ISRP Retrospective Report 1997 - 2005

Executive Summary

This report satisfies a provision of the 1996 Amendment to the 1980 Northwest Power Act, which charges the Independent Scientific Review Panel (ISRP) to provide a retrospective report of the results of prior-year expenditures to the Northwest Power and Conservation Council. The scope of past ISRP reviews has for the most part been limited to specific projects. With this report the ISRP enlarges the perspective and evaluates the cumulative effect of our reviews on program accountability, project effectiveness, and scientific soundness. The ISRP hopes that this report sets the stage for successive retrospective reviews that examine measurable benefits to fish and wildlife and provide biological information for the Council's evaluation of Fish and Wildlife Program expenditures and effectiveness.

This report has two major sections. The first section discusses the ISRP review process from 1997 through 2005 and its results. The second section covers major programmatic themes including, in order: research, monitoring and evaluation (RM&E); habitat and passage in the mainstem Columbia River (including white sturgeon, lamprey and exotic species); tributary habitat; wildlife; artificial production; and the ocean and estuary. The report also includes an appendix that describes the development of the peer review process in greater detail than the main report.

The ISRP Review Process

The ISRP has two major focus areas of its reviews: the Fish and Wildlife Program projects directly funded by BPA; and the "reimbursable" projects, sponsored by the Corps of Engineers and others, whose costs are reimbursed by BPA. The 1996 amendment to the Northwest Power Act of 1980 directs the ISRP to conduct an independent peer review based on a determination that projects:

1. are based on sound science principles;
2. benefit fish and wildlife;
3. have a clearly defined objective and outcome
4. with provisions for monitoring and evaluation of result; and
5. are consistent with the Council's fish and wildlife program.

The Council must fully consider ISRP reviews before making funding recommendations to Bonneville and explain in writing wherever the Council's recommendations differ from the ISRP's.

Fish and Wildlife Program Proposal Review

Initially, the ISRP found Fish and Wildlife Program proposals to be generally inadequate for scientific review; however, the quality of proposals improved significantly over time

under the stimulus of the review process. The detailed proposal review process that has developed involves the ISRP, Council, CBFWA, the public, and BPA. The respective review roles of the ISRP and the Council, as well as requirements for formal feedback from the Council to the ISRP regarding scientific recommendations, are detailed in the 1996 Amendment. As a result the review process is transparent and effective in providing feedback on decisions about project funding. In fact, the well-documented ISRP reviews combined with the Council's formal feedback requirement have proved to be an excellent approach to instill scientific review in management decisions that could be used as a model in other settings where science and policy interact.

In contrast with the Council's process, the proposal review process within BPA is less transparent. In the absence of specific feedback requirements, the extent to which BPA funding decisions remain consistent with the scientific guidance obtained through the Council and ISRP's peer review process is unclear. The ISRP has recommended that the consistency of BPA funding decisions and contractual Statements of Work with the technical aspects of ISRP-approved proposals be assessed.

It is important to emphasize that the ISRP reviews focus on evaluation of the technical merits of the proposals. Recommendations to the Council may indicate that the proposal is "fundable" or not, based upon its technical adequacy. Budget decisions are made by the policy bodies affected, the Council and BPA as informed by CBFWA. Thus the ultimate direction of the FWP is determined by the policy makers' decisions on funding. The question is whether funding reflects the technical evaluations by the ISRP.

The ISRP has found that proposals were funded for many of the identified needs in the Columbia Basin, but there has been limited funding of targeted, competitive solicitations for new projects that could address significant data gaps, critical uncertainties, or other unfunded needs. The majority of project funding decisions occur in annual solicitations in which new projects compete with established projects for funding. On its face, this approach has significant logical appeal; however in practice, many established projects with ongoing operation and maintenance costs continue to dominate the program often to the extent that funding opportunities for new and potentially important work are foreclosed. The ISRP recommends that alternative review paths be investigated for continuing and new projects. For example, obligatory operations and maintenance projects could receive administrative review or programmatic review of common methods, other continuing projects could receive periodic scientific review for progress attained (with non-performers recommended for termination), and new projects could be reviewed both technically and administratively for responsiveness to targeted solicitations. The annual review process might thus concentrate on new proposals and a subset of the continuing projects.

In 1998, the Panel recommended that the Council permit funding for new artificial production projects only if the proponents can demonstrate they have taken specific measures or requirements of the Fish and Wildlife Program (FWP) to address risk and impacts on native stocks into account. In response, the Council developed the Three-Step

Review process including ISRP review, which was built upon one used by BPA for the design, review, approval, and implementation of new artificial production initiatives.

Recommendation: The ISRP believes that the Three-Step review model of focusing on a specific complex program and conducting an iterative review with specific criteria drawn from the FWP has worked well and could be applied to other complex core programs.

Finally, data from past and current projects to support a comprehensive retrospective analysis of biological results has not been available to the ISRP. This lack of data and topical syntheses was also evident in the subbasin plans, the guidelines for which also called for the reporting of project results in the inventory section. This deficiency underscores the need for continued monitoring and evaluation in future FWP projects. BPA's new project tracking database, PISCES, appears to offer significant promise for tracking the status of tasks.

Recommendation: The ISRP recommends that future projects and BPA's tracking database be linked to emphasize reporting of data, biological results, and task completion. In addition, projects should be required to report results at specific milestones as a condition for continued funding.

Reimbursable Program Proposal Review

The ISRP has also conducted proposal reviews for BPA's "reimbursable" program. For the Lower Snake River Compensation Plan, the ISRP project review was successfully incorporated into the provincial reviews. Most recently, the ISRP reviewed proposals submitted to the Army Corps of Engineers (Corps) Anadromous Fish Evaluation Program (AFEP). The ISRP found that the AFEP's current internal process of proposal development did not lend itself to an independent proposal review process. Most of the information available was not well enough developed to be amenable to scientific review, nor did AFEP proposal development process have clear junctures where technical review could be appropriately interwoven.

Recommendation: The ISRP recommends that the Council, Corps, and ISRP identify a clear place for ISRP input before another review of AFEP proposals is undertaken.

Major Programmatic Issues Arising in ISRP Reviews

Research, Monitoring, and Evaluation

The Council's successive fish and wildlife programs have consistently been organized around the concept that adaptive management be employed to modify the program as new information becomes available. Effective adaptive management requires the existence of monitoring data, evaluation of study results based on mathematical and statistical procedures, and if appropriate, integration of results into development and

adoption of new management actions for the future. The ISRP notes that it is difficult to imagine how one would proceed in adaptive management without consistent, unbiased monitoring of results under present management actions.

The 1996 Amendment to the Northwest Power Act directs the ISRP to review projects in regard to whether they: "…have provisions for monitoring and evaluation of results." The ISRP has been consistent in recommending that all projects have provisions for not only monitoring of task completion, but also low-cost monitoring to indicate benefits to fish and wildlife. Monitoring may be as simple as comparing photographs taken of riparian stream bank habitat at fixed points every five years or documenting that anadromous fish are spawning in an area previously blocked by an irrigation diversion dam. Most project proposals should also document larger scale monitoring provided by another FWP project or other government agency.

The ISRP has struggled with inconsistent terminology concerning research, monitoring, and evaluation among the various fields of science (e.g., fisheries, hydrology, wildlife, genetics) and in particular with the scientific basis for "effectiveness monitoring" of management actions. We present unified terminology in this retrospective report. The goal is to help clarify the research and monitoring that is necessary for establishing the effectiveness of management actions intended to meet objectives of the FWP, the Endangered Species Act, and other legal obligations of fish and wildlife managers in the Columbia Basin.

Development of a systemwide monitoring and evaluation program is presently in a formative stage with three relatively new initiatives. First is the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP), which is a Fish and Wildlife Program project administered by the Columbia Basin Fish and Wildlife Authority (CBFWA). Second, Federal Action Agencies have proposed a draft RME Plan. Finally, a cooperative monitoring and evaluation program in the Pacific Northwest has been established by an ad hoc partnership of biologists from concerned federal, state, and tribal agencies under the name Pacific Northwest Aquatic Monitoring Partnership (PNAMP). The need to develop a coordinated, systemwide monitoring and evaluation program has been recognized by the ISRP from our initial reviews to the present and we continue to recommend that the Council support the effort. The three new initiatives should be coordinated, and not redundant.

The failure of some projects to report on progress (or the lack of progress) toward project objectives and to provide primary data and metadata to the databases of the region has been a recurring concern of the ISRP. In principle, all data obtained through public funds should be available to the public and recorded in the region's databases. If there are restrictions on data use (e.g., locations of sensitive species or a restricted-use time period for preparation of reports and manuscripts), then the restrictions should be specified and justified. The ISRP supports this principle.

Recommendation: The ISRP has recommended that Smolt Monitoring, PIT Tag, Radio Telemetry Technology, Coded Wire Tag, and Sonic Tag projects should be subjected to a

comprehensive programmatic review that gives special consideration to the complex interactions between the projects. This review is critical because regulations requiring mass marking of hatchery fish and selective fisheries has significant impacts on the results of the projects. The Council concurred with the recommendation. Although the ISRP reviewed the set of projects in the Mainstem and Systemwide Reviews in 2002, the ISRP envisions a more focused, comprehensive programmatic review than can be accomplished during a standard proposal review process.

Mainstem

Salmon and Steelhead

From the outset of fisheries mitigation research in the basin by the Corps of Engineers in the 1930s and the Northwest Power and Conservation Act's mandated (BPA-funded) Fish and Wildlife Program since 1982, mainstem issues on the Columbia and Snake rivers have held center stage. In the mid-1990s, the National Research Council's (1996) *Upstream: Salmon and Society in the Pacific Northwest* and the Independent Scientific Group's (ISG; 1996) release of the pre-publication copies of *Return to the River* added new dimensions, those of considering the mainstem as a habitat for life functions rather than just a migration corridor functioning to simply move smolts downstream, a fuller consideration of full life-cycle components of salmonid success (and decline), and the need to protect biodiversity among salmonid species and populations.

Early in the review of projects, the ISRP, observing the dominance of mainstem projects devoted to the flow-survival issues and the persistent disagreements between competing smolt passage and survival models, recommended that there be a quantitative evaluation of assumptions upon which structural (e.g., passage facilities) and operational (e.g., flow augmentation) measures in the FWP and Recovery Plan are based. Despite reorientation of modeling efforts toward evaluations of persistence of ESA-listed species, the controversies over passage survival and relationships to river flow persist. There is a continuing need for improving technical information through mainstem experiments and evaluation of technical assumptions for both research and modeling.

Also, in early reviews the ISRP requested a review of the gas bubble disease issues and projects because of potential biological effects and their high cost to the region. Such a specific review was not conducted, but regional negotiations among agencies settled on workable guidelines within acceptable levels of uncertainty. The gas cap and monitoring of gas saturations have become well institutionalized in the basin, and research requests have diminished.

The ISRP reviewed mainstem projects during the Mainstem/Systemwide Province Review in 2002. At that time, projects became much more aligned to the specific actions in the National Marine Fisheries Service's 2000 Biological Opinion than to the Council's FWP. In 2003, the Council adopted a specific Mainstem Amendment to the Fish and Wildlife Program that includes objectives and measures relating to the protection and

enhancement of mainstem habitats, water management, adult and juvenile passage modifications at mainstem dams, adult survival, water quality, and research, monitoring and evaluation. Many of the ISRP (also ISG and ISAB) recommendations are included in this amendment.

The ISRP has not conducted a comprehensive review of projects associated with the Mainstem Amendments; however, the ISRP has participated in a review associated with a particularly contentious provision. This provision involved tradeoffs between upstream effects of water storage and augmented mainstem river flows for salmon. The ecological damages from the operations of Hungry Horse and Libby dams in Montana were to be reevaluated and compared to benefits to downstream salmon in the mainstem. The ISRP has supported these comparisons; however, downstream studies adequate for the comparison have not been conducted. The ISRP concluded that the Council's amendment provision for changed operations was reasonable for reducing upstream effects, but that the ability to demonstrate a benefit for downstream salmon was technically problematic. The Council requested that the operations be approved by NMFS and a study conducted to determine if flows in the lower Columbia River were measurably affected by flow augmentation. Technical analysis is yet to be provided of relative benefits of flow augmentation to survival of downstream migrating juvenile salmon versus associated reduction of production of resident fish in the reservoirs. The issues of comparative upriver and downriver effects of Columbia River flow management therefore, remain unresolved at a technical level.

In the summer of 2004, the ISRP participated in review of draft subbasin plans. Few plans included adequate assessment of habitat in the mainstem Columbia and Snake River reaches, even though the boundaries defined by the Council clearly included them. Mainstem issues were generally treated by the sponsors as "out-of-subbasin" questions that affected stocks within tributary subbasins. The issue is subbasin stock-specific estimates of needed escapement and the impediments to those escapements arising in the mainstem. The subbasin planning exercise, therefore, did not adequately cover mainstem issues related to specific tributary fish stocks. This was a serious oversight, considering the significant mortalities imposed upon juvenile and adult salmonids in their migrations through the mainstem Columbia and Snake Rivers. The joint ISAB and ISRP reported this deficiency to the Council, with no specific Council action taken to date other than the Mainstem Amendment.

The ISRP notes that there are continuing issues of flow management in the mainstem. An ideal flow regime that gives equal consideration to fish and hydropower has not been established, with the possible exception of flow stabilization measures in the Hanford Reach. The operation of upstream storage reservoirs and the role of their limited flow "augmentation" for fish have yet to be agreed upon basinwide. The importance of reservoir hydrodynamics with regard to smolt passage and survival has yet to be fully recognized as equal in importance to passage at the dams themselves. There are long-range predictions of higher average Columbia River flows in winter and less snowmelt in summer in future years. Spring/summer flows could be reduced for all uses (including fish), and winter flows could be high, but undependable (more floods). With water flow

management already a divisive social issue, the need for projects to study the results of flow management alternatives in a changing climate is clear. Large-scale operational experiments have been identified by the ISRP as important for resolving these major flow-survival issues, in spite of the difficulty of conducting them.

At the dams, surface bypass technologies (especially the Removable Spillway Weir – RSW) are emerging as the alternative to massive water spills for fish passage. They offer increased effectiveness in passing juvenile salmonids with less water than standard spillways. Furthermore, experimental research to evaluate these technologies in laboratory facilities are likely to provide answers much faster and at less cost than in-river trial and error with fully implemented prototypes, a procedure which has dominated recent history. One consequence of surface bypass technologies might be a reduced ability to monitor smolts, which now pass through turbine screening and bypass systems where counting stations and PIT-tag detectors are located, though new methods are being developed to monitor smolts passing via these alternate surface routes. There remains a problem of identifying species and stocks that pass in spill.

Non-Salmonids in the Mainstem

Mainstem issues affect species other than Pacific salmon and steelhead. Lamprey passage problems at dams, that are the apparent cause of major population decline, will need to be resolved if these native species are to persist. Sturgeon tend not to use fish ladders, which are not designed for such large fish, so populations are isolated in specific reservoir reaches except for downstream export of larvae and some juveniles. The white sturgeon lacks habitat for reproduction in most of the mainstem and many reservoir sub-populations are in decline, except for the tidal freshwater reach below Bonneville Dam. There appears to be a reproductive bottleneck between egg dispersion and metamorphosis to juveniles that is likely habitat related. For both lamprey and sturgeon, the ISRP and Council sought better integration of planning and research basinwide before major investments in management (especially artificial production). The non-native American shad proliferation in the mainstem, with annual runs past Bonneville Dam of 2- 4 million fish, must be better understood. In spite of ISRP encouragement, little study has been funded. It is unlikely that such a large population of an exotic species could exist without some effect on mainstem migrants or resident fish. Predatory exotic fish species (e.g., walleye, northern pike) provide challenges for smolt survival. As a policy matter, the Council ought to recommend that no new exotic freshwater species of any kind should be deliberately introduced anywhere in the basin, and efforts should be initiated to halt expansion of these populations. The long-standing predator control program focused on northern pikeminnow appears to be well run and effective at controlling this native predator.

Conclusions and Recommendations for the Mainstem

The ISRP is gratified that most of its recommendations regarding projects in the mainstem have been adopted by the Council or another agency. The interchanges among the ISRP, the ISAB, the Council and the Council staff have been very positive. They have

yielded considerable progress toward developing a mainstem program that is scientifically sound, benefits fish, has defined objectives and intended outcomes. In addition, intensive effort is underway to provide for continual monitoring and evaluation of results without overwhelming the needs of other parts of the Fish and Wildlife Program. Nonetheless, research, monitoring, and evaluation on the mainstem are not completed, and significant technical issues remain, especially if the often competing socioeconomic and fisheries interests are to be wedded as equal objectives. Recent events show that the persistent issues of flow and spill, for example, are not resolved. The mainstem programs of the Corps (AFEP) and the Council require improved interchange and coordination. Species other than salmon need attention. Climate change offers both opportunity and challenge for the mainstem for both fish and other uses. The challenge will be to work with climate researchers to adequately prepare for long-term changes. As subbasin plans formalize expectations for recovery of salmon populations in tributaries, the spotlight will be on the mainstem to preserve the up-river gains.

Tributary Habitat

Upstream (National Research Council 1996) and *Return to the River* (Independent Scientific Group (ISG) 1996; 2000) identified freshwater tributary habitat degradation as a major cause of the demise of both resident and anadromous fishes. Taken as a whole, the various reports and reviews conclude that major long-term intervention will be required to restore habitat diversity and connectivity.

Habitat rehabilitation will require action on both public and private lands. Core or reserve areas that currently contain high quality conditions and maintain strong populations of salmon and trout are of particular ecological importance and should be identified, protected, and reconnected to each other by networks of suitable habitat to form functionally intact migration corridors. Restoration should focus on ecosystem characteristics and processes including watershed features and processes, recruitment of large woody debris, water quality, natural sedimentation rates, floods and other natural disturbance regimes, adequate stream flows, and upland processes. The role of periodic natural disturbances such as wildfires and floods in maintaining healthy watersheds also should be acknowledged and their benefits protected.

Subbasin Planning and Habitat

Although there was a clear programmatic commitment the importance of tributary habitat for restoration of native species and to habitat planning prior to the 2000 FWP, the ISRP consistently found that project proposals suffered from a lack of subbasin-level habitat objectives, watershed assessments, prioritization, and effective monitoring and evaluation – in spite of a commitment from Council since the mid-1990s to develop an approach that would provide guidance for development and selection of tributary habitat projects.

Several issues contributed to this inconsistency. First, watershed assessments and comprehensive planning at the subbasin level required funding, as well a substantial time commitment. Funding specifically earmarked for this activity was not available at that

time. The Council, with a grant from BPA, provided funding in 2003-2004 to develop Subbasin Plans as called for in the 2000 FWP. Second, although the Council repeatedly called for habitat objectives and assessments at the subbasin scale, there were few penalties assessed for proposals that lacked these key elements. The Subbasin Planning Technical Guide was an attempt to identify the detailed elements needed for the comprehensive biological assessments required in the Subbasin Plans.

Unquestionably, the subbasin planning effort represented a major step forward in development of a comprehensive strategy for recovery of salmonid species within the major subbasins of the Columbia River. Watershed assessments were a core component of Subbasin Plans, which also called for an analysis of factors limiting production of focal species. Prioritization of objectives and strategies were key components, as was coordination among actions agencies, tribes, and stakeholders in development of the Plan. The subbasin plans constituted a beginning – an important step toward planning – but many plans had important deficiencies related directly and indirectly to tributary habitat. All plans had a strong tributary habitat component; however many did not reflect some of the more recent scientific knowledge pertaining to ecological restoration. A particular weakness of nearly all plans was inadequate treatment of natural variation in habitat conditions and the landscape processes that caused the variation. The Subbasin Assessments will provide useful resources for future planning; however, habitat objectives and strategies were not prioritized in many plans, which could hamper their effectiveness.

Recommendation: It is the ISRP's understanding and expectation that selection of habitat proposals in the future will be determined in part by their conformity with Subbasin Plans. Such an approach is a logical follow on to the Subbasin Planning effort, and indeed, validates the work and analysis conducted by many hundreds of individuals throughout the Columbia River subbasins. This requisite should make reviews by the ISRP more manageable and transparent, and reward efforts that tie projects to the Plans.

Wildlife

The Wildlife Program has been significantly smaller than the Fisheries Program, and was largely a separate program when the ISRP began its reviews in 1997. The Wildlife Program was also very different in focus from the Fisheries Program, having had a separate history of development based on assessment of habitat losses as an assumed proxy for wildlife losses. Thus, the Wildlife Program had focused on habitat acquisition to replace habitat losses due to development of the federal hydrosystem. Although the Wildlife Program presumably was effective in its emphasis on habitat acquisition and protection, which were assumed to benefit the wildlife species themselves, there was little if any attempt to measure directly the benefits of habitat acquisition (or intended habitat improvement, through management actions) at the level of wildlife populations themselves.

In early reviews, the ISRP was critical of the monitoring and evaluation of results in ongoing wildlife projects and of the lack of clear and well-described plans for future monitoring and evaluation. Many proposals continued to lack clear descriptions of sampling design or of procedures and criteria for assessing the outcomes of management plans, but several proposals had significantly improved monitoring and evaluation sections. The ISRP urged the program away from continuing emphasis on Habitat Evaluation Procedure (HEP) evaluation as a tool for long-term evaluation or management planning and toward more accountability for actual wildlife populations.

Few fisheries projects, if any, related potential benefits of habitat improvement to terrestrial wildlife. The ISRP believes that better integration of fish spawning and rearing habitat protection/restoration projects with protection/restoration of terrestrial habitat will provide long-term benefits. For example, many fisheries projects called for fencing of streambanks to limit access by cattle, while most wildlife projects call for purchase of land or conservation easements. Both of these practices are desirable, but it may be more cost-effective as well as more ecologically effective for the two programs to be coordinated and complementary where possible. Thus, the ISRP recommended "that the wildlife and fish habitat protection programs be better integrated and that projects be evaluated on criteria that favor those projects with documented benefits to both terrestrial and aquatic species."

Recommendation: The Management Plans portion of subbasin plans tended to pay far less attention to wildlife than to fish and often did not include much consideration of landscapes, ecosystems, and overall biodiversity. There is a critical need to evaluate (and demonstrate, if possible) where and when habitat restoration efforts increase or sustain fish and wildlife populations and at the same time maintain or increase biodiversity.

Overall, much progress appears to have been made in developing productive scientific review and dialogue about wildlife. Several challenges remain for the wildlife portions of the FWP. First, integration of all elements of the FWP remains to be realized in the continuing development and implementation of subbasin plans. Second, additional time and thought must be given to criteria and procedures for selecting focal species that will be useful and effective in monitoring and evaluating project effectiveness. Third, the focus on ecosystems and biodiversity that is a central emphasis of the Council's 2000 FWP is only beginning to be incorporated into actions.

Artificial Production

In 1996, *Upstream* (National Research Council 1996) and *Return to the River* (Independent Scientific Group (ISG) 1996; 2000) included criticism of artificial production activities in the Columbia River basin, due to their failure to achieve their mitigation goals. In fact both reports specifically identified the scale and ineffectiveness of previous artificial production activities themselves as likely major contributors to the decline of anadromous salmon and steelhead.

Over the near decade period of review (1996 to present), the ISRP examined each BPA-funded artificial production project – often multiple times through various review processes – and extensively reviewed the larger, more complex artificial production programs in the basin, such as those in the Yakima, Hood, Klickitat, Grande Ronde, Clearwater, and Salmon river systems.

Recommendations: Four primary themes emerged over the ISRP review history. These include:

- approaching artificial production and supplementation as an experiment that includes defined treatment and appropriate experimental controls, as well as rigorous implementation monitoring and effectiveness evaluation;
- managing artificial production within a subbasin and habitat context, such as matching releases to subbasin and estuary-marine carrying capacities; and,
- integrating and coordinating natural and artificial production at various hierarchical levels including the drainage, subbasin, province, and if possible, entire river basin levels;
- recognizing the Fish and Wildlife Program's priority on native populations in native habitats, including the need to establishment a system of core natural populations within a framework of healthy habitats.

We acknowledge that initial steps of this reform are currently being undertaken through the Council's Artificial Production Review and Evaluation (APRE) initiative and its integration with the recent subbasin planning effort. There remain, however, enormous challenges. There is a need, for example, for greatly increased coordination among the major Council and BPA-supported supplementation programs in the Yakima, Hood, Grande Ronde, Imnaha, Salmon, and Clearwater rivers subbasins in order to answer basic questions about the efficacy and potential limitations of supplementation as a rebuilding tool. The need can be met through development of coordinated monitoring protocols and standardized "common currency" data that allow retrospective comparisons between programs, stocks, and geographic locations.

The ISRP believes the subbasin planning effort and the subbasin plans were not adequate with respect to their consideration of artificial production. Almost without exception the subbasin plans failed to adequately describe artificial and natural production elements within a subbasin and to provide a defensible overall production plan that integrated artificial and natural production with programs addressing the subbasin's limiting factors. The artificial and natural production components were either missing or were not linked to habitat limiting factors and proposed restoration activities.

Recommendation: The ISRP recommends that a defensible overall production plan be developed for each subbasin that integrates natural and artificial production elements and explicitly links them to prioritized habitat limiting factors and proposed habitat actions identified in the Subbasin Plan.

Ocean and Estuary

The Council's 1994 FWP included the statement that "*Because most of the loss of salmon and steelhead production as a result of hydroelectric development has occurred above Bonneville Dam, the Council will continue to focus its efforts in this area.*" Since 1994, the region has become more aware of the extent that anadromous fish are affected by changes in the estuary, nearshore, and ocean conditions and the potential negative effects of operation of the hydropower system on those areas.

The 1996 Power Act amendment added to these concerns by calling for the Council to consider the impact of ocean conditions on fish and wildlife populations in making funding recommendations. The Council's initial policy response to this charge was adopted in an issue paper entitled *"Consideration of ocean conditions in the Columbia River Basin Fish and Wildlife Program"* (Issue Paper 97-6) on June 3, 1997. In 2000, at the Council's request the ISAB (with significant overlap of membership with the ISRP) released a report examining the impacts of estuarine conditions and management on the Council's mission to *"…protect, mitigate and enhance…"* fish and wildlife in the Columbia River as affected by development and operation of the hydroelectric system (ISAB 2000d, 2000-5).

The ISAB, ISRP, and other advisory groups have recommended funding of projects to understand the impacts of ocean, estuary, and nearshore conditions on anadromous fish populations and the interaction of human management actions with those environments. In general, the Council has supported funding of these projects and recognized the importance of the estuary and Columbia plume to anadromous fish population. In an obvious and important shift from the 1994 FWP, the Council included the strategy in its 2000 FWP to identify the effects of the marine environment (the freshwater plume, the near-shore, and the high seas) on anadromous fish and use this information to evaluate and adjust inland actions. Research efforts since 2000 have made great strides in understanding ocean cycles of variability, and in documenting habitat variability in the estuary, nearshore, and plume environments; however, our understanding of these areas is in its infancy and the ability to manage inland habitat and fisheries programs based on variable climate, environmental, and productivity cycles in the estuary and marine environments is distant and likely to remain so for some time.

Consideration of the impact of ocean conditions on fish and wildlife populations is not exclusive to the Council's Fish and Wildlife Program. A number of multidisciplinary efforts and programs, whether regional, national, or international, continue to devote significant efforts on research, monitoring, and evaluation to understand the forces driving variability in the northeastern Pacific Ocean and how these affect ecosystem productivity. Of particular interest to the Council's Program are the estuary and near-shore studies funded by the Corps of Engineers Anadromous Fish Evaluation Program. However, these studies (funded by BPA's Reimbursable Program) are not fully amendable to scientific review yet and have not been adequately reviewed by the ISRP. The U.S. Environmental Protection Agency is also expanding research on the Columbia River estuary through its National Estuary Program.

Recommendation: The ISRP and Council should encourage innovative ecosystem-based research and monitoring in the estuary, with emphasis on the effects of the hydrosystem (altered flows, primarily) on all components of the ecosystem.

The mainstem Columbia River between Puget Island (upper estuary) and Bonneville Dam remains largely un-assessed even after the subbasin planning process. This limitation has been identified by the ISRP and ISAB numerous times, but it still persists. Approximately 100 miles of river is either a gauntlet common to all up-river and Willamette River salmonids, or could be viewed as a hundred miles of restoration opportunities. At this time there is apparently insufficient information to assess the importance of this large and highly modified subbasin.

Recommendation: A more thorough assessment and increased attention in regional research, monitoring, and evaluation (RME) plans are needed for the mainstem Columbia River between Puget Island (upper estuary) and Bonneville Dam.