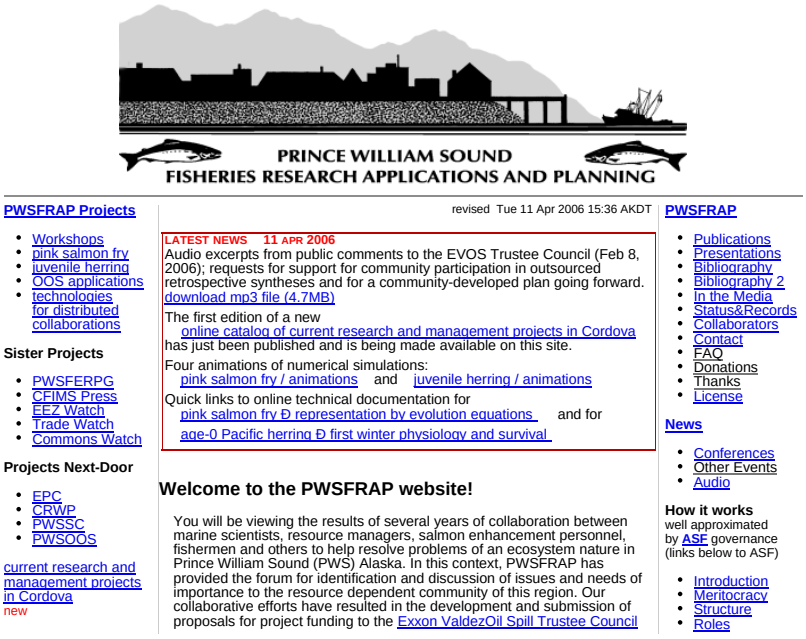
Category	PI	PI e-mail	Agency/Org.	Project Title	Objective/Activities	Collaborators	Start/end date
C	Ray Ralonde	afrlr@uaa.alaska.edu	UAF Sea Grant	Monitoring & ID vibrio in AK shellfish	2-yr survey, eval. lab testing, recommend best practices	AK Shellfish Growers Assoc.	2005 - 2007
A	Ross Hopcroft	hopcroft@ims.uaf.edu	UAF Sea Grant	Interannual patterns of GOA Larvaceans as related to pinks		PWSAC	2005 - 2007
C	Torie Baker	torie@sfos.uaf.edu	UAF Sea Grant	Seabird-Longline gear interaction deterrance	Extension to small boat fleet; policy contribution	USFS, UW Sea Grant	2003 - ongoing

PWSAC

2005 - 2006 CR/PWS Marine/Terrestrial/Wildlife Research Projects

A: salmon B: herring C: other marine fishes D: freshwater fishes E: fresh water fish habitat F: other wildlife G: other

Category	PI	PI e-mail	Agency/Org.	Project Title	Objective/Activities	Collaborators	Start/end date
A	Martinek	martinek@ak.net	PWSAC	PWS otolith thermal mark analysis	Estimate the contributions of hatchery and wild fish to commercial fisheries	ADFG, VFDA	May - September
A	Martinek	martinek@ak.net	PWSAC	Copper River otolith strontium mark analysis	Estimate the contributions of hatchery and wild sockeye salmon to sampled fisheries	ADFG	June - September
A	Chris Mitchell	chris-pwsac@gci.net	PWSAC	Thermal othili	Chum, pink, sockeye marking	ADFG	annual
A	Chris Mitchell	chris-pwsac@gci.net	PWSAC	Zooplankton watch			annual


PRINCE WILLIAM SOUND
FISHERIES RESEARCH APPLICATIONS AND PLANNING

PWSFRAP Projects

- Workshops
- pink salmon fry
- juvenile herring
- OOS applications
- technologies for distributed collaborations

Sister Projects

- PWSFERPG
- CFIMS Press
- EEZ Watch
- Trade Watch
- Commons Watch

Projects Next-Door

- EPC
- CRWP
- PWSSC
- PWSOOS

current research and management projects in Cordova
new

revised Tue 11 Apr 2006 15:36 AKDT

LATEST NEWS 11 APR 2006
Audio excerpts from public comments to the EVOS Trustee Council (Feb 8, 2006); requests for support for community participation in outsourced retrospective syntheses and for a community-developed plan going forward.
download mp3 file (4.7MB)

The first edition of a new
online catalog of current research and management projects in Cordova
has just been published and is being made available on this site.

Four animations of numerical simulations:
pink salmon fry / animations and juvenile herring / animations

Quick links to online technical documentation for
pink salmon fry Ð representation by evolution equations and for
age-0 Pacific herring Ð first winter physiology and survival

Welcome to the PWSFRAP website!

You will be viewing the results of several years of collaboration between marine scientists, resource managers, salmon enhancement personnel, fishermen and others to help resolve problems of an ecosystem nature in Prince William Sound (PWS) Alaska. In this context, PWSFRAP has provided the forum for identification and discussion of issues and needs of importance to the resource dependent community of this region. Our collaborative efforts have resulted in the development and submission of proposals for project funding to the Exxon ValdezOil Spill Trustee Council

PWSFRAP

- Publications
- Presentations
- Bibliography
- Bibliography 2
- In the Media
- Status&Records
- Collaborators
- Contact
- FAQ
- Donations
- Thanks
- License

News

- Conferences
- Other Events
- Audio

How it works
well approximated by ASF governance (links below to ASF)

- Introduction
- Meritocracy
- Structure
- Roles

The figure at the right is the top of the opening page at `www.pwsfrap.org`. The horizontal cut-line is positioned just below the link to the Baker-Marquette Catalog in the left "navigation" column.

There are reasons to consider the situation with herring with some urgency. The magnitude of the biomass "missing" in PWS with the loss of herring is as much as 30 to 60 times the biomass of all hatchery releases of fry combined. Such a major "hole" in the ecosystem could be unstable in the sense that with sufficient time it may become "occupied" by something other than herring. Deferral of action is an intentional action that has consequences.

The Baker-Marquette Catalog provides the means to determine whether there is any investment in herring recovery by sources other than the Trustee Council. Baker and Marquette predefined seven focus areas, one of which is "herring." The count of times "mentioned" for each focus area is shown in the table below. The score of seven projects listing herring as a focus area puts this topic dead last. Moreover, only one of the seven is addressing herring recovery, this project.

Baker-Marquette Catalog of R&M for CR/PWS in Cordova — matrix summary: source X category — 08/27/2006

2005 - 2006 CR/PWS Marine/Terrestrial/Wildlife Research Projects

A: salmon B: herring C: other marine fishes D: freshwater fishes E: fresh water fish habitat F: other wildlife G: other

	A	B	C	D	E	F	G	total
list source	**salmon**	**herring**	**mr fish**	**fw fish**	**fw hab**	**wildlf**	**other**	by lister
AKSG	1	0	2	0	0	0	0	3
PWSAC	6	0	0	0	1	0	0	7
CRWP	1	0	2	0	0	0	0	3
Ecotrust	6	1	0	0	0	0	4	11
USFS	5	0	2	6	6	14	0	33
PWSSC	2	1	4	1	4	2	7	21
NVE	8	0	0	0	0	2	1	11
PWSFRAP	1	1	0	0	0	1	1	4
ADFG	15	4	2	2	0	6	0	29
total by cat.	45	7	12	9	11	25	13	
						total (incl multi-category projects) =		122
							total # projects =	110

3.3 Community resources for pink salmon dynamics, for herring restoration

See the discussion in §1.1.

4. Community Involvement/TEK & Resource Management Applications

4.1 Community Involvement/TEK

1. Communicated the findings from this project and from complementary, privately funded inquiries to groups in the community as well as to coalitions of groups within the extended community, including
   - coalition of stakeholders and conservation organizations pursuing complete, transparent, participatory, and scientifically rigorous reviews, analyses, and decision-making for matters arising from the reopener clause of the spill-settlement agreement;
   - members of the board of directors of Cordova District Fishermen United (CDFU);
   - members of the Executive Committee of PWS Aquaculture Corporation (PWSAC);
2. Findings from this project were among the results presented at the Council's workshop on herring ("Herring Summit") on April 24 and 25, 2006. In particular, the basis for the one-page description of a candidate one-year project on the dynamics of juvenile herring and on answers to core questions arising from intervention was the reanalyses of results for pink salmon fry conducted by this project.
3. **IMMEDIATELY PENDING** Presentation to the Board of Directors of CDFU at the scheduled meeting of September 20, 2006 (*the presentation follows and is primarily based on the full-text version of the Annual Report.*):
   - status plus short-term and long-term prognoses for continuing and unresolved loss of natural resources and regional income due to EVOS;
   - semi-annual update on gains and losses of restoration-produced infrastructure and expertise, short-term and long-term prognoses, and quantitative estimates of the significance of past and projected changes for regional resources and income.
4. **PENDING** The communication and explanation of the findings from this project will be part of presentations to persons and groups in the community on the fundamentals behind the alternative options for intervention plus recovery tracking for herring restoration. The format, content, and timing of this transfer is designed to address the information and technology transfer necessary for effective participation by the community in upcoming reviews of restoration projects and work plans for fy2007.

4.2 Resource Management Applications

See the discussion on relevance to herring restoration in §1.1 Note also that the relevance to management is local, statewide, national, and international.

5. Information Transfer

5.1 by Journals & Symposia

1. Ken Adams. July 2006. Oil on Troubled Alaskan Waters. *Underwater Naturalist, Bulletin of the American Littoral Soc.*, 27(4):39–42.

   > We have learned that there is no rest, no cessation of the need for industry oversight.... Not to participate as citizen stakeholders in the process of environmental defense cedes the playing field to industry.

2. Ken Adams and Ross Mullins. January 2006. Tackling the Post-IERP Problem: PWSFRAP as prototype. POSTER, Marine Science in Alaska 2006 Symposium, Anchorage Jan 22–25.

   > In 2005, the North Pacific Research Board (NPRB) and the National Research Council published a science plan whose centerpiece is the "Integrated Ecosystem Research Program" (IERP).... In 1993, the Prince William Sound Fisheries Ecosystem Planning Group (PWSFERPG) and the Exxon Valdez Oil Spill Trustee Council published the Sound Ecosystem Assessment (SEA) Science Plan.... both plans share a fatal flaw — neither includes a contingency plan for success. The five-year SEA plan...said nothing about year six. The new NPRB plan, suggesting a ten-year IERP...says nothing about year eleven. ...first lesson is acknowledgement that post-IERP outcomes are stakeholder responsibilities....
   >
   > *In January, the presenters thought that maybe the phrase "fatal flaw" was too direct. After a 6-month immersion in the 1994 Restoration Plan and the Reopener Clause and the insights in §1, the delivery now seems overly indirect.*

5.2 by Documentary films

1. *Endless Fallout*, documentary film on Bhopal, Chornobyl, and the *Exxon Valdez* spill, Robert Cornellier, Macumba International, 2006. Ross Mullins contributed production consultation, archival video and documents, and extensive time on-camera.
   `http://www.extremis.tv`

2. *The Day the Water Died*, documentary film on the *Exxon Valdez* spill by Brave New Films and Sierra Club Productions, 2006. Ross Mullins contributed production consultation, archival video and documents, and extensive time on-camera.
   `http://www.sieraclub.org/tv/episode-exxon.asp`

5.3 for Public policy

1. Findings from this project were an essential part of the overall understanding of past and present trajectories for herring that made possible the construction of the reopener plan communicated to Governor Murkowski.
   `www.pwsfrap.org/reherring/letter2gov_20060530_reopen_case+plan4herring/`

2. **PENDING** Communications of findings, construction of formal questions, analyses of responses and position statements, for use in upcoming sessions with candidates for public office, especially sessions which convey an implicit CDFU branding.

6. Budget

As currently projected, the budget is sufficient for the completion of the project.

References

[AM05] K. M. Adams and C. R. Mullins. Ongoing synthesis and modeling activities restoring injured commercial fishery services. Proposal (revised) EVOS Project 060784, Prince William Sound Fisheries Research Applications and Planning, Cordova, Alaska, September 14, 2005.

[Bak06] Andrew Bakun. *Wasp-waist* populations and marine ecosystem dynamics: navigating the "*predator pit*" topographies. *Progress in Oceanography*, in press, 2006. pre-publication manuscript from limited-distribution mailing by the publisher.

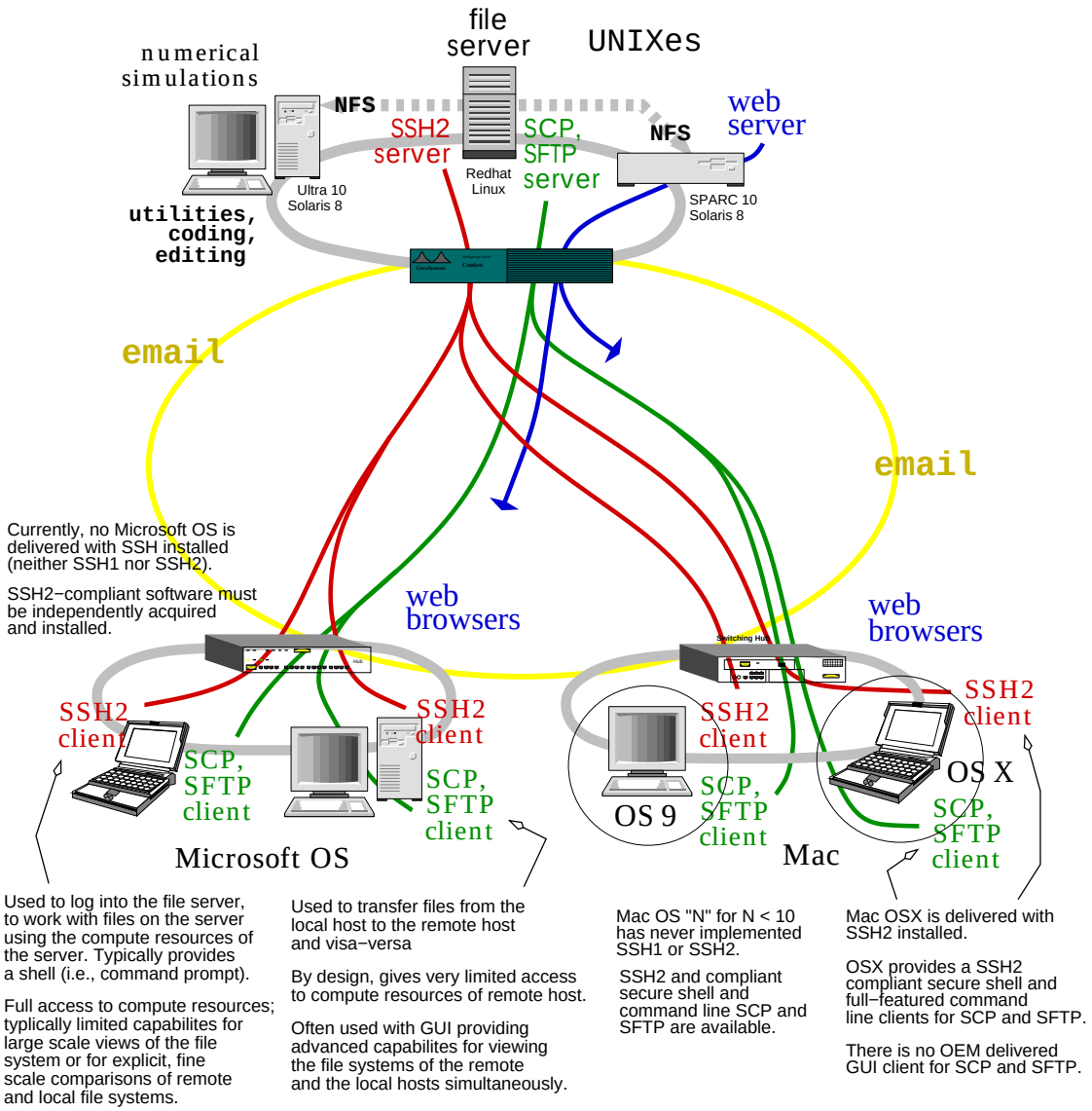
[Bro05] Evelyn D. Brown. Long term effects of the *Exxon Valdez* Oil Spill on Prince William Sound Herring. Position paper, Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, Alaska, February 2005. Current address: Flying Fish Ltd., 866 Hwy 141, Husum WA 98623.

[EVO94] EVOSTC. *Exxon Valdez Oil Spill Restoration Plan. Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska, November 1994. `www.evostc.state.ak.us/Policies/Downloadables/1994_resorationplan.pdf`.

[PMW+06] E. V. Patrick, D. M. Mason, T. M. Willette, R. T. Cooney, R. H. Nochetto, J. R. Allen, S. P. Rao, and R. Kulkarni. *An Evolution Equation Representation of the Marine Ecosystem Associated with Juvenile Pink Salmon*, volume 1 and 2. CFIMS Press, Cordova, Alaska, 1st edition, 2006. Sample chapters from pre-publication version online at `www.cfims.org`.

Appendix 1

Communication, collaboration, coordination — starting point from 2005



This graphic was prepared December 22, 2004, as part of EVOS Project 050757. Its function at that time was to communicate to the PWSFRAP collaborators the configuration of the collaboration server which, after a review of options during December, was proposed for use in the project and was newly online and ready for testing and comments. Although there were several open source projects for collaborative environments available at the time, a very streamlined, bare-bones approach was

recommended in part because platform-specific applications such as putty, wincp, fugu, and mac-ssh provided very effective graphical interfaces for those who wanted them.

The graphic is relevant to the current continuation of that project because all of online resources shown in the graphic (the three servers in the upper half of the figure) have continued to deliver the services described in the graphic without interruption since December 2004. This graphic and some additional information have been part of the PWSFRAP website since that resource first went online in June 2005. See the link technologies for distributed collaborations on the main page or the URL `http://www.pwsfrap.org/pwsfrap/CollabTech/`.

But the services provided by the systems described in the graphic go back much farther than 2004. In fact, the services of each of the systems has been used exclusively for PWSFRAP work and for restoration related research and development since before 2000. Not enough attention has been given to this history of service to the community, to restoration, to PWSFRAP objectives in general, and to its several projects in particular.

Index of /psfcollab

Name	Last modified	Size
Parent Directory	16-Aug-2006 12:52	-
by_topic/	25-Aug-2006 17:56	-
by_collab/	25-Feb-2005 16:37	-
oldview/	25-Feb-2005 16:36	-

Apache/1.3.26 Server at cahier.isr.umd.edu Port 80

Index of /psfcollab/by_topic

Name	Last modified	Size
Parent Directory	15-Oct-2005 16:39	-
UnionHall/	10-Sep-2006 04:49	-
annualreports/	05-Sep-2006 18:10	-
fy07/	06-Aug-2006 14:02	-
osri_2006jul_catchup-revu/	12-Jul-2006 21:05	-
00Calendar/	07-Jul-2006 13:45	-
herring2006/	20-May-2006 15:51	-
EndangeredSpsAct/	17-May-2006 15:31	-
reopener/	22-Apr-2006 16:31	-
otolith_chem/	22-Apr-2006 16:01	-
website_design/	16-Feb-2006 09:57	-
psfry_latest/	04-Jan-2006 09:43	-
psfry2006/	04-Jan-2006 07:48	-
ComputingSystem/	25-Dec-2005 13:07	-
calendars/	24-Dec-2005 23:14	-
media_coverage/	24-Dec-2005 22:31	-
EconPlan/	15-Dec-2005 11:30	-
Foundations/	15-Dec-2005 11:27	-
incorporate_opts/	15-Dec-2005 09:20	-
on_the_radio/	11-Dec-2005 08:22	-
NPRB/	08-Dec-2005 21:30	-
proposals/	05-Dec-2005 09:02	-
simplicity/	05-Dec-2005 08:59	-
biodiesel/	07-Nov-2005 15:05	-
contracts/	19-Oct-2005 10:57	-
curriculum/	19-Sep-2005 12:22	-
techdoc_archv/	08-Sep-2005 17:31	-
maps/	08-Sep-2005 17:28	-
teleconf_logs/	01-Sep-2005 21:50	-
Tags_Marks/	31-Aug-2005 05:12	-
correspondence/	31-Aug-2005 02:01	-
OilandTheFuture/	19-Aug-2005 23:23	-
Essays/	19-Aug-2005 00:14	-
howto-records	15-Jun-2005 07:30	1k
records/	06-Jun-2005 04:00	-
injuredresources/	18-Apr-2005 08:49	-
publish/	27-Mar-2005 16:38	-
policydoc_archv/	04-Mar-2005 10:50	-
media_release/	28-Feb-2005 05:26	-
SciPlan/	17-Feb-2005 08:31	-
how-to/	22-Dec-2004 09:43	-

Apache/1.3.26 Server at cahier.isr.umd.edu Port 80

Appendix 2

Coordination, long term — Poster: 2006 Alaska Marine Symposium

Tackling the Post-IERP Problem:

PWSFRAP as prototype

Ken Adams and Ross Mullins

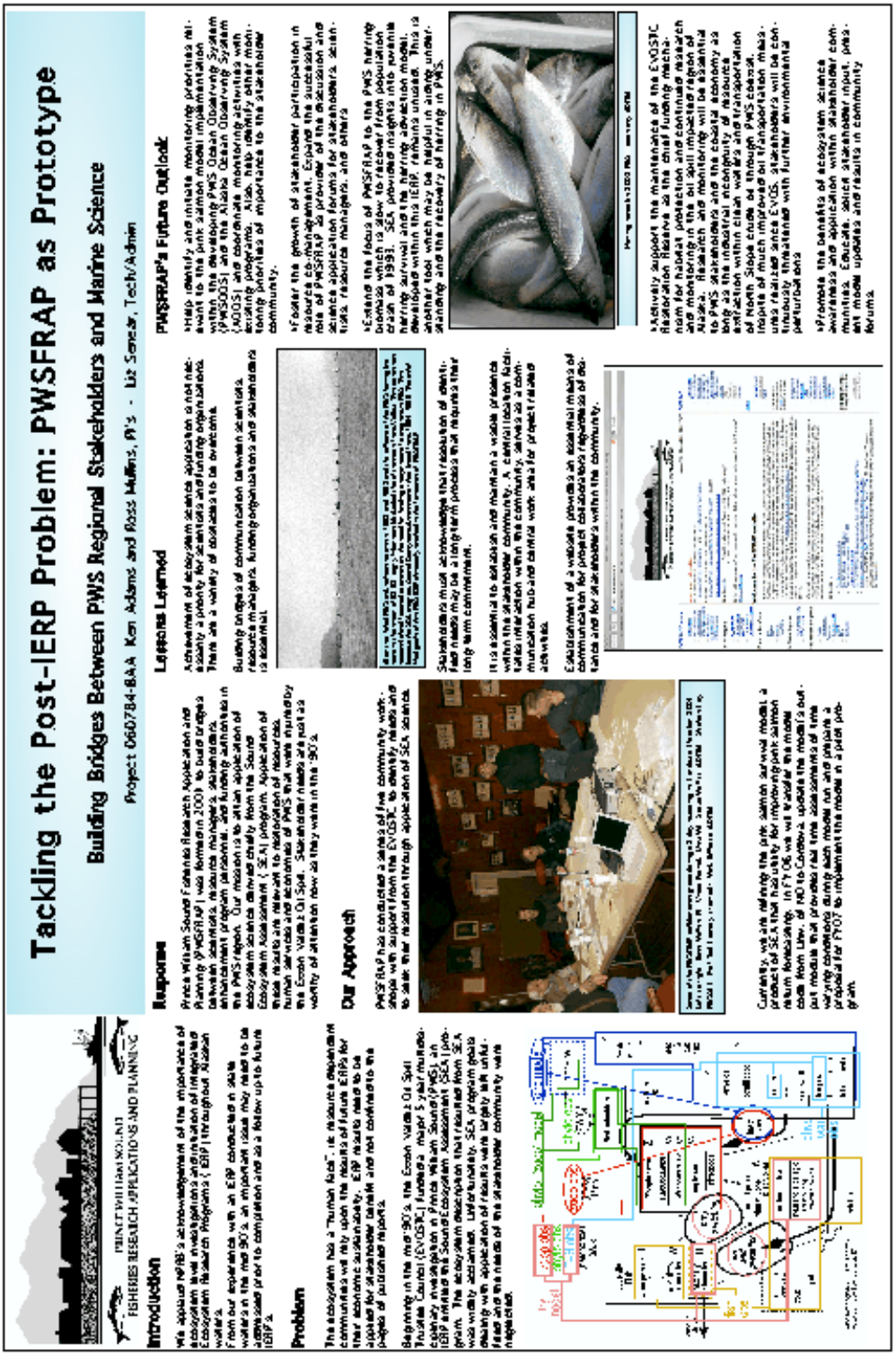
In 2005, the North Pacific Research Board (NPRB) and the National Research Council published a science plan whose centerpiece is the "Integrated Ecosystem Research Program" (IERP). The IERP is a significant and explicit refinement of prior formulations (e.g., 10-year duration, interdisciplinary, no single-factor analyses, stakeholder inclusion, prediction-based objectives and assessments).

In 1993, the Prince William Sound Fisheries Ecosystem Planning Group (PWSFERPG) and the Exxon Valdez Oil Spill Trustee Council published the Sound Ecosystem Assessment (SEA) Science Plan. Driven by economic urgency and scientific necessity, the authors took a loose collection of contemporary ideas and capabilities and produced one of the first IERPs (then called "ecosystem approach").

Despite the lessons of a dozen years, both plans share a fatal flaw --- neither includes a contingency plan for success. The five-year SEA plan, based on a $20 million investment in research findings, capacity building, and region-specific scientific expertise, said nothing about year six. The new NPRB plan, suggesting a ten-year IERP with a $10 million investment in similar asset development, says nothing about year eleven.

At the same moment in March 1999 when the highly-tuned, interdisciplinary, program-funded, SEA collaboration ceased to exist, the founders of the future Prince William Sound Fisheries Research Applications and Planning (PWSFRAP) met, set aside despair over forthcoming losses, and set about minimizing those losses, seeing the original motivating problems solved, and finding new applications as a means to economic viability.

This poster describes PWSFRAP, its approach, lessons learned, and an outlook for the future. The first lesson is acknowledgement that post-IERP outcomes are stakeholder responsibilities, the second that useful outcomes require help. The poster argues for inclusion of the post-IERP problem in the current public dialogue regarding IERP and spill restoration and for its inclusion in statehood anniversary retrospectives.



This page and this figure to be replaced with high resoluton, minimum margin graphic in PDF available at `www.pwsfrap.org/rsrcs/Records/060757rev/posterIERP.pdf`