



**The PNAMP Fish Population Monitoring Work Group**

**The Tagging, Telemetry & Marking  
Techniques Compilation Project**

**Information Sharing, Access and Technology Transfer**

**CRITICAL PATH WORK PLAN**

**ISRP REVIEW DOCUMENT**

04/24/08

Insert updated graphics (March 09)

## Executive Summary

**What** - This document sets forth the Critical Path Work Plan for a comprehensive compilation and review of information on tagging, telemetry and marking techniques for fish. Currently, fishery management programs use a variety of tagging, telemetry and marking techniques to track animals during rearing and migration life phases, but typically answer an individual or limited number of questions using probability statistics. In some cases, this does not provide satisfactory information to understand sources of data variability or other factors such as atypical mortality or provide probable causes and corrective actions. Nor are these programs able to provide regionally comparable or spatially relevant information. The objective of PNAMP's Tagging, Telemetry, and Marking Techniques Compilation Project (TCP) is to move away from short-comings of non-comparable data by growing comparability across individual and/or subregional stock information for regional, population and or fishery management inferences using current designs or methods.

**Why** - Fishery managers throughout the Pacific Northwest and beyond currently rely on natural "intrinsic" or *human* applied "extrinsic" identification methods to distinguish individual animals or groups of animals of interest. The "data" have important implications in many diverse biological and ecological science and policy forums. These approaches both rely on the assumption that individual animals are representative of the population from which they originate and thus provide unbiased data within the study design. Yet, both intrinsic and extrinsic approaches to animal identification have pros and cons, as information can be in improperly interpreted or applied resulting in bias or misinformed management actions.

It has been over twenty years since the last effort to provide a comprehensive compilation of the information available on advances in tagging, telemetry and marking techniques. It is unknown if, or which, methods accurately measure performance benchmarks. This confounds efforts of scientists and management executives to evaluate actions and gauge the effect of regional recovery, mitigation, trust and or enhancement programs. Research, monitoring and evaluation is also used to permit specific actions and programs that may threaten viable and sustainable populations or jeopardize species altogether. These evaluations are required under a multiplicity of Acts, laws, international treaties, adjudications and voluntary programs.

Given these needs and the consequences, it is clear that dissimilar designs and methods cannot provide data of sufficient inferential power. It is necessary to improve this situation and objectively assess the current state of the science and its implied knowledge. Therefore, a compilation that reviews up-to-date information and an assessment of supplementary and or new methods while simple in nature is of high relevance.

This need was articulated over six years ago and has been continually re-enforced by managers, researchers, practitioners, professional societies and most, if not all, population monitoring programs. The techniques and their many possible combinations number in

the hundreds. Consequently, the Fish Population Monitoring Work Group's review and findings will inform and improve future TTM designs.

The compilation, investigative and product path outlined in this plan are necessary to optimize the use of tagging, telemetry and or marking technology and designs. The findings will then be reviewed and communicated widely. PNAMP believes this will improve the opportunity for data collection to provide more reliable information and result in improved analyses and more informed decisions.

**How** - To address this priority the Pacific Northwest Aquatic Monitoring Partnership Steering Committee and its Fish Population Monitoring Work Group developed and approved *The Tagging, Telemetry & Marking Techniques Compilation Project* in 2005. To date over 100 expert practitioners and managers from around the globe provided submissions in response to the First Call for Contributions. This outreach effort will continue with expanded requests for case studies, published and unpublished data. A comprehensive database and Networked Information System queries to generate the largest possible sample of tagging, telemetry, and marking techniques. The Critical Path work plan and appendices explain how this information will be compiled, organized, and assessed to make it available to regional scientists and others. The compilation is not intended to be prescriptive or propose "standardized" methods. Rather, the TCP will jointly examine the data and its potential over the next 18- months. During this time the TCP will generally continue to prepare for some form of e-publication, report, and or other form of information organization and dissemination process.

Specifically, the Fish Population Monitoring Work Group has identified milestones and technical products to provide information addressing high level management questions. Accordingly the Techniques Compilation Project will describe contemporary methods and protocols and provide the basis for consideration and prospective use in an integrated and regionally comparable set of data products.

**What** - The scope of the Techniques Compilation Project includes all populations of Pacific Salmon and many marine and resident fishes in Washington, Oregon, Idaho, British Columbia and Northern California. The scale, as initially assessed, is that tagging, telemetry and/or marking techniques, technology, protocols, and their methods are used by over thirty-one (31) population monitoring divisions/subdivisions of state, federal, provincial, tribal, and private agencies and organizations. Encompass the single most used fish population monitoring tool for contemporary and priority management decisions.

**Keywords:** Fish Population Monitoring; Tagging; Telemetry, Marking; Techniques; Methods, Protocols, Technology; Case Studies; Research; Benchmarks and Performance; Genetic Stock Identification; Harvest; Preseason Forecasting; Post Season Evaluation; Escapement; SAR; Hatchery Evaluation; Restoration and Protection Action Effectiveness; Passage; Survival; Analytical Procedures; Status and Trend; ESA, Mitigation; Conservation; Enhancement; Collaboration, and, Networked Information Sharing Systems.

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## Introduction

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) is comprised of 20 state, federal, tribal agencies and private organizations and their Executives. The PNAMP Steering Committee tasked the Fish Population Monitoring Workgroup to produce a comprehensive compilation of Tagging, Telemetry and Marking techniques (TTM) that unites distinct and individual programs, projects, and research applications. The Fish Population Monitoring Workgroup is strongly positioned to implement this task, being comprised of 156 regional scientists and agency representatives.

The findings of this project will likely support a large number of current and pending actions that rely upon tagging, telemetry and marking techniques and improve the acquisition of reliable and data needed in the immediate and distant future. For example, pending Biological Opinions that will use data to assess recent and future “jeopardy” determinations. The contents will also provide techniques to consistently collect data on productivity, mortality, exploitation and genetic stock identification.

This Critical Path Work Plan Techniques Compilation Project will facilitate a concerted effort by hundreds of contributors and reviewers to *discover* the most relevant and valuable end product(s) rather than subjectively try to *invent* the end. The tasks, work elements and milestones documented in this *Critical Path* and its appendices will allow PNAMP to incorporate information from the broadest base of practitioners and researchers possible

PNAMP believes it is necessary to deliberately match new and emerging technologies with existing research designs and implementation techniques. The Techniques Compilation Project provides a basis for determining whether work currently underway is sufficiently addressing the regions most pressing data needs. This plan outlines a path to achieve this by linking current and emerging options to existing and proposed ecosystem and population research, monitoring and evaluation (RME) projects and key management questions (PNAMP, 2008 and [Appendix IV](#)).

This compilation will organize information into logical topical and technique categories. Two more Calls for Contributions will be made to over four-hundred individuals, professional societies and agencies in the spring of 2008. Advanced literature searches of published and non-published materials will provide a basis for a gap analysis of information and techniques. A key objective is to provide the widest possible range of information support; and improvements in data collection and program efficiencies (*see* [Appendix II](#) for examples).

The Critical Path document sets forth the work plan and outlines initial goals and objectives consistent with the results of a recent PNAMP poll (PNAMP 2007) identifying primary and secondary management questions. A preliminary analysis identified over thirty categories of questions and management decision processes where TTM is either the primary tool for, or an important component of, data collection. The Critical Path

work plan is compiled and organized in a manner that links the appropriate techniques to the relevant fish population management questions. Documented examples of specific needs and requests for products and statements that support PNAMP as the appropriate organization to conduct the investigations are provided ([Appendix V](#)). This plan describes the path by which PNAMP will help advance the science necessary to answer these questions with increased confidence (FPM, 2008).

## **General Guidance for the Work Plan**

### ***Goal***

*Profile on-going, individual, disparate efforts implementing the science of tagging, telemetry and marking into a compilation of global expertise that can analyze to advance fish population monitoring techniques by providing the basis for learning from collective experience.*

### ***Objectives***

1. By August 2009, provide the region with information and analysis that will facilitate optimization of the use of tagging, telemetry and or marking technology and designs.
2. Provide findings that are organized, peer-reviewed and can be communicated widely.
3. Increase the opportunity for data collection to provide more reliable information and result in improved analyses and more informed decisions.

To date, over 100 authors, from six Countries, seven Universities and seven of the United States have submitted proposals to provide findings, case studies, methods, protocols and designs to be reviewed by this project. An unexpectedly large response resulted from the first outreach effort in November 2007. Second and Final Calls are scheduled for March and April 2008. The formation of an ad-hoc collaborative network that is approaching 400 researchers, practitioners and managers will generate a voluminous body of material for review.

This plan does not yet describe the final form of the main technical products, appendices, and networked information system resulting from this project. However, the following work plan sections provide details that have been input into a Microsoft Project<sup>®</sup> management system ([Appendix I](#)). A conceptual Networked Information System is also described with investigative information provided in [Appendix III](#). The following section describes several platforms and approaches for how PNAMP will organize, maintain and make information available and easily accessible.

### ***TTM First Principles:***

1. Consistent data standards and collection protocols are necessary for efficient project, program and resource allocation;
2. Information sharing is essential for coordinating many regional and local programs and projects;
3. A technical framework comprised of methods, protocols, design elements and training and implementation elements is necessary to help succeed in meeting the stated goals and expectations of the TCP;
4. Review and careful analysis of existing and new information presented by the contributors is necessary to consolidate and summarize the best available science;
5. Delivery of well-organized and accessible findings is required to meet the project goal and objectives, and,
6. The project's value is maximized by including new and relevant techniques, technology advances, methods and protocols in a systematic manner.

## **Methods**

### ***Summary of Steps***

Over the course of developing this project the FPM has held five meetings, numerous conference calls and small group discussions. The FPM has produced eight “updates” to the full FPM (156 member list), the PNAMP Steering Committee and many of the existing RME regional organizations and individuals. Over 130 individual review documents have been developed from nearly 700 drafts and information files. An ad-hoc network of over 400 TTM practitioners, academics, biologists, technology developers and agency/organization members has been established.

1. The current draft of the Critical Path Work Plan was developed iteratively over the course of many months. Its final version, due by the end of March 2008, will contain the fullest detail available from work that has been on-going during this time.
2. The final draft will be reviewed by external groups and individuals.
3. All review comments will be compiled and responses will be documented.
4. A draft set of ~60 task elements have been input into a draft MS Project.
5. Currently, the FMP has staged six planned SC briefings, four FPM meetings, and four concurrent subcommittee workshops to perform and complete project tasks.
6. In sum, these tasks are:
  - a. Seek and compile information;
  - b. Organize, review and analyze methods, protocols, technology and designs;
  - c. Report findings in a form or forms to be determined by the projects activities and the members of the PNAMP Steering Committee; and,
  - d. Disseminate, update and maintain the information in a form(s) to be determined by the projects findings.

## ***Data Defined***

In this project, information has more forms than just data. Rather, it is described as the sum total of compiled TTM literature, unpublished works, case studies, methods, new technology and experience. This approach is used in other disciplines to address the absence of data and or well-designed and reported case studies. The FPM work group and subcommittees seek:

1. written, peer-reviewed and referenced materials
2. case studies
3. proposed, in process works
4. well-documented reports
5. other information that contributes to the base of knowledge

The plan also allows unlimited appendix material (data defined). This provides an excellent opportunity for contributors to provide alternatives approaches for review and consideration. The FPM will consider *all* comments made in response to this project, but will request additional information if the comments conflict with the preponderance of information obtained by the compilation.

## **The Critical Path Work Plan**

All successful projects require a clear framework that integrates resources and implement a chronology of steps a functional end.

This sequenced process will make the Critical Path Work Plan final in March/April 2008. Then, work will be consistently updated and compared against subsequent (MicroSoft) baselines. The review comments on draft products and achievement of milestones will provide the impetus for following or refining the appropriate steps and timelines.

The following tasks are to be completed for the March 2008 SC summary:

1. Meeting notes and any final comments for consideration for the March SC meeting;
2. The Critical Path Work Plan with MS Project tasks and summary reports appendices;
3. Gantt sequencing to link all TTM tasks, milestones, reports, briefings and project deliverables;
4. Adaptive task and subtask process steps to derive the highest value end product over a 15-18 month production timeline;
5. The project's Executive Summary, and,
6. A short summary Power Point (March)

The **Critical Path Work plan** is based on the following BPA task elements will guide completion of the work plan (adapted):

1. Obtain PNAMP SC concurrence on the final Critical Path Work Plan and submit to the ISRP for review (tentatively scheduled for March);
2. Compile current information (*e.g.* existing and in process documents, publications, web sites, and data bases) on TTM methods, protocols and information management standards;
3. Catalogue compiled information in a structured format organized by the management questions identified in PNAMP's survey (FPM workshops 1 & 2);
4. Begin a gap assessment of additional needs based on a review of existing information and its current utility (FPM subcommittee 1); [Appendix IV](#) (\*add names)
5. Identify options for developing a web-based platform for housing the TCP product (FY08). Based upon the findings further explore a regional TTM information resource and coordination tool in FY09.
6. Obtain PNAMP concurrence on the structure and content of a prototype web-based resource.
7. Facilitate development of a FY09 multi-party work plan for review by the ISRP (August 2008). Facilitate review and concurrence on FY09 work by PNAMP and ISRP/AB and others.

This TCP will encompass a wide range of TTM science on the use and application of fish population monitoring protocols, methods, technology and designs in common use today. The information will cover ~50 methods x 31 management information and decision processes. Eventually, each of these TTM methods and or technology advances may directly and significantly affect the highest levels of decision-making for hundreds of individual populations. Thus, the way to begin with an integrated baseline (*i.e.* judicious use of software and hardware) is to incorporate and manage emerging and known information adaptively.

### ***Organizing the Information: Practical and Achievable Steps***

The TCP proposes initiating of the following science-based approach, to move beyond expert opinion, to compile and organize tagging, telemetry and marking "data:"

1. Collect the data (*i.e.* compile TTM science, technology, and designs)
2. Pedigree the data (two FPM subcommittees to QA/QC data)
3. Identify the gaps (basis for the next targeted requests)
4. Secure the necessary resources (contributors, FPM and outside peer-review, funding)
5. Evaluate and manage the data (form logical parts, sections, index, appendix information etc.)
6. Summarize the findings (editing process TBD)
7. Formal PNAMP recommendations (TBD)
8. Publish and or disseminate findings (final form or forms TBD)
9. Update as new and relevant information becomes known.

*\* Is more detail needed here, or can we link and rely upon the task list from MS Project?*

A full and summarized graphic timeline can be seen in the MS Project Appendix. (can put a simple Visio summary here.)

The Critical Path Work Plan also describes methods and mechanisms to update the entire region when additional and relevant TTM information comes online making this approach inherently more efficient and cost effective than traditional publication approaches. This is possible with a dual approach of using (1) e-publication as a familiar and attractive method to acquire the largest possible sample of information for analysis and reporting, and, (2) a simple Networked Information System to organize and circulate PNAMP findings and the supporting information itself. (Clarification on whether this is as a required part of the BPA contract is being sought.)

### ***Adaptive Management***

Even though adaptive management remains a promise unfulfilled, it is included as a foundation in many management and recovery plans. Monitoring programs explain *how* the data to *adaptively manage* is collected. Monitoring data is the element of adaptive management that will validate or adjust restoration, mitigation, and enhancement and/or conservation actions quantitatively. Thus, monitoring through tagging, telemetry and marking provides much of data that makes adaptive management possible. Currently, genuine and effective adaptive management programs are rare due to poorly-designed RME programs and failure to use, or have access to, contemporary TTM technology; this is because the majority of techniques were designed for stand alone, project scale use.

Unfortunately, the ability to quantitatively test for the “biological confirmation” that Kai Lee and Jody Lawrence (Lee, 1993) recommend be used to determine whether or not restoration efforts are having a beneficial effect is often confounded. Generally, the default approach in the region is to simply repeat past mistakes, rather than learn. This is manifest in what has come to be accepted as “prioritized actions” and repeatedly altered precedence rather than supporting a longer-term “sequenced” strategic planning, implementation and monitoring (Wolf and Furstenberg, 2008 in process). Without better techniques, protocols, methods, training and a basic information support and organization system, data with an acceptable level of inferential power will remain elusive. TTM and its NIS systems approach are specifically designed to support adaptive management and informed decision processes. This catalytic, long-term vision has been in place since this task’s inception.

### ***Practitioner Guidance Section***

The TCP will include sections and information on practitioner techniques, methods, data management, staff training and implementation procedures in each chapter, similar to the *Salmonid Field Protocol Handbook* of publication (Johnson, et. al 2007),

### ***Scope of Techniques***

The scope of this effort will include:

1. Satellite Tags
2. Archival Tags
3. Acoustic Tags and Acoustic Arrays
4. Chemical and Biological Markers
5. Radio Telemetry
6. Transponder and Non-electronic Tags
7. Integrated Approaches
8. Tagging Data in Fisheries Management
9. Type of tagging project and research, monitoring, and evaluation effort
10. Purpose of the monitoring (what is the relevant management question)
11. Entities utilizing the technology and/or resulting data
12. Cost of the monitoring
13. Supported by short- or long-term funding source
14. Experience of project to date, accomplishments and failures

### ***Profile for Each Technique***

In addition to the technical information, each contributor will be asked to provide information on logistics. In PNAMP's 2006 John Day protocol comparison tests (publication in process), one of the conclusions clearly demonstrated bias and significant variability that can affect the data when consistent training and logistics are not provided ahead of data collection through any guidance, techniques or protocol documents.

The following list will be further developed by a subcommittee of the Fish Population Work Group to develop a profile for the each technique that includes:

- a) The physical characteristics of the tag, mark or interrogation system;
- b) How the tag, mark or interrogation system works;
- c) How the tag, mark or interrogation system is deployed;
- d) Life expectancy of the tag, mark or interrogation system;
- e) Equipment Needs,
- f) Training Needs;
- g) Infrastructure and labor needed;
- h) The cost of the tag, mark or interrogation system;
- i) Advantages and disadvantages, and
- j) Examples of use in projects and/or programs ("Case Studies Section).

***Criteria for profile content selection:***

In addition to using of the Management Questions approach, the following threshold question will be applied by one of the FPM TTM subcommittees:

1. Will inclusion of the proposed information increase data comparability and rigor?
2. Will inclusion of the proposed information aid in identification of program efficiencies targeting the region's priority management questions?
3. Will inclusion of the proposed information provide practitioners, program managers and their staff with clear training and logistical information?

***Benefits, Products, and Services:***

1. Improved data quality and management across the thirty-one management sectors (see [Page 11](#))
2. Broadened and possibly extensible functionality for status and trend, harvest regimes etc;
3. Improved inferential capacity through optimization of design criteria recommendations, and science methods commonality with other programs and,
4. Operative product dissemination, communication and tools to create an enhanced RME network of scientists, researchers, managers and policy/decision makers at the full PNW scale. Examples include e-publication, a Networked Information System (see [Page 12](#)) and or through the proposed Communications Director, and the pending IT specialist and data steward positions.

***Management Questions as a Foundation***

The list of key management questions and sub-questions included in 2006 PNAMP Management Question survey, *see* [Appendix IV](#), is the result of a collaborative effort within PNAMP and the federal RME process, and provides a basis for increased comparability with other regional efforts. A majority of questions that TTM techniques can answer will be solicited and identified as additional contributions or results from internal investigations in the gap analysis (FPM Subcommittee). The FPM believes this is a better approach than second and subsequent editions of technical compilations which require years to get to press.

The immediate need for a project with high utility for increasing consistent use and application of TTM technologies and methods is compelling. Sound science will be required to monitor performance standards and benchmarks for existing Habitat Conservation Plans, pending and existing biological opinions, and the ~12-15 federal ESA recovery plans and their actions. Many of these are in process; others will be coming on line very soon and will be in place for many years. To meet and sustain these requirements PNAMP must produce the best product possible with a long-term and

reliable support system, an effort that will require both in-kind and direct funding support.

## **Rationale**

### ***Taking Action***

This project is important because tagging, telemetry and marking provide much of the data that underpins adaptive management. Adaptive management is dependent upon biological confirmation that planned actions have had the expected effect, and any program changes are necessary as a consequence. To evaluate the effectiveness of actions, plans and performance measures requires unbiased data. Such data provide the building blocks for developing initial and testable hypotheses and for examination of assumptions. Examples of additional benefits include improved harvest forecasting, fishery regime agreements and permitting reviews.

Also, because there is no continuity in the application of these large and expensive projects at this time, many of them could continue using methods or designs that have not been considered within the context of multiple high-level management questions (Appendix IV). In sum, given the extent of public investment and the consequences of science and management limitations, many in government and the public are rightfully insisting that organizations managing tagging, telemetry and or marking programs coordinate efforts to link and use comparable data collection techniques. If individual projects are unnecessary, duplicative or deficient, then they are not beneficial and resources should be allocated differently.

This project has already facilitated a major improvement in coordination and collaboration. The methods proposed should result in better defined criteria for accountability. Recently, several organizations have begun to work on these issues in closer collaboration, and are increasing the potential for collecting and applying comparable data to management alternatives. *The Tagging, Telemetry and Marking Techniques Compilation* will also generate the sought after level of accountability by increasing data quality and regional convergence to more accurately and completely report population and habitat status and trends.

### ***Specific Examples***

PNAMP is responding to the strong and persistent calls for treatment of these issues by state, federal, tribal and private organizations comprising the Executive Network and its Steering Committee. This project was deemed a high priority by PNAMP's Fish Population Monitoring work group and approved by the Steering Committee because of the recurring needs identified by numerous sources. At the initial work plan meeting of the FPM the need for this project was identified as a top priority and the Steering Committee concurred.

Thus, PNAMP, its Fish Population Monitoring work group and leaders and the Bonneville Power Administration (funding) are responding to the strong and persistent options for consideration of the Independent Scientific Review Panel (ISRP) as raised initially in their [first report in 1997](#) and repeatedly raised in the following reports:

1. The ISRP Preliminary Review of 2007-09 Proposals [Report No. 2006-4](#)
2. The ISRP Retrospective Report. [Report No. 2005-14](#)
3. The ISRP 2006 Fiscal Year Proposals for Acoustic Tracking. [Report No. 2005-19](#)
4. The ISRP Database Review. [Report No. 2000-3](#)
5. The ISRP2006 Retrospective Report  
<http://www.nwcouncil.org/library/isrp/isrp2007-1.htm>

Additionally, FPM representatives are participating and/or conferring with the following technical meetings and symposia:

1. The 2007 Annual Meeting of the American Fisheries Society—San Francisco—  
<http://www.fisheries.org/sf/>.
2. Recent Advances in PIT-tag technology for fisheries (<http://www.fisheries.org/sf/>).
3. The Tagging and Telemetry Focus Group White Paper (various agencies)--  
[https://www.nwp.usace.army.mil/pm/e/afep\\_system.asp](https://www.nwp.usace.army.mil/pm/e/afep_system.asp)
4. Summary of Fish Tagging and Evaluation Techniques Currently Used in the Columbia River Basin (NPCC and ACOE)—<http://www.fisheries.org/sf/>.
5. The Imaging and Geospatial Information Society ([asprs.org](http://asprs.org) annual meeting in Portland, OR., April 2008).
6. 2008 Annual General Meeting of the North Pacific International Chapter of the American Fisheries Society—<http://www.npic-afs.org/>
7. Advances in Fish Tagging and Marking Technology—Auckland, New Zealand., February 2008)—<http://www.fisheries.org/units/tag2008/> (AFS/ASOB).

The June 2007 issue of *Fisheries* (Vol. 32 No 6) provides clear and convincing rationale for PNAMP to continue and expand its organized efforts and ask for contributions and contributions.

*Measurement is the key technique in most investigations of fish and shellfish. The ability to identify individual and groups of fishes, as well as their habits, movements, and mortality, is crucial to effective fisheries science. The methods used must be appropriate, accurate, and repeatable.*

*While uncertainty is an integral part of dealing with biological systems, as scientists it is crucial that we use methods that minimize uncertainty in order to improve the conservation and sustainability of fisheries and aquatic resources. In June 1988, over 400 fisheries and aquatic scientists gathered in Seattle, Washington, for the "International Symposium and Educational Workshop on Fish-Marking Techniques." This landmark event included presentations on virtually every fish tagging method in use at that time. The ultimate product was the 1990 publication *Fish Marking Techniques*, American Fisheries Society*

*Symposium 7, arguably one of the most influential fisheries publications in decades. In the nearly 20 years since that symposium, the world of fisheries science has changed dramatically; the technologies and analytical procedures available for marking and monitoring fisheries have evolved as well. Fish marking technologies on the cutting edge two decades ago are now commonplace, and new technologies are developed yearly. **Clearly, the time has come to bring together again global expertise on fish tagging techniques and data analysis [emphasis added].***

The TCP initiative is PNAMP's response to the Fisheries article and explains why the FPM and authors are coordinating and collaborating locally, regionally and internationally.

If the necessary resources and support are provided, the *Tagging, Telemetry and Marking Techniques Compilation*, and its potential findings, are scheduled to be completed in August 2009.

## **Uses of TTM Technology and Designs for Fish Population Management**

### ***Informing and Optimizing Decision Making***

Designing studies to collect unbiased data is essential to the evaluation of the effectiveness of actions, plans and performance measures. They provide the building blocks for developing testable hypotheses and intermittent confirmation of assumptions under standard designs. Other examples of benefits include improved: harvest forecasting and regime agreements, rate case development, relicensing and permitting reviews.

### ***Examples of science and management's use of TTM data***

1. Status and Trend Fish Population Monitoring;
2. Run-Size Forecasting;
3. In-Season Harvest Monitoring;
4. Harvest Allocation;
5. Harvest Rates by population;
6. International Harvest Allocation and Rates;
7. Delayed Mortality;
8. Hooking Mortality;
9. Predator Indexing, Standing Stock and Juvenile Consumption Rates;
10. Post Season Evaluation; Escapement;
11. SAR calculations;
12. Adult and Juvenile Survival Studies for Viability and Sustainability;
13. Spatial Distribution;
14. Habitat Productivity;
15. Estuary Use and Survival;
16. In River Habitat and Microhabitat Use;
17. Ocean Use, Survival and Productivity;

18. Migration Routes;
19. Run Timing;
20. Passage routes, mortality and survival;
21. Total Gas Saturation Monitoring;
22. Benchmarks and Performance for mitigation and recovery actions;
23. Habitat Action Effectiveness Monitoring;
24. Watershed Condition Monitoring;
25. Genetic Stock Identification;
26. Otolith Microstructure and Microchemistry Techniques;
27. Hatchery Evaluation;
28. Supplementation Studies;
29. Stray Rates and Locations;
30. Research, Monitoring and Evaluation design evaluation, and
31. Validation Studies for Legally-Mandated, International Adjudicated and/or Interlocal Agreement Monitoring.

## **Impetus for a Simple Networked Information System (NIS)**

The FPM has also outlined an information and support system that will provide a simple way to share and communicate results. An example of what we wish to see comprises two parts: 1) a web system resembling the following template (<http://www.eenews.net/>) and 2) a Communications Director for PNAMP. This system and position will be used to report improvements in designs, protocols and techniques and tangible and formally peer-reviewed products. The TCP will review hundreds of articles, journals and publications to determine feasibility of scholarly electronic publication and the opportunities for dissemination through NIS systems. Our investigations have confirmed the legitimacy of e-publication (Johnson et al 1995), the peer-review standards (Crow, 2002) and the form and functions NIS systems provide (CNI, et. al 2008—[Appendix III](#)).

Simply put, an NIS is necessary given the volume of the work in progress. Further, the significance of contemporary decisions and management requires our best efforts to develop logical and superior data collection processes and the capacity to implement the options developed by these efforts.

## **FY 07 Funding and Work Completed**

### ***Summary of Work to Date and the Final Product***

Since the FY09 SOW scoping work must begin in April, several work elements have been staged. Progress towards the March milestone and the deliverables are being prepared for draft dissemination at this winter's SC briefings. The FPM will provide pre-March meeting products and information so that the decision process will be informed and can be accomplished at the March SC meeting.

Since tagging, telemetry and marking programs are the most broadly and extensively used tools for fish population monitoring and the need to provide better science is clear, the TCP requires a high level of practitioner/participant interaction. Specifically, cost sharing will be a required element beginning in October of this year.

The TCP will require that each PNAMP representative consult with their Executives and agencies and plan for this eventuality. The FPM will provide a preliminary budget estimate for the cost of this update and maintain advances in TTM from the twenty-two year-old techniques manual by March.

### ***Completed Tasks and Deliverables to date***

1. Convened Expert Workshop with 27 regional TTM participants;
2. Established an international network of 400 TTM scientists and practitioners;
3. Established two oversight committees (one combined remains):
4. Published a First Call for Contributions;
5. Attended the San Francisco American Fisheries Society Meeting;
6. Presented the TTM project to the 2,500 participants in San Francisco;
7. Attended the North Pacific International AFS meeting in Bellingham—provided the 2<sup>nd</sup>. Call for Contributions. This call will go out in early May 2008 to our current network of 400;
8. Coordinated with the PNAMP Steering Committee on work plan development;
9. Developed two BPA contracts in PISCES;
10. Received 22 manuscript proposals from over 100 authors from the First Call;
11. Developed a work plan to compilation our internal FMP processes;
12. Developed the FY08 BPA Contract;
13. Began investigations into Networked Information Systems, and,
14. Began literature review into Scholarly Publication via electronic information

Second and final calls for compilation materials will be sent out this spring 2008 based on interim refinements, identified topical gaps, and reviews of this Critical Path.

### **Conclusions**

Since TTM covers at least thirty-one aspects of fish population monitoring this is a high priority project for nearly all Pacific Northwest state, federal and tribal agencies and for many RME organizations and private businesses.

The need and value for updating tagging, telemetry and marking compilation comes from a diverse and extensive audience of scientists, professional societies and policy leaders in many forms including direct testimonials, reports, retrospective analyses, and direct requests to PNAMP.

In the past funding and support for tagging, telemetry and marking programs suffered to the point where natural resource management and courts had to make questionable decisions based on variable interpretations, resulting in the common sense call for collaboration, objectivity, confidence and fiscal accountability. RME programs conducted in isolation with no set of common guiding management goals, objectives or testable questions have lacked defined and consistent methods, adequate training, basic data management infrastructure, analytical consistency and quality control. This generated inefficiencies and has provided little in the way of dependable scientific assessments and resultant counsel for policy and legal decisions. This made it much more difficult to defend resource management policies because the science itself suffered from poorly-articulated and unproven results.

Similarly, the lack of long term commitments to funding has handicapped much of the RME work in the region. This continues to be the case while fish and wildlife populations, continued their precipitous decline and ecosystems and habitats degraded. Results were typically accepted if they were peer-reviewed. However, the realities of public needs, economics and legal obligations have cofounded the actions and allocation of non-RME project funding. These factors may have contributed to a present-day situation that continues to allow: harvest levels to be set on questionable and imprecise data analysis; unanswered questions about the role and effects of artificial production; identification of limiting factors; and actions that may in fact exacerbate the sustainability and long-term viability of species.

It is a weakness of regional restoration efforts that considerable public funding of actions intended to improve population status and habitat/ecosystem conditions are predicated on current RME standards not designed for program scale. The Fish Population Group has completed a number of investigations, meetings, consultations and analyses tasks to provide the components for this Critical Path Work Plan. By following this work plan, the Tagging, Telemetry and Marking Techniques Compilation products will be full available in August of 2009. Interim products may also be approved for dissemination by the PNAMP steering committee based upon their context and relevancy as it relates to the overall goals and objectives of this project.

## **Appendices:**

- I. Microsoft Project Management Examples
- II. Submissions to date
- III. A Simple Networked Information System
- IV. Management Questions and Gap Analysis
- V. Science, Manager, and Practitioner statements of focus and support

## **Attachments:**

1. MS Project Draft
2. Select MS Project .pdf examples and preliminary task list