Puget Sound Partnership Strategic Science Plan
Draft 3.1a 14 April 2008

I. Introduction

This section lays out the context of this plan, and the history, responsibilities, and goals of this effort. It will also cover progress and challenges from the past and important considerations for the future.

I.A. Context and history
- I.A1. The role of science in meeting PSP goals
- I.A2. Intended uses for and audiences of this Plan
- I.A3. This Plan in context of previous documents
- I.A4. This Plan in context of other PSP products
  - a. Input to the Action Agenda
  - b. Relation to other products (Monitoring, Risk Assessment, Indicators)

I.B. Overall Science Plan Goals
- I.B1. Ensure that science is an integral part of both the evolving PSP organization and of all PSP activities, employing the principles of adaptive management to provide decision support for PSP
- I.B2. Identify and prioritize the information and components required to successfully meet PSP goals and objectives

I.C. Responsibilities and Role of Science Panel
- I.C1. Rigorous science is a necessary but not sufficient component of an ecosystem management and restoration program. Creating and nourishing a strong and continual dialog between scientists and policy makers is critical, as is clearly translating often complex ideas to broad audiences.
- I.C2. The Science Panel is responsible, through this Plan, of defining the best possible structure for the Puget Sound science enterprise. The Leadership Council, Ecosystem Coordination Board, and others are responsible for addressing governance structure, financing, and implementation of this Strategic Plan.
- I.C3. This Plan is authored by the SP, with input from experts in various facets of Puget Sound science. It will be externally peer reviewed.

I.D. Overarching challenges affecting the region. In writing this Plan, the Science Panel recognizes:
- I.D1. Human population in the Puget Sound watershed will increase substantially by 2020 and beyond (put in the estimates).
- I.D2. Climate change is happening and affects the Puget Sound ecosystem in ways that are both predictable and unpredictable (include a few highlights of what is known/not known).

II. Guiding Principles

This section defines our overall philosophy, and will specifically include lessons learned from other programs.

II.A. A sustained investment in the science of Puget Sound will provide many of the tools necessary to effectively manage and restore the ecosystem. This requires:

II.A1. Analysis, synthesis, integration, and translation of existing scientific knowledge into the Action Agenda and management/policy
II.A2. Discovery of new scientific knowledge on Puget Sound, including:
a. distinguishing between, and understanding, both natural processes and human influences
b. other high priorities

II.B. A sustained investment in the process of adaptive management will provide a process where science and policy work in concert to define and achieve the goals of the Puget Sound Partnership.

II.B1. This Science Plan should initially define and then continually refine the six broad PSP goals into measurable elements, consistent with the collective understanding of ecosystem structure and function and changing environmental baselines and policy goals.

II.B2. This Science Plan should address accountability in the application of science to meeting PSP goals (e.g., compliance with regulatory standards or laws (e.g., clean water act, HPAs), with application of guidance in GMA and SMA). There is a need for independent confirmation of general compliance and effectiveness of current regulatory and incentive based protection strategies and tactics

II.B3. Program needs to identify and address how current management actions are conducted and how these decisions use science to make adjustments, and how new science will be used in meeting PSP goals (i.e., what policy decisions are contingent on more or better science and why). This should lead to doing more relevant science and is part of adaptive management.

II.B4. Program needs to explicitly link new science (data) needs with new expected policy actions as much as possible (this is also part of the adaptive management loop).

II.B5. Program should facilitate the development of coordinated scientific roles for agencies relative to the action agenda. Part of creating a science program may include understanding how major science players collect data to manage public

resources and how they might be leveraged to change how they collect data to answer broader questions useful to all stakeholders.

II.B6. Program needs to ensure accountability for monitoring, research and modeling that PSP funds (either directly or through the actions of other agencies/institutions/governments).

II.C. Desired characteristics of the Puget Sound Science Program

II.C1. Highlights from our SP discussion of February 26th
II.C2. Ensure PS science community is engaged
II.C3. Ensure process is transparent to public
II.C4. Robust—open to and responsive external review
II.C5. Durable—permanent, stable financing
II.C6. Responsive—driven by and adaptable to management needs

III. Scientific information required to achieve the six PS Partnership goals.

This section defines the status of scientific and science-policy knowledge regarding each of the six Puget Sound Partnership goals.

III.A. Human Health
III.B. Human Quality of Life
III.C. Species, Biodiversity & Foodwebs
III.D. Habitat and Land Use
III.E. Water Quality
III.F. Water Quantity

For each of these six goals, we will address the following:

III.A-F1. What is the fundamental conceptual science required to state with confidence the current situation in Puget Sound?
III.A-F2. Evaluate the adequacy* of current scientific information and/or new research/analyses needed to achieve the goal
III.A-F3. What observations are required to describe the current situation?
III.A-F4. What tools are required to guide policy to meet this goal by 2020?
III.A-F5. Evaluate the adequacy* of science-policy linkage information and strategies.
III.A-F6. What tools are required to assess the efficacy of these policies?
III.A-F7. Evaluate where most effectiveness is to be gained.
III.A-F8. Evaluate status of benchmarks to assess progress (has it been done?, is more work needed?, etc.)

*Note: "adequacy" should be considered in light of external drivers, such as climate and population changes, and scenario testing/alternative futures analysis and current knowledge limitations to conducting those analyses.

IV. Foundations of a Rigorous, Durable, and Responsive Puget Sound Science Program

This section defines the component parts of the strategic science plan that will enable a scientific understanding and incorporation of such into the regional management and planning process. It also defines how the components and programs described above will be functionally organized.

IV.A. Organizing questions. The Puget Sound Science Program provides the scientific underpinnings to address three broad questions:

IV.A1. How is the Puget Sound ecosystem structured and how does it work?

a. Why this question is important to PSP goals: we cannot manage a complex system that we don't understand. Just as medical professionals must first understand the anatomy (how is it structured?) and physiology (how does it work?) of *healthy* individuals before addressing injury and disease, environmental scientists must describe linkages among ecosystem components and quantify how materials (water, biomass, pollutants) and energy move through the Puget Sound ecosystem. This knowledge is the foundation upon which more applied questions may be answered.
b. What is required: flesh this out, but certainly observations at the proper spatial scales, models that link air, land, and water, food web models that link fisheries and nutrient management, detailed studies of specific processes or mechanisms.
c. Current state of knowledge:
d. Current state of capacity to address this question:
e. Roadblocks and opportunities:

IV.A2. How has the Puget Sound ecosystem changed and what will it look like in 2020?

a. Why this question is important to PSP goals: The Puget Sound ecosystem is not static, and will continue to change by both natural and anthropogenic influences. Identifying the drivers that caused prior changes and understanding previous rates of change allow us to build credible predictive capabilities. Unless we project the most likely conditions in 2020, it is not possible to develop or assessment restoration strategies.
b. What is required: flesh this out, but certainly long-term (status and trends) monitoring, analysis of natural variability at several temporal scales, hindcast modeling, detailed studies of drivers of temporal change, etc.
c. Current state of knowledge:
d. Current state of capacity to address this question:
e. Roadblocks and opportunities:

IV.A3. How can the Puget Sound ecosystem be managed to meet the six PSP goals? (needs to be reworded—the idea is that there is a suite of scientific questions around the efficacy of specific management actions)

a. Why this question is important to PSP goals: Deliberate actions may influence the future conditions in the ecosystem, but we must understand how effective each contemplated action will likely be on the desired outcome.
b. What is required: more to come. Deterministic and probabilistic models, targeted monitoring and comparative studies at current restoration sites, economic analysis, futures analysis, R/D of restoration/prevention technologies.
c. Current state of knowledge:
d. Current state of capacity to address this question:
e. Roadblocks and opportunities:

IV.B. Required Capacity and Competency. The Puget Sound Science Program should maintain a balanced portfolio that includes:

IV.B1. Integration, synthesis, and application of existing information
IV.B2. Observations of current status and trends
IV.B3. Exploration of ecosystem structure and function
IV.B4. Ecosystem-scale prediction
IV.B5. Anticipatory science (getting ahead of the restoration curve)
IV.B6. Development of new tools
IV.B7. A healthy scientific community in Puget Sound also requires investments in:
a. Training/education
b. Infrastructure
c. Communication (conferences, publications, outreach)

IV.C. Peer Review. This section defines an essential aspect of any scientific strategy, how scientific information is reviewed for accuracy prior to publication and dissemination to a wider audience. This element has several aspects.

IV.C1. Peer review of scientific results from funded research: conducted either from journal submission or other process provided by PSP
IV.C2. Peer review of proposals for evaluation for funding: recommend using existing functionary such as Washington Sea Grant or WSU Extension, etc.
IV.C3. Peer review of science messages from the PSP: conducted by the Science Panel. Messages from PSP that involve scientific perspectives will be reviewed by the Science Panel for accuracy.
IV.C4. Communication to science community:
a. Peer reviewed publications from any PSP funded research

IV.D. Adaptive management framework. This section discusses adaptive management as a framework to formalize the interface between science-policy and invigorate a process that continually: 1) defines and refines PSP goals and critical objectives, in light of current knowledge, and identifies knowledge gaps that prevent us from achieving those goals, 2) allows us to identify those critical needs and prioritize the application of science/monitoring to fill knowledge gaps, and 3) builds an explicit bridge between the management actions and their outcomes by providing reliable information that allows policy makers to "act upon" or "adapt to" new information that will help attain the PSP goals.

Establish a science panel - policy process that:

IV.D1. Characterizes (e.g., model) the ecosystem and its relationship to human activities

a. Update Puget Sound risk assessment as necessary

b. Identify key unknowns and uncertainties

IV.D2. States PSP policies as goals, objectives, and performance targets

IV.D3. Creates prioritized list of science/monitoring questions to

a. Better understand the ecosystem and what factors affect it

b. Link those drivers with management decisions that play a role

c. Measure collective progress against performance targets

d. Redefine objectives and performance targets as needed

IV.D4. Predicts potential outcomes of current actions (timelines, inferences, uncertainty) in light of new information that comes out of the science, about cause and effects relationships

IV.D5. Anticipates (and seeks to define alternatives) policy responses to new insights that point to a need for alternative, more effective actions (holds policy/science system accountable)

IV.D6. Repeats line of inquiry to refine actions and outcomes

IV.D7. Acknowledges relevant realities

a. We will always be faced with scientific uncertainty about the ecosystem. We will never have perfect knowledge about how the system responds to different drivers. The best predictive efforts of scientists will need to continually be refined in light of new data.

b. Policy decisions must be made despite scientific uncertainty. The strategic application of science can help policy makers make informed decisions by insights gained through a deliberative process of understanding the relationship between decisions and outcomes, and by considering alternative strategies that meet stated goals.

c. Rigorous science is a necessary but not sufficient component of an ecosystem management and restoration program. Creating and nourishing a strong and continual dialog between scientists and policy makers is critical, as is clearly translating often complex ideas to broad audiences.

V. Implementation

This section contains specific call-outs of foundational elements of the Puget Sound Science Program, to be discussed by the Science Panel.

V.A Modeling
V.B Monitoring
V.C Research
V.D Data Information and Management

VI. Science Education and Outreach Plan

(SP members to meet with PSP staff and other parties for coordination and to better define this section; below are placeholder concepts.)

For education, this section defines essential programs that assure focus on Puget Sound science continues to the next generation of scientists, to the youth in the region, and to all of the residents and general public. For outreach, this section defines major pathways for how information is communicated to wider audiences.

VI.A. PSP Fellowship Program: a program that funds both graduate and post-doctoral research of direct relevance to the PSP. Have a competitive program and evaluation of proposed work.

VI.B. K-12 educational programs: a program leveraging the Marine Facilities in each of the Action Areas to connect with regional schools to visit the facility, understand issues of high priority to the region and be a centerpost for Puget Sound/marine environmental curricula that may be shared.

VI.C. Public Outreach:

1. Programs within each of the Action Areas at the Marine Facilities to engage the public on local issues and general understanding. Involve public through hands-on activities and demos from the Fellows and other scientists.
2. Website section
3. Newsletters

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The material below is from the 2.0 draft. Skip down to below the next XXXX

A. Monitoring (follow-up from SP discussion) Here we need some introductory discussion about the purposes of monitoring. This would include: 1) The need to assess at large scale, such as ecosystem health, including indicators, and system-wide trends, etc; 2) assessment at variable scales for specific restoration activities as a part of an adaptive management cycle, where certain measureables identified by the modeling process are tracked in a specific experimental design for evaluation; and 3) such things as compliance monitoring for accountability. The purpose of monitoring will inform design, and design will fulfill statistical power needs. It must be clear to all that the designs will have to be specific to the purposes, and that there is not just a single catch-all monitoring program.

1. Hierarchically distributed system of monitoring, that integrates physical, chemical, social and biological sciences, that is coordinated and reasonably comprehensive.
2. Support well-coordinated, comprehensive, sustained funding for monitoring, and take advantage of other ongoing monitoring data/efforts that can be leveraged.
3. Existing assets: Note that there are many existing monitoring and observing programs, some of which are coordinated already
4. Organization: Monitoring will be distributed but coordinated through PSP or by a body that reports to PSP with guidance from SP on priorities

B. Research

1. Competitive process open to all
2. Need for mix of directed and open focus research (short-term applications vs. long-term knowledge that may result in later application). The former needs explicit link to management implication and assessment of policy information needs. I think the former and the latter both need relevance to restoration. Note that a single approach might fulfill both needs, that is the SP could routinely provide very specific, directed guidance in an RFP but leave the approach wide open as long as the objective is achieved. I am not sure we should ever put out an RFP that is so generic (open) that is leaves open the possibility that relevance to restoration is low. We should think in terms of strategic and tactical scientific approaches to restoration, not directed and open research. Good scientists will address very interesting science questions, and restoration, at the same time.
3. Existing assets: Note that there is no existing Puget Sound restoration focused research funding mechanism
4. Needs external body to conduct peer review and evaluation of funding
5. Organization: Research will be directed through a competitive review process by an entity (preferably existing) with capability for proposal review and evaluation. Overall metrics of evaluation will be reviewed / established by the SP

C. Modeling Just as for monitoring, we need to explain how varying purposes for modeling fit onto the science picture: 1) broad ecosystem models, to summarize our understanding, stimulate collaborations during their development, create common ground for the Partnership as a whole, and generate hypotheses in the face of uncertainty about the system; 2) modeling as an explicit step in adaptive management, where a specific management action or policy concept is modeled in the context of natural processes, and the action outcome predicted in advance to generate benchmarks and trigger points for success/revision of the restoration action; 3) types: conceptual, numerical, etc.

1. Competitive process open to all for targeted projects The common approach should be for the SP to clearly define the purpose/outcome of the modeling relative to restoration, in any funding process.
2. Development of community resources ?
3. Applied projects need explicit link to management implication and assessment of policy information needs.
4. Existing assets: Note that there is an existing self-organized modeling consortium for marine waters
5. Organization: Modeling will be distributed but coordinated through PSP or by a body that reports to PSP with guidance from SP on priorities

D. Data management

1. Requirements for metadata, archival, and interoperability
2. Existing assets: Note that there is the possibility to leverage existing efforts, including NANOOS, NOAA, and other
3. Organization: Data management is recommended to leverage off existing coordinated efforts currently operational or planned. (Need to evaluate if these can satisfy requirements for metadata, archival and interoperability. Make recommendations for enhancement if not adequate.)

E. Facilities(I think this element needs full panel discussion)

1. Create a consortium of marine facilities (i.e., labs, docks, vessels, etc) to include existing Labs, Marine Science Centers, etc. Call these the PSP Marine Facility Consortium
2. Existing assets: Identify in each of Action Areas
3. Linked to education and outreach programs, including fellowships, K-12, and public
4. Organization: Facilities will be distributed in each of the Action Areas, with member Facility Consortium partners that may receive competitive funds for enhancements but provide must provide capability to PSP researchers and fellows. The Consortium and its members will have an identity on the web that allows for identification of assets and capabilities within the region.

F. Arenas for communication to science, management and interested communities

1. Puget Sound-Georgia Basin Research Conference
2. Puget Sound Update

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Material Above From Version 2.0