PNAMP Intensively Monitored Watersheds 2013 Workshop NOTES

March 20 - 21, 2013 · (Day 1: 8:30 a.m. – 5:00 p.m.; Day 2: 8:00 a.m. – 4:00 p.m.)
Ambridge Event Center, 1333 N.E. Martin Luther King Blvd., Portland, OR

Workshop Objectives

Provide an opportunity to share and discuss information, to ultimately:

- Improve existing Intensively Monitored Watersheds (IMWs)
- Offer guidance for new IMWS
- Identify ideas (actions) for next steps

Workshop Results

- Attendance: more than 80 individuals from 35 organizations participated
- Information shared
  - 15 presentations by noted experts in IMW's: posted here
  - Summary table of IMW information: posted here
- Discussion and Recommendations
  - See discussion notes below with emphasis on recommendations for next steps
- **Please participate in our survey** regarding your interest in next steps and input about this workshop: http://www.surveymonkey.com/s/CRF8XFP

➢ **Meeting materials are linked throughout the agenda and can also be found at**: http://www.pnamp.org/event/4127

Actions Proposed

- Use workshop results to draft a framework document ("IMW manual") that outlines general guidance for developing/planning new IMWs
- Establish web presence for information sharing among IMW practitioners
  - Document sharing
    - Improve content breadth at PNAMP IMW project page as it exists now http://www.pnamp.org/project/3133
    - Link to other websites, data repositories as they are identified
  - Discussion forum(s) to discuss IMW issues, interests
    - https://www.monitoringmethods.org/Discussion/Index
      - If there is interest in pursuing the use of the discussion forum at monitoringmethods.org, a new landing page could be developed and content would be restructured so discussions are grouped by topics.
      - Input from IMW workgroup is needed
- Improve communications
  - Among IMW practitioners – regular interaction (workshops/webinars)
  - Between IMW practitioners & management/policy staff
  - See offer from NOAA and BPA staff to assist with communications projects (Link to section of notes)
- Establish task specific teams to
  - Develop generalized framework (would be addressed in manuscript)
  - Develop specific recommendations with respect to:
    - Design, including more emphasis on analyses of causal mechanisms to increase transferability of IMW results to other watersheds
    - Flexibility in IMW design and analysis, restoration often doesn't go as planned

        - Metrics, including discussion of interest in a set of shared metrics
        - Data Management
            - Data documentation
            - Data sharing agreements
    - Explore potential for meta-analysis across IMWs; need to determine if there is enough data, any funding, and who's interested in participating. Coordination between analysis approaches of IMWs is needed.

Acknowledgements

For their investment of time and energy to make this workshop a success, the PNAMP staff and Steering Committee would like to thank the workshop planning group: Stephen Bennett, Chris Jordan, Phil Roni, Bill Ehinger, George Pess, Sean Gallagher, Keith Dublanica, Michael Newsom, and Frank McCormick. We would also like to thank the presenters and discussion session moderators for their time, as well.

Day 1 – Wednesday, March 20, 2013

Presentations:

- Welcome to the IMW Workshop- Jen Bayer, PNAMP Coordinator, U.S. Geological Survey
- Intensively Monitored Watersheds: Definition, History, & Challenges- Phil Roni, NOAA Northwest Fisheries Science Center
- Oregon Coast IMW Cummins & Tenmile Paired Watershed Study- Erik Suring, Oregon Department of Fish and Wildlife
- Hood Canal IMW Study – does habitat restoration improve Coho production and survival?- Kirk Krueger, Washington Department of Fish and Wildlife
- Evaluating Fish Response to Habitat Protection and Restoration: The Washington IMW Project- Bill Ehinger, Washington Department of Ecology
- Lower Columbia River IMW- Mara Zimmerman, Washington Department of Fish and Wildlife
- ISEMP approach to IMWs in Idaho, Oregon, and Washington- (3 presentations in 1) Chris Jordan, NOAA Northwest Fisheries Science Center ; Nick Bouwes and Stephen Bennett, Eco Logical Research, Inc.; Pamela Nelle, TerrAqua, Inc.; Chris Beasley, Quantitative Consultants, Inc.
- Upper Middle Fork John Day River IMW- Jim Ruzycki, Oregon Department of Fish and Wildlife
- Wind River IMW: Steelhead Responses to Dam Removal and Habitat Restoration- Thomas Buehrens, Washington Department of Fish and Wildlife
- Elwha River Dam Removal Fish and Habitat Monitoring- George Pess, NOAA Northwest Fisheries Science Center (presentation not available)
- Methow River IMW- Michael Newsom, U.S. Bureau of Reclamation

Day 1 Closing Comments –Chris Jordan (NOAA)

- Think about what the **M** in IMW stands for - monitoring, manipulations, something else?
- IMWs are large scale ecological experiments, so the trick is to have a big enough manipulation in these experiments to see a signal/detect a response.
- One major question that everyone focuses on and reports out on: What is the effect of habitat change on fish populations?
    - We continue to review fish methodology, analyzing and re-analyzing data to get at metrics, response, life history information to answer this question.
- But, we are constantly focusing on the SCIENCE and forgetting about the communication and coordination
    - What we really need more focus on is communicating with each other: what hasn't worked and why?
    - Let's focus on our failures -- these failures of ecology -- so we can learn from our failures and pass these lessons on to each other.
        - This workshop is an opportunity to share those mistakes so others don't repeat them
        - Consider the best ways for us share lessons and for others to learn

- In all of these IMWs, coordination with partners and land owners is the BIGGEST limiting factor.
    - Social science issue – need someone to help with communication and identify which communities and partnerships will best foster IMW work.
    - Consider how we can better communicate with people so this work can keep moving forward
    - Important to remember that our value system is not shared with everyone we need to coordinate with; Example: a stream side land owner bought that property so they could enjoy looking at the creek, not the backside of the willow! (Want to keep riparian area groomed - which is in conflict with restoration goals) - How can we work with these folks?
    - We also need to consider that most areas have been altered so extensively and for so long that for many locals, their memory doesn't know what a natural system looks like or what to expect from a restored system.
        - We need to consider how restoration projects will change people's enjoyment/interactions/use of the system; how can we do a better job of communicating outcomes with partners and stakeholders

DAY 2 – Thursday, March 21, 2013

Presentations:

- Potlatch River IMW- Brett Bowersox, Idaho Department of Fish and Game
- The Skagit IMW: Examining the Effects of Estuary Restoration on Chinook Salmon- Correigh Greene, NOAA Northwest Fisheries Science Center
- Salmon Life Cycle Monitoring in Coastal California- Sean Gallagher, California Department of Fish and Wildlife

Break-out Discussion Groups: The workshop included short discussion sessions organized by specific topic. Our focus was on sharing lessons learned, current issues, and identifying recommendations. These are very short synopses of each discussion session; for full notes, please contact Jen Bayer.

Experimental Design Metrics, and Analyses Discussion Summary – handout

The following notes are based on breakout sessions with the entire group (Experimental Design), and further discussions with smaller groups on Monitoring Designs, Sampling Designs, Metrics, and Analyses. Discussion groups were led by Phil Roni, George Pess, Nick Bouwes, Steve Bennett, Chris Jordan, and Michael Newsom.

Experimental Design - Problem Statement and General Conclusion:
IMWs are experiments at the watershed or sub-basin scale with the overall goal of answering two basic questions: 1) is a particular restoration action effective at increasing salmon and steelhead populations, and 2) what are the mechanisms that are causing the population response. To design an IMW experiment practitioners need to know:

- What is the presumed link between the restoration action and the life history requirements of the target species
- How much restoration is required to be able to statistically detect a response (requires a power analysis)
- What are the limiting factor(s) on the population?
- What is the timing and type of restoration proposed
- How availability are treatment and control areas
- What are the potential confounding factors on the experiment
- What are the expected habitat and biological responses
- What are the key life history requirements of the species of interest (or develop design to fill in gaps in knowledge)
- Is baseline monitoring possible
- Is long-term funding and access to monitoring sites available and secure

The group recognized that there is a need to develop a framework that outlines general guidance for developing an IMW experimental design and there is a need to clarify terminology, document agreed upon definitions, and then begin using them consistently when discussing IMW designs. However, a one size fits all approach for experimental designs is not

appropriate. A framework document could identify a process for developing an IMW design but not necessarily impose design constraints. Ultimately an experimental design needs to be based on the goals of the study.

Several IMWs have been running for some time now and it would be helpful to document a list of lessons learned regarding appropriate experimental designs. The following is a short-list of some lessons learned. A more complete list will be developed in a forthcoming IMW manuscript.

- Have a modeling framework upfront—this is key to building a successful IMW
- Restoration work and monitoring design need to be well coordinated
- Power analysis of the design and analyses is essential
- Standardization of terminology is essential (e.g., controls and reference sites are not the same)
- Communication/collaboration between practitioners and monitoring agencies critical
- Some type of IMW review board would be beneficial (link back to implementation necessary)
- Coordinate with other managers in watershed
- Plan for a large manipulation; small or scattered efforts will not produce a detectable response
- Designing experiment to accommodate "failure"
    - look at multiple spatial and temporal scales
    - have multiple controls
    - Focus more on processes or mechanisms that influence a response (so even if the response is negative the experiment will important knowledge to the broader community)
    - Have a backup question or plan in case you have unforeseen problems and are unable to answer your original question

Experimental Design Types
Workshop participants identified several experimental designs being used by IMWs including before-after (BA), before-after-control-treatment (BACI), staircase, hierarchical and combined hierarchical-staircase (HS) designs. There are no current standards for IMWs experimental designs but it is recognized that BA are not as robust a design as BACI, and there is some evidence that HS are more robust because they take spatial and temporal scales into account and are flexible in regards to the timing of restoration implementation. Regardless of design type, pre-treatment data is recognized as being essential. It is also important to understand that both negative (further degradation) and positive (habitat recovery) may be ongoing in a study watershed and these trends could confound any experimental results if not fully recognized.

Some IMWs are explicitly implementing and designing their experiments in an Adaptive Management framework. This is strongly advised because of the number of political, financial, biological, and management uncertainties when working at the scale of a watershed. Essentially you want to learn and adjust as the experiment progresses and new information and knowledge becomes available. An explicit adaptive management cycle should redefine hypothesis based on multiple feedback loops throughout the different phases of the project.

Design Review Process
The above notes refer to what each IMW could do to develop and improve an experimental design. The group also noted that it is important that some type of review process be implemented at the regional scale to help develop a set of standards for IMW designs. This would help stream line data gathering and analysis and increase the ability to do meta-analyses using multiple IMW projects. CADDIS (EPA) might be a useful tool to evaluate and look for design deficiencies. It is likely that in the past, not enough time was dedicated to developing an IMW design and therefore, new IMWs should plan for at least a year of design and data gathering work before trying to implement an IMW.

Power analyses
Most IMWs reported some type of power analysis was performed on the design or analysis of data. This is essential because IMWs are an expensive undertaking and it should be proven that there is a reasonable likelihood that an effect of restoration can be detected. Power analyses require some estimate of variance, sample size, effect size, and level of confidence. These variables can be estimated from the literature, but it may be more suitable to use local historic data and

collect data prior to developing the design. Most power analyses that IMWs are currently performing are for simple T-tests on a BA or BACI design. However, some IMWs have performed more complicated power analyses on hierarchical-staircase experimental designs which may provide better insight into the probability to detect an effect, and provide greater guidance on how to allocate treatments and sampling effort within the spatial scales of interest.

Limiting Factors - Problem Statement and General Conclusions:
In order to have a successful IMW it is important to identify the most important limiting factors within the watershed of interest. The most common sources of this information are subbasin plans and other watershed and ESA population level planning documents. However, much of this information is based on expert opinion, there can often be numerous limiting factors operating at the same time, and other factors that are not formally recognized may be limiting salmon and steelhead populations more. These issues highlight the need for a more standardized way of incorporating uncertainty into IMW designs. For example, a common limiting factor identified in subbasin plans is the lack of large pools. However, other habitat features such as gravel bars, side channels, and concealment habitat may be equally or more limiting. IMW designs need to acknowledge these uncertainties and have monitoring designs that explicitly account for them.

Metrics - Problem Statement and General Conclusions:
The majority of IMWs recognize that freshwater productivity, as defined by smolts/spawner, is a key measure of the effectiveness of restoration activities. This metric will provide for a reasonable way to compare responses across IMWs. However, the data to calculate smolts/spawner rely on very intensive adult and juvenile monitoring at fixed sites that can be difficult to maintain over the long-term due to extreme flows. Life-cycle modeling approaches can also be very informative for both developing appropriate IMW questions and for determining the response to restoration. Incorporating a life cycle modeling approach for how you are collecting and analyzing data is something that we should be focusing on as a common approach among IMWs. Other metrics such as production (g/g/area), survival, growth, and movement are being derived by some IMWs and these metrics can be used to infer causal mechanisms of responses to restoration. There was consensus that a core set of metrics and standardized reporting be required for all IMWs to facilitate larger scale analyses and learning across IMWs.

Data Analyses - Problem Statement and General Conclusions:
There are several different approaches groups have taken to analyze fish and habitat data and develop an understanding of the causal relationship between habitat change and fish responses. The common approach is *Fish in-Fish out analyses* which require adult and smolt capture data. These analyses are almost entirely focused at the watershed scale. Some IMWs are using other model based approaches to analysis such as life cycle, bioenergetics and net rate of energy intake (NREI), trophic production, food web, life history, and spawning distribution models. These approaches cover a greater variety of scales from the watershed to in some cases the site level. More discussions regarding specific analyses are still needed.

Analyses approaches to test fish/habitat relationships identified were:

- T-test comparisons
- ANOVA/BACI
- Simple regression, multiple regression
- Intervention analysis
- Life cycle modeling
- Bayesian boosted regression trees

Common Issues identified during presentations were:

- Coordinating restoration—unplanned activities in a watershed can impact the experimental design/analyses
- BACI have a large number of covariates which can reduce statistical power to detect change
- Identifying good reference/control streams for the BACI design can be difficult
- Managing expectations—most designs require time and money before changes can be detected
- long time series of smolts/spawner required to assess success
- Infrastructure for smolts/spawner is difficult to maintain due to high discharges and limited resources

- Measure of smolts/spawner also does not provide direct link to causal mechanisms of fish response (especially when measured at the watershed scale)
- How do we determine response variables for fish & habitat and what goes into calculating them:

Recommendations

- Group should draft a framework document ("IMW manual") that outlines general guidance for developing/planning new IMWs
- Group should convene and participate in an online forum to discuss IMW issues
- More emphasis on analyses of causal mechanisms to increase transferability of IMW results to other watersheds
- More coordination between analyses approaches of IMWs so that meta analyses of results can be conducted
- Restoration often doesn't go as planned; therefore, need to build in flexibility to design and analysis

Restoration Coordination and Implementation (handout); Moderator— Bill Ehinger

Problem statement: IMWs are intended to evaluate the effects of habitat restoration actions on fish populations (smolt numbers, size, survival, spawners). While all participants recognized that a substantial portion of a watershed will need to be restored in order to produce a detectable effect on fish, a common theme across IMWs was the lack of coordination between the habitat restoration actions and the monitoring intended to evaluate those actions. Several causes were mentioned:

- Funding for monitoring and restoration comes from different sources or is administered by different entities (with dissimilar priorities). These differing priorities (recovery vs. monitoring of fish response) direct restoration efforts away from IMW's.
- IMW's are viewed as competition for restoration funding
- Lack of commitment to monitoring effort by local entities

Recommendations

- Funders need to be engaged so that the funding process encourages adequate restoration in the IMW basins and coordination of restoration and monitoring with respect to the type, quantity, and timing or restoration actions.
- Some top-down guidance will be necessary to keep all parties focused on the need to monitor.
- It is critical to get the local restoration entities to come to the table and agree as part of the IMW implementation. There needs to be, if not agreement, then at least communication between scientists and restorers.
- Ideally, it would be nice to have well-coordinated IMWs but due to landowner and funding constraints, we'll not have complete control of restoration activities. Be willing to take advantage of opportunities around specific restoration actions (e.g. Hemlock dam removal).

Data Management (handout); Moderator – Kasey Bliesner

Problem Statement: Many IMW practitioners have interest in sharing data across multiple partners and/or integration of datasets; however, a variety of barriers currently exist.

- Differences exist among agencies and tribes regarding requirement for sharing data
    - Public agencies are supposed to share data, but tribal partners don't have same requirements
    - Solution could be to establish different levels of sharing (i.e., only share indicator level data vs. have to go to data collector to get raw data)
    - State agencies have a history of being decentralized – a lot of data sits on computers at field biologists desks
        - States currently working to rectify this situation, various stages of progress across states
    - BPA is trying to combine data into regional databases; rolling out a data management framework and striving to get toward more standardized databases
- Differences exist in interests with respect to data types desired to be shared
    - Synthesis of data is often what people want to see, not raw data – create MOAs with this type of language. There are some cases where people do want raw data (ex. temperature data)

    - People have data in separate databases, but don't necessarily have a connection between them (i.e., fish database, habitat database, spatial database)
    - Need to consider differences in scales when compiling data from different sources, so some pieces may not link
    - Are there common metrics that we can standardize in one database?
        - Need to decide what information is useful for the IMW community to share
        - Focus on indicator level to streamline reporting of indicator information – similar to Coordinated Assessments project – they started at this level because indicator level reporting to NOAA is required ; now it is opening up discussion about the lower level information – metrics, methods, designs
        - Practitioners often feel they have unique data they want to include, so they need to create their own database instead of putting all the data into one database
    - Concerns exist with respect to protection of intellectual property
        - Need to be explicit with people with respect to what you're sharing with them and how they may use the data
        - Some IMWs have had experiences with data being shared and used inappropriately
        - Data sharing agreements can result in more buy-in from rest of community; result is that you get more work done than what was allocated for in your funding
- Some data sharing agreements do exist:
    - Methow IMW informal data sharing agreement: developed a model and use a data harvester to bring data into model; have one year time lag agreement with partners (i.e. have to analyze and publish within one year, then data is public)
    - MF John Day – ad-hoc agreement that you won't publish ahead of/over lead investigators – this sharing allows for more analysis in a shorter amount of time
    - ISEMP has written a white paper on data sharing (link)– not agreement, but guidelines; differences for management purposes vs. scientific publication
    - Good example in Fisheries article on data management in the Great Lakes—built relational database to tie together the different types of sampling
- Metadata documentation:
    - Metadata is best documented real-time, not after the fact
    - Need for more consistent documentation –
        - practitioners need to learn more about metadata and terminology
        - make data management and metadata documentation part of contractual obligations
        - electronic infrastructure for projects to upload data to could make it easier
    - Most practitioners are using FGDC standard, but new ISO standard does exist
    - Hard to get people to create metadata records: don't want to take the time, haven't left themselves time in a contracting performance period, or haven't planned for the costs associated with documentation

Recommendations:

- Request support from PNAMP for ongoing dialog
    - PNAMP is striving to promote coordination/collaboration among different entities and will host a series of data management focused workshops starting later this year
- Establish a place where people can interact on a fairly regular basis – communicate information – here is data, we just finished report – get more discussion about specifics
    - Can use PNAMP website or other places can be developed
- PNAMP data management tools are available (www.monitoringresources.org) as well as guidance documents at http://www.pnamp.org/project/3265
- Consider developing a one-stop IMW database
    - relational database with different data types – water quality, fish, habitat
    - Issue is the difference in people's protocols
    - In Columbia River Basin—DART could start to help bring the IMWs together.

Communicating about IMWs (handout); Moderators – Lauren Senkyr/Michael Milstein

Problem Statement:

- Communication and coordination are very important to IMW success, including communicating effectively with partners, collaborators and funders
    - Why should people care about IMWs?
    - What are the most important things for people to understand about IMWs?
    - We need different communication approaches for different audiences, with range of values and interests
        - Communicating to the public
        - Communicating to funders and policy makers
        - Interface between public, land managers and research professionals
        - IMWs need opportunity to share successes and failures with each other

Recommendations:

- Learn from and share with other IMWs projects
    - Keep reviewing your fish methods -- metrics/response/life history
    - Continue to re-analyze your data
    - Share by finding ways/making opportunities for IMW practitioners to keep communicating as a group
- Work with project funders to get at what they really want (vs. what they asked for or what we think they want)
    - Understand their monitoring investment strategy
    - make recommendations for modifying these programs
    - accountability/transparency is very important
- Develop a communications plan for your IMW during the project development stage;
    - for example, develop a calendar of metrics, design, before-after (see Buhrens presentation)
    - Show effort that went into design and testing process – develop limiting factor evaluation graph (see Zimmerman presentation)
- Annual write-up and review of process/progress
- Use local news as outlet to feature IMW work
- Train field crews so they have the correct language and message to communicate with land owners and the public
- Land owner specific reports have been a successful approach for some IMWs
    - Extra follow up with the landowner seemed to go the extra mile for keeping them engaged
    - Can be as simple as a 1 page report—i.e., here are the number of fish we found on your property
    - Can be presented with a time series approach
    - Mass mailings can be sent out with additional site specific data for each land owner
    - Study sites are connected to the land owner and the database was linked to them so we could do automatic reports
- Request that websites such as State of the Salmon, PNAMP add (or add more info to) IMW page—to help educate folks about IMWs
- Use communications experts to do IMW outreach, such as communications with landowners, public

NOAA and BPA would like to put more emphasis on communicating about IMWs and have **staff available to assist with IMW communications.**

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These communications experts are offering to help you:

- Develop outreach materials for non-technical audiences, such as:
    - materials describing IMW concept and/or specific IMW's or types of IMW's
    - materials may be written and/or visual including video, animation and other venues
    - materials can be designed to be posted on a website, hand-outs or otherwise distributed through various venues

- promoting outreach through traditional and social media
- can help develop messages, or short 'plain language' descriptions and examples that help bring IMWs alive to folks and can be used in many different communications formats and venues (web, handout, media, video, etc, and by anyone interested)

- Provide guidance/advice on public involvement and other communications strategies as requested

Workshop Wrap-up Discussion

Recommendations for Current and Future IMWs

- Coordination & communication are two of the biggest challenges for IMW success
- IMWs need opportunities to learn from each other:
  - There is a need for a consistent IMW structure/format so we can more easily share and learn from each other
  - Recommend that this group develop a framework document that outlines general guidance for developing an IMW experimental design
    - Framework document could identify process, identify things to think about, not necessarily impose design constraints
    - Guidance/framework doc should also have recommendations/lessons learned - use items identified in workshop, such as (see the notes below this list for more details):
  - Convene small leadership teams that will meet periodically to keep momentum of this group, share information, develop draft framework/guidance doc, provide base for IMW internal review process – teams should be based on the breakout groups
    - Support from PNAMP
    - Have quarterly sessions to keep momentum going
    - NOW: visit Survey Monkey survey (link here) to identify your interest in these teams
  - Share information between IMWs– share reports, discuss, etc.
    - If you are willing to give PNAMP content, information can be posted at www.pnamp.org
    - We can also explore other avenues of posting material – Wikis, etc.
    - Consider online space where practitioners can post and discuss information about their IMWs, learn about other IMWs
      - Currently, an online Discussion Board exists on the Monitoring Methods site – we could explore expanding this to meet IMW practitioner needs (https://www.monitoringmethods.org/Discussion/Index)
- Consider doing a meta-analysis across different IMWs,
  - Need to determine:
    - If there is enough data - develop plan to do meta-analysis
    - If there is funding
    - Who would like to participate, lead
  - Force coordination, metric comparison
- Communication is a limiting factor in IMW success and coordinators should consider these recommendations:
  - Need communication with each other as scientists/researchers about design, databases/data management, implementation, analysis, reporting – see framework doc recommendation above
  - Need to communicate with management/policy staff to better manage their expectations about, expectations, study results, timelines, and to better support long term funding
  - Need to communicate with field personnel to assure standardization of data collection and methods over time and appropriate/beneficial field crew communications with landowners, public.
  - Need more communication and coordination with partners/collaborators, so we know who is doing what, where, and when; this includes with restoration implementers, students, or other organizations who have planned activities in the same watershed, but may have a different source of funding.

- Need communication with potential partners/collaborators—how to find and connect up with other organizations collecting data in the watershed – consider having an online space where practitioners can share and discuss IMW issues
- Need to communicate with land owners to coordinate and manage their expectations for the long term

IMW Workshop List of Participants

March 20 - 21, 2013

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