MEMORANDUM

To: John Hamilton, US Fish and Wildlife Service

From: John Hefner

CC:

Date: August 4, 2010

Subject: Independent Peer Review of the Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River

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This memorandum presents a summary of the major comments submitted to PBS&J by two independent peer reviewers on the *Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River* (July 16, 2010). Detailed comments are also provided (Attachment A) as are complete reviewer (Attachment B). The reviewer's resumes are included in Attachment C.

General Comments

The two peer reviewers of the subject document found the authors' presentation approach to reasonable and the background information comprehensive. They agreed that consistency of thought and overall logic presented in the report were good. Most importantly, the reviewers believed conclusions drawn and presented in the report seem to be scientifically plausible. Few typos and grammatical issues were identified by the reviewers. However, one reviewer felt that the there was too much use of fisheries jargon. He also felt that there was not enough map information to inform the reader about locations referenced in the report.

Both reviewers had serious concern that there was not enough use of primary literature sources and descriptions of the findings of those studies to fully support the conclusions of the report. As on reviewer put it: "…it was also very clear that they did not, in many cases, adequately mobilize and describe the relevant scientific literature and data available to defend their statements. They made their case but did not thoroughly enlist the primary studies to strongly attempt to defend or prove their case." References to primary sources and more explanation of the findings of those studies would strengthen the report considerably.

One reviewer felt that limiting the scope of the report to the effects of dams and dam removals on individual species and their populations and not considering broader community-level or ecosystem-level interactions to be a significant shortcoming of the report. The reviewer suggested that the report could be made more complete by considering and evaluating the broader riparian effects, food web effects, riparian-aquatic interaction effects, species interaction effects, or any of the more complex, higher level effects such as river connectivity and river function. Similarly the second reviewer felt that the related topic

of the relationship between diversity and ecosystem stability/services should be explored. If these omissions are intentional, the authors of the report may want to inform the reader up front.

Finally, one reviewer felt that the "total lack of quantitative evaluation and any weighting of ecological, social, and economic benefits and costs" could be viewed by some scientists as a significant report deficiency. The authors may wish to inform the reader that this more inclusive evaluation is intentional and beyond the scope of the work, if in fact that is the case.

Attachment A: Specific Comments

The following are collated near verbatim (with minor editing for clarity) section-by-section reviewer comments, questions and suggestions:

1.4.1 para. 2: The last sentence may be true, though it conveys subjective opinion about the process.

1.4.2: It is not clear that "The report…" at beginning of para. 2 and 4 is "this report" and hence, it is unclear about how this document fits into the larger process. A flow diagram of the process would be helpful.

Pg 12, footnote. It is not clear why the Ackerman et al (2006) model was excluded—specifically why could the BSG not agree?

Pg 13 para.1-3: These paragraphs describe major projects and management efforts rather than watershed condition. Recommend moving up to section 1.4.

Section 2.1.1: A couple of summary tables with 303(d) listed parameters by stream/reach and the relative discharges of each stream would be helpful.

Section 2.1.1: The headers "Conditions without dams and KBRA in…" is correct, but one could frequently read as "without dams and without KBRA" rather than "without dams and with KBRA".

Section 2.1.1.2: As written, it was unclear why Wood R. is considered a significant source of P if the Wood is 19% of P loading to UKL and 25% of discharge. These values suggest a low relative loading compared to other water sources.

2.1.1.4 para. 2: "UKL was historically eutrophic, but…" awkward sentence structure.

2.1.1.4 para.4: "Water is also lost from the lake through evapotranspiration" change to evaporation?

2.1.1.4 para.6: "…fish kills have occurred more frequently…" What resident fishes are common and what dies in kills?

2.1.2: Not clear why the authors state that the seasonality of purchased water is unknown—presumably it would become available during irrigation season, or am I missing something?

2.1.3 para.1: What is the potential for owners to sell water rights and how much water is reasonably expected to become available? Is it 5,000 AF or 30,000 AF?

2.1.3 para.2: Agency Lake Ranch and Barnes Ranch lands are not well described.

2.1.4.1 para. 3: This background para. on DO should be moved up, perhaps to a general section on WQ parameters of interest, their effects on biota and relevant thresholds. Alternatively, should at least be moved up to the first mention of DO issues.

2.1.4.1 para. 6: Last sentence—what are the months adult salmonids migrate? A figure with the run timing of salmonid populations would be useful for the reader not steeped in KB salmonids, even if stylized.

2.1.4.1 para. 7: It is not clear what Lost R. diversion channel or Klamath Straits drain are or what the flows are for.

2.1.4.2 para. 2: It is not clear why trout size in Keno ladder has declined or what other fishes are in Keno Reservoir. Jeld-Wen is not defined.

2.1.4.3 last para: It is not clear what "interrupted flows" are or whether they are naturally occurring. Also, what is the potential to restore the hydrologic function of Buck Lake?

Attachment A: Specific Comments

2.1.4.4: The "plumbing" of this reach is complex and a diagram would be very helpful for visualizing the flows, impacts, groundwater inputs, and refugia.

2.1.6 para. 4: Is there any information available on how much of a nutrient trap the reservoirs are?

2.1.9 para.2: What the effects of reed canary grass on riparian birds in general?

2.1.12 last para: How do KBRA management changes relate to future predicted drought conditions?

2.1.13 Table 1: More information on the data in this table and the data sources would help readers rigorously evaluate the information. I am still not clear what the two categories represent
(Actual post project estimates and historical and potential production estimates).
Klamathon Racks is not shown on the map or well described in the text.

2.1.13.4: Next to last para: What is the explanation for this conclusion?

2.1.13.6: Historical harvest can be used, but there is an implicit assumption that watershed habitat conditions during the 1925-1961 period and 2012-2020 periods are similar and would support similar smolt production. I suspect habitat and watershed conditions will have changed substantially between the two periods. The KlamRas model is frequently cited and should be better described.

2.1.13.6 para 1: What evidence is there for this very plausible suggestion?

2.1.13.7: Steelhead and Pacific lamprey are discussed without much background. Would
Pacific lamprey colonize tributaries above UKL as well?

2.1.14: A brief summary of the current effects of the pathogens listed would be useful here.

2.1.15: I found this section confusing because the "options" were not well described and most of the effects cited relate to conditions below IGD, not above.

2.1.16: How do KBRA conditions affect the future likelihood of disease given the known environmental changes anticipated and the effects of those changes on disease transmission and expression?

2.1.16 para.1: Additional documentation is needed.

2.1.16 last para: Clarify what is meant here.

2.1.17.3: Citations of studies on bull trout food habits could strengthen this section.

2.1.17.4 para.1: When were the two suck species listed under the ESA?

2.1.17.6 para. 3 and 4: Provide studies to support these plausible conclusions.

2.1.17.9 para. 3: The Pearsons and Temple (2010) citation is relevant if the supplementation produced natural densities of salmon; if supplementation produced unnaturally high salmon densities, the example seems misleading as this case is not expected to occur without dams. The section on redband trout is out of phylogenetic order.

2.1.17.9 Last para: Provide primary references to support this conclusion.

2.1.17.18: This statement seems weak as there will likely be increases in Pacific lamprey allowing recolonization and KBRA would presumably have positive effects via improved habitat and hydrology on resident lampreys.

2.1.18.2: In some cases in this report, it is stated that there will be little change to the existing situation. But in some cases it is not at all clear what the existing situation is. For example is the species of interest increasing,

stable or decreasing? Are there any strong or reliable trends? This seems to be important but is seldom addressed.

2.1.18.3 pg. 49 last sentence: How many nest sites would be lost? 10? 100? How are overwintering waterfowl distributed between UKL and PR reservoirs?

2.1.18.10: Would breeding bird survey data for Willow Flycatcher and Cliff Swallow be useful? (http://www.pwrc.usgs.gov/BBS/)

2.1.18.15: Are there any potential negative effects to deer if the habitat does not return to a predam condition?

2.1.19 pg. 56: The Howe (1968) citation characterizing the Klamath runs as "not equal" to Columbia runs feels out of place as the per-human run size (salmon per human) seems more important to wealth and stability than absolute run size.

2.1.21: How many salmon, steelhead and lamprey would be available in the Copco 1 and IGD reservoir reaches after removal? What is the cultural value of trading a recent non-native species (perch) with returning salmon and steelhead and lamprey? With which group(s) are the perch and bass fisheries popular? These seem important to evaluating the loss of the yellow perch fishery. The authors cite spring Chinook as more value on a per fish basis than fall Chinook; certainly the same is true for salmon vs. perch.

2.1.21.2: What is the potential for inland commercial fisheries under dam removal?

2.1.21.2: Second part of para.2: Is this extra harvest necessarily a benefit to the salmon?

2.2.4 pg 61: How might the duration of and variability in warm water periods affect salmonids and how does that relate to thermal regimes under the two actions?

2.2.4.1: Why would temperatures below IGD continue to degrade?

2.2.4.4: A short description of the current proposed dam removal plan and plans to ameliorate short term effects would be helpful. Also, through the discussion of the direct effects of dam removal, it would be helpful to explicitly define the time scales for "short" and "long" term effects. I did not follow the logic in the third paragraph of this section.

2.2.5: Table 4 has a section labeled "Geomorphic Processes" while discussion of sediment dynamics is subsumed as a topic in 2.2.5. Given the importance of dams on sediment dynamics/geomorphic processes and the importance of sediment dynamics on fish habitat, I would suggest elevating the topic to its own section, placed after sections on hydrology and temperature but before nutrients.

2.2.7 para. 2: Plausible conclusion but needs references.

2.2.7 pg. 68 first full para: Could point out that Pacific salmon and steelhead evolved in a geomorphically unstable region and have frequently been exposed to episodic high sediment loads.

2.2.7 pg 69: Many, if not most anadromous salmonid species are thought to function as metapopulations and increased connectivity and subpopulation diversity are thought to increase metapopulation (e.g., ESU) persistence. The metapopulation concept should be introduced and could be used to evaluate the potential effects of actions, especially connectivity, throughout.
Also, marine derived nutrient delivery to headwater streams is not discussed anywhere as a potential benefit to dam removal—what role did MDNs play in the historic landscape and how might restoration of MDN delivery via salmon, steelhead, and lampreys benefit these species and others (such as bull trout)?

2.2.8.3 pg 71 first full para: The meaning of this paragraph is unclear.

Attachment A: Specific Comments

2.2.8.4 para.1: Dwinnell Dam is not identified on the map.

2.2.8.6: What are the probable effects of altered temperature regime under dam removal on adult and juvenile coho mainstem migration? Specifically, would the change increase or decrease the probability of a 2002-type die-off?

2.2.8.7: Are summer, fall, and winter steelhead considered parts of the same ESU by NMFS (implied but not explicitly stated)? How much of the change in time series of abundance is thought to be related to ocean regime?

2.2.8.12 First sentence: At which locations? Mainstem? How much use of tributaries is there in these fish?

2.2.9: What is the habitat of the polychaete and how does it relate to reservoirs? How do DO concentrations affect the polychaete relative to other benthic invertebrates (e.g., does low DO below dams favor the polychaete?)

2.2.12.1: Might largescale suckers occur afterward? Would Bull trout then be able to migrate?

2.2.12.4-6: The sections on suckers are thin on detail compared to other sections.

2.2.13.12: There appears to be no prediction or conclusion in this section.

2.216.1: Why the reference to sockeye salmon?

3.1 pg. 98 last para: Might it be useful here to recast the emphasis of this section to point out that changes in mean temperature are not likely to strongly negatively affect groundwater temperatures, even for fast flowing/short residence time systems. Rather, the big effects will be on daily maximum temperatures in stream with little GW input.

3.1 Last para: “aquasition” is an excellent Freudian slip?

Summary and throughout: An important topic that is lacking is the relationship between diversity and ecosystem stability/services. Specifically, recent papers by Schindler, Quinn and Hillborn provide relevant examples that the Portfolio effect and biocomplexity (e.g., life history diversity in salmon) damp the effects of environmental variability on population abundance at the metapopulation scale. Improved habitat diversity, increases in life history diversity, increases in the number of subpopulations, and the increased connectivity among subpopulations following dam removal all suggest further benefits and probability of population persistence in the presence or absence of climate change.

Table 4: The table provides an excellent summary of the findings that will be a valuable resource to readers. I would suggest reorganizing it more logically (e.g., BGA precedes Geomorphic processes). Where possible it would be good to identify which risks and benefits are minor (unlikely), moderate, or major (probable).

Specific comments on Table 4:

Nutrients: What is specific benefit of reduced HRT?
Hydrology: What are the effects of KBRA flows in drought years?
Coho salmon w/dams: Is the benefit not also true for the w/out dam state?
Bull trout: What is the role of marine derived nutrients?
Anadromous fish habitat: What is the role connectivity/ metapopulation structure?
Recreational reservoir fisheries, w/out dams: What is the benefit of replacement with mainstem anadromous fishery in PR? See also 4) under Steelhead w/out dams.
Steelhead w/ dams: Would fishing opportunities not also continue w/out dams?
Geomorphic processes: This could move up. W/out dams risk should include movement of sediment plug downstream.

Attachment A: Specific Comments

Figure 2: It is unclear what data sources are and/or how data were simulated. An indication of minimum pool level would be helpful.

Figure 4: This figure may not be necessary since it could be easily explained in the text.

Figure 6: Because the number for the current dams is so low, it may be good to put an arrow with the number indicating that it is low.

Figure 9: Why include only to Spencer Creek? Why not include UKL tribs?

Attachment B: Reviewer Comments

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2 August 2010

John M. Hefner
Senior Scientist
PBS&J
1616 Millbrook Road
Raleigh, North Carolina 27609

Dear Dr. Hefner,

Please find below my letter report describing my peer review of the 16 July 2010 draft of the document:

Synthesis of the Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River (Draft)

My review is as an expert in the field of fisheries biology and freshwater ecology. I am currently primarily employed by the University of Idaho as a Research Assistant Professor where I direct a research program focused on anadromous fish migration and ecology in regulated rivers and monitoring of freshwater resources. My strengths in conducting this review are a broad training and experience in fisheries ecology, marine science, fisheries management, and environmental monitoring, including Pacific salmonids and Pacific lamprey. My primary limitation in conducting the review is a lack of experience or knowledge with the specific details of the Klamath Basin populations, ecosystem and associated literature, though I have direct knowledge of identical species or similar species in the nearby Columbia and Willamette basins. I am conducting this review as a private consultant and do not represent the University in the following work.

I have reviewed the document to:

"review the subject document and prepare a letter report critiquing its completeness, scientific approach, consistency of thought, and soundness of conclusions. In essence the reviewer is asked to determine if the document represents "good science" and if conclusions in the report seem reasonable based on the best available scientific information." Specifically I have evaluated, as relevant, "the clarity of hypothesis, the validity of the research design, the quality of the research design, the quality of the data collection procedures, the robustness of the methods employed, the appropriateness of the methods for the hypotheses being tested, the

extent to which the conclusions follow from the analysis, and the strengths and limitations of the overall product."

The purpose of the document is to provide expert synthesis of available data, empirical models, conceptual models, expert opinion, and literature that 1) describe the current effects of four lower Klamath River dams on fish and wildlife in the basin, 2) predict the effects on the ecosystem and fish and wildlife populations after a) no change, or b) dam removal and implementation of the Klamath Basin Restoration Agreement (KBRA).

The focus of the review is on listed and non-listed anadromous fishes and considers effects above and below Iron Gate Dam (IGD) separately from those below IGD. The document is to be used by the Secretary of the Interior to make a determination for dam removal and enactment of the KBRA or a negative determination to leave dams in place without enactment of the KBRA. The criteria to be used by the Secretary are whether removal and the KBRA will advance the restoration of Klamath Basin salmonid fisheries and whether a positive action is in the public interest, including affected local communities and tribes.

In my reading of the report, this document will be specifically used as a component in support of a non-use economic valuation study that will help guide the SD, as a resource for Expert Panels to the Secretary, and possibly during preparation of NEPA and CEQA documents (these purposes are outlined on pgs. 11-12, but, as written, are not fully clear to me; see below for more detail).

Chapter 1 provides background on the policy issues and context for the document, Klamath Basin resource programs, and the purposes and future uses of the document.

Chapter 2 provides the summary and synthesis of effects under existing and the two future conditions. Chapter two comprises the bulk of the document and includes both narrative background information on natural history and ecosystem condition and reviews of specific effects by location and population or ecosystem component. The document ends with a treatment of the likely effects of climate change on both future conditions and a summary matrix of effects.

Overall, it is my opinion that the document represents "good science" as the conclusions are reasonable and are based, to my knowledge, on sound ecological principles and the best available information.

The general approach is reasonable and in line with the purpose(s) of the document. Specifically, the authors have reviewed effects on relevant population and ecosystem components and have reviewed each under current conditions (providing the reader with background on current status) and then under each potential future action. Importantly, the authors considered effects at multiple spatial and temporal scales, including effects within and across population and ecosystem components. The review correctly places emphasis on both

mean conditions and variation in conditions through space and time (e.g., temperature). The review structure is logically divided at IGD because effects below the dam differ strongly from those within the Project Reach (PR; IGD to Link River Dam) and above the PR. The review focuses on factors known to affect the distribution, abundance, and population growth rates/viability of focus species: hydrologic regime, temperature, sediments, nutrients, dissolved oxygen, access to and connectivity of habitats, disease, habitat diversity and heterogeneity.

The metrics considered include both abundance and other factors recently recognized as important to sustainable populations and fisheries including metapopulation structure, life history diversity, and environmental heterogeneity. The influence of important factors outside the Basin or acting at large scales are considered, including effects of changing climate and changing ocean conditions and productivity. I have made minor suggestions for strengthening the conceptual context of the review below.

I found the treatment of effects under the two conditions to be consistently and logically evaluated, with no evident bias toward presenting benefits or risks under either action. For example, the risks under removal and KBRA are presented in Table 4, and risks related to removal of reservoirs are evaluated clearly. The limitations of the author's conclusions are presented clearly in most cases. I found no evidence that the conclusions in the document went beyond those drawn from source studies, and rather, that the limitations of cited studies were typically clearly articulated. Review of data sources appears broad and comprehensive. I found the section on diseases and climate change exceeded my expectations for a document of this type by the inclusion of the topics and completeness of treatment.

In short, the overall strengths of the document include a solid presentation of the background material, a logical approach to synthesizing and evaluating the general effects of dams and reservoirs, a comprehensive treatment of the major factors known to affect the species of concern, the major ecosystem processes affecting them, and how both are affected by dams.

The weaknesses of the document are primarily related to presentation. Specifically, the current draft assumes a quite knowledgeable reader and freely uses fisheries jargon and occasionally refers to specific locations without reference to previously described locations or locations on the provided map. The overall organization is logical, though several improvements could be made, as detailed below. The most substantive weakness in my reading is in presentation of results from other studies because, in some cases, I had a difficult time understanding what results were being presented (e.g., I still am unclear what the volitional passage data in figures 7&8 represent). More importantly, in these cases it was difficult to critically evaluate the findings presented because there was little or no information presented on the reported study assumptions, data sources, limitations, etc. (e.g., the Oosterhout 2005 results in Figure 7&8). A refreshing exception was review of the data and models on coho salmon summarized in Table 2. In general, I found the treatments of steelhead and Pacific lamprey to be less organized and comprehensive compared to treatments for salmon.

Below I provide specific comments and suggestions for improvement of the document.

Title: Wow. Accurate, but it's a mouthful.

Could present a preferred citation format.

1.4.1 pp 2: Last sentence may be true, though it conveys subjective opinion about the process.

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Pg 56 The Howe (1968) citation characterizing the Klamath runs as "not equal" to Columbia runs feels out of place as the per human run size (salmon per human) seems more important to wealth and stability than absolute run size.

2.1.21 How many salmon , steelhead and lamprey would be available in the Copco 1 and IGD reservoir reaches after removal? What is the cultural value of trading a recent non-native species (perch) with returning salmon and steelhead and lamprey? With which group(s) are the perch and bass fisheries popular? These seem important to evaluating the loss of the yellow perch fishery. The authors cite spring Chinook as more value on a per fish basis than fall Chinook; certainly the same is true for salmon vs. perch?

2.1.21.2 What is the potential for inland commercial fisheries under dam removal?

Pg 61. How might the duration of and variability in warm water periods affect salmonids and how does that relate to thermal regimes under the two actions?

2.2.4.1 Why would temperatures below IGD continue to degrade?

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Pg 73. Dwinnell Dam not identified on map.

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2.2.8.7. Are summer, fall, and winter steelhead considered parts of the same ESU by NMFS (implied but not explicitly stated)? How much of the change in time series of abundance is thought to be related to ocean regime?

2.2.9 What is the habitat of the polychaete and how does it relate to reservoirs? How do DO concentrations affect the polychaete relative to other benthic invertebrates (e.g., does low DO below dams favor the polychaete?)

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Pg. 99: “aquasition”: excellent Freudian slip?

Pg 100 and throughout. An important topic that is lacking is the relationship between diversity and ecosystem stability/services. Specifically, recent papers by Schindler, Quinn and Hillborn provide relevant examples that the Portfolio effect and biocomplexity (e.g., life history diversity in salmon) damp the effects of environmental variability on population abundance at the metapopulation scale. Improved habitat diversity, increases in life history diversity, increases in the number of subpopulations, and the increased connectivity among subpopulations following dam removal all suggest further benefits and probability of population persistence in the presence or absence of climate change.

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Hydrology: What are the effects of KBRA flows in drought years?

Coho salmon w/dams: is the benefit not also true for the w/out dam state?

Bull trout: role of marine derived nutrients?

Anadromous fish habitat: role connectivity/ metapopulation structure?

Recreational reservoir fisheries, w/out dams: benefit of replacement with mainstem anadromous fishery in PR? See also 4) under Steelhead w/out dams.

Steelhead w/ dams: would fishing opportunities not also continue w/out dams?

Geomorphic processes: could move up. w/out dams risk should include movement of sediment plug downstream.

Climate change: See pg. 100 comment above.

Figure 2: I’m unclear what data sources are and/or how data were simulated. Indication of minimum pool level would be helpful.

Figure 9: why include only to Spencer Creek? Why not include UKL tribs?

Please do not hesitate to contact me if any of the above is not clear.

Chris Caudill

Critique of

"Synthesis of the Effects of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River"

By:
Dennis L, Scarnecchia
Professor of Fish and Wildlife Resources
University of Idaho,

The information is presented in a clear, readable style. There are very few typos and few organizational or grammatical issues.

Completeness and Scientific approach -- The report does an adequate job of identifying and considering, at least in a general, non-quantitative way, *individual species* and the potential effects on them of the dams remaining and the dams being removed. However, the presentation of effects only considers individual species, one at a time. It is strictly a species or population segment approach. Perhaps the report was conceived of in this way and intentionally limited to this scope. The fact remains, though, that there is no community-level or ecosystem assessment on the impacts of dams remaining vs. dams removed in the report. That is, there is no consideration of the broader riparian effects, food web effects, riparian-aquatic interaction effects, species interaction effects, or any of the more complex, higher level effects such as river connectivity and river function. Connectivity is discussed briefly, but it refers to *physical connectivity* more than *ecological connectivity*. None of the higher-level concepts useful in characterizing community structure and ecosystem function, such as the river continuum concept of Vannote et al. (1980), the serial discontinuity concept (Ward and Stanford 1995, Stanford and Ward 2001) of the flood pulse concept (Junk 1989; Junk and Wantzen 2004) are brought into the report at all. Ward et al (2002) reviewed 9 distinct conceptual frameworks useful for investigating rivers and evaluating changes in rivers such as dams added and dams removed. *None* of the many papers that they reviewed are in this report. There is much work that could be referenced and brought into this report to address these limitations (if the intent is to broaden the scope and present a more complete picture). In addition to the papers cited above, books such as "Return to the River" (Williams 2006) contain several papers that provide scientific background for issues related to natural river function.

This very obvious omission may have been intentional. However, a more complete assessment of the potential conditions associated with dams remaining and dam removal would frame the situation on this broader context, would consider ecosystem effects, community effects, and would then address the individual species effects, and their interactions, Only the anticipated individual species responses are considered in the report. Those omissions, and the resulting limitation of the scope of the evaluation, will be viewed by many scientists as a significant deficiency in the report.

Consistency of thought and soundness of conclusions. In many locations, the information presented and conclusions drawn are scientifically *plausible*, but too little primary literature is used to scientifically defend the statements being made. I have flagged several of these locations in the attached edited version, but there are many others besides the ones I have noted. In addition, too much emphasis was placed on referencing *Administrative Law Judge (2006)* and too little on primary literature. To this reviewer, it seemed that as experienced scientists their consistency of thought and their overall logic were good. To this reviewer, it did not seem that their logical thought processes were off base. But it was also very clear that they did not, in many cases, adequately *mobilize and describe the relevant scientific literature and data* available to defend their statements. They *made their case* but did not thoroughly enlist the primary studies to strongly attempt to *defend or prove their case*. This is a difficult task, but one that can be done more effectively. It starts with a command of the relevant scientific studies in and out of the basin. That is a broad literature in many disciplines and sub-disciplines that undoubtedly will take time to sift through. It may be beyond the planned scope to do so.

Another area of potential improvement in the report is in the way that the studies were referred to. Sometimes to provide strong evidence, it is necessary to not just passively refer to a study (as is typically done in the report) but let the reader know *what the study said*; i.e., exactly what result from that referenced study provided support for the point that the authors are trying to make. There are numerous places in the report where a slight elaboration of the actual result of the study would provide a clearer rationale for the authors' conclusions as to effects of dams vs. no dams.

It is certainly true that not all of the studies necessary for evaluating impacts have been done. Some studies on critically-needed information have not been done anywhere, let alone in the basin. For that reason, it might be useful for the authors to classify studies in support of key scientific points the authors are trying to make as conducted (1) in the Klamath Basin, (2) outside the basin but in the Northwest and (3) outside the northwest. It might also be useful to be able to quickly identify the three types of studies as they are referenced, i.e., bold and italics for (1), bold for (2) italics for (3) so that the reader can quickly see how effectively studies are brought to bear on the point being made.

There is clearly a total lack of quantitative evaluation and any weighting of ecological, social, and economic benefits and costs. An example would include loss of reservoir habitat versus gain in river habitat. This omission was evidently intentional; perhaps it is beyond the scope of the work. It will also be viewed by some scientists, however, as a significant deficiency.

Overall assessment:

The main positives of the report are its organization and clarity of text. There are several important omissions, however, and these omissions constitute the main shortcoming of the report. The shortcomings including the lack of a ecosystems/community perspective, the failure to provide a perspective in terms of river function and river connectivity concepts, a marginal usage of refereed primary literature to support what are generally reasonable assertions and conclusions, and a lack of quantitative assessment of benefits and costs. It is not clear how

many of these omissions were deliberate (i.e., outside of the planned scope of the report) and how many were accidental.

In addition, I have provided numerous comments on the draft itself, using track-changes. That draft with comments is also attached. I hope these comments prove useful

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Attachment C: Reviewer Resumes

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EDUCATION

Ph.D., 2002, Department of Entomology, Cornell University, Ithaca, N.Y. Dissertation: *Metapopulation biology of the mayfly* Callibaetis ferrugineus hageni *in high-elevation beaver ponds.* Advisor: Barbara Peckarsky.

M.S., 1995, Department of Zoology, University of New Hampshire, Durham, N.H. Thesis: *Molecular evidence of population genetic differentiation and sibling species in* Acartia tonsa *(Copepoda: Calanoida).* Advisor: Ann Bucklin.

B.S., 1991, General Biological Sciences, with Honors in Biology, University of Maryland, College Park. Advisor: Roger Newell.

PROFESSIONAL EXPERIENCE

Research Assistant Professor (2009-present) and Director/Lead Scientist, Fish Ecology Research Laboratory (FERL; 2008-present). Department of Fish and Wildlife Resources, University of Idaho. Example project titles: 1) Migration behavior and survival of adult salmon and steelhead of the Columbia River Basin; 2) Migration ecology of introduced American shad in the Columbia and Snake rivers; 3) Development of long-term monitoring plans for water resources in National Parks of the Upper Columbia Basin and Mojave Inventory and Monitoring Networks; 4) Migration behavior of Pacific lamprey in the Columbia River Basin. The FERL program is comprised of 18-24 employees working on 8-10 externally funded projects occurring in 6 western states.

Research Scientist, 2006-2009. Department of Fish and Wildlife Resources, University of Idaho & FERL.
Research Associate, 2004-2006. Department of Fish and Wildlife Resources, University of Idaho & FERL.
Postdoctoral Fellow, 2003-2004. Department of Fish and Wildlife Resources, University of Idaho & FERL.

Postdoctoral Fellow and Instructor, 2002-2003. School of Biology, Georgia Institute of Technology, Project title: Susceptibility of chemically-defended aquatic insects to fish predators: determining the relative importance of predator versus prey traits in the outcome of predator-prey interactions. Advisor: Mark Hay.

Instructor, 2002. Rocky Mountain Biological Laboratory (RMBL), Gothic Colorado.

TEACHING EXPERIENCE

Instructor, University of Idaho, 2006-7.

Fish and Wildlife Population Ecology (upper-level undergraduate course co-taught with Oz Garton and Chris Peery)
Cumulative Watershed Processes (graduate seminar co-taught with Tim Link).
Limnology (upper-level undergraduate/graduate course co-taught with Chris Peery).
Models of Cause and Correlation in Biology: Structural Equation Modeling for Non-experimental Systems (graduate seminar co-taught with Edward Oz Garton).

Instructor, Georgia Institute of Technology, 2002-2003.

Aquatic Chemical Ecology Laboratory (graduate course co-taught with Mark Hay and Julia Kubanek, School of Biology).

Biological Applications of Fluid Dynamics (graduate course co-taught with Phil Roberts, School of Civil Engineering).

Instructor, Rocky Mountain Biological Laboratory, 2002.
Ecology and Conservation of Freshwater Invertebrates (upper-level undergraduate course).

Teaching Assistant, Cornell University, 1995-2001.
Freshwater Invertebrate Biology, Stream Ecology, Evolution, Insect Ecology, Insect Biology, Introductory Biology.

Teaching Assistant, University of New Hampshire, 1993-1995.
General Ecology, Marine Biology, Anatomy and Physiology.

PUBLICATIONS

Peer-Reviewed Publications

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Johnson, E.L., C.C. Caudill, M.L. Keefer, T.S. Clabough, and M.A. Moser. Effects of water velocity on fishway entrance success by adult Pacific lamprey and fishway use summaries at Bonneville Dam, 2009. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla Walla, WA.

Caudill, C.C., E.L. Johnson, C.T. Boggs, M.L., Keefer, M.A. Jepson, and B.J. Burke. Evaluation of adult spring-summer Chinook salmon and adult Pacific lamprey passage at the Cascade Island fishway after entrance modifications, 2009. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla Walla, WA.

Boggs, C.T., C.C. Caudill, and M.A. Moser. Evaluation of adult Pacific lamprey passage and behavior at McNary Dams including preliminary evaluation of a reduced nighttime flow velocity operation, 2009. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla Walla, WA.

Caudill, C.C., T.S. Clabough, E.L. Johnson, D.C. Joosten, and C.A. Peery. 2009. Use of video to quantify adult lamprey passage at night at Bonneville and The Dalles dams on the Columbia River. American Fisheries Society Western Division Annual Meeting, Albuquerque, New Mexico.

Keefer, M.L., M. Moser, C.A. Peery, C. Boggs, E.L. Johnson, and C.C. Caudill. 2009. Size Matters: adult Pacific lamprey migration in the Columbia River. American Fisheries Society Western Division Annual Meeting, Albuquerque, New Mexico.

Mann, R., G.A. Taylor, C.A. Peery, and C.C. Caudill. 2008. An assessment of energetic condition for two populations of adult summer Chinook salmon in the Willamette Valley of central Oregon. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Keefer, M.A., C.T. Boggs, E. Johnson, C.A. Peery, C. C. Caudill, and M.A. Moser. 2008. Adult lamprey passage success and behavior in the lower Columbia River, 2008. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Ho, B., C.A. Peery, E. Johnson, and C.C. Caudill. Relationship between energetic status and migratory behavior and success in Pacific Lamprey: Preliminary results. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Johnson, E., C.A. Peery, C.C. Caudill, and M. Moser. 2008. Effects of water velocity on fishway entrance success by Pacific lamprey and fishway use summaries at Bonneville Dam, 2008. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Boggs, C.T., C.A. Peery, C.C. Caudill, and M. Moser. 2008. Evaluation of adult Pacific lamprey passage and behavior at McNary and Ice Harbor Dams. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Clabough, T.S. E. Johnson, D.C. Joosten, C.C. Caudill, and C.A. Peery. 2008. Use of night video to quantify adult lamprey passage at Bonneville and the Dalles dams, 2007 and preliminary 2008 results. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Jepson, M.A., C.A. Peery, and C.C. Caudill. 2008. Adult Chinook salmon passage at Little Goose Dam in relation to spill operations, 2008. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Clabough, T.S., G.P. Naughton, C.C. Caudill, M.A. Jepson, C.A. Peery, and B.J. Burke. 2008. Adult salmon and steelhead passage at Lower Granite Dam with a modified transition pool and in relation to ladder temperature. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Caudill, C.C., C.A. Peery, C.T. Boggs, M.L. Keefer, and M.L. Moser. 2008. Down the river and back up again: toward conservation of Pacific lamprey in the Columbia Basin, USA. Society for Conservation Biology, Chattanooga, Tennessee.

Caudill, C.C., and M. Parsley (symposium co-organizers). 2008. Overview of shad in the Columbia Basin: history and current status. American Fisheries Society Western Division Annual Meeting, Portland Oregon.

Caudill, C.C, C.A. Peery and S.R. Lee. Up and down and back again, adult biology of American shad in the Columbia basin. American Fisheries Society Western Division Annual Meeting, Portland Oregon.

R. Hogg*, and C.C. Caudill. Relationships between recent ocean growth, condition, spawning history, and adult migration behavior in American shad. American Fisheries Society Western Division Annual Meeting, Portland Oregon. *Undergraduate researcher.

M.J. Parsley & C.C. Caudill. What's that small shad doing here? Evidence of multiyear freshwater residence by juvenile American shad. American Fisheries Society Western Division Annual Meeting, Portland Oregon.

Caudill, C.C., L. Garrett, E. Starkey, T. Rodhouse, R. K. Steinhorst, and K.M. Irvine. 2008. Integrated water quality monitoring plan for the Upper Columbia Basin Network (poster). 2008 National Park Service Aquatic Professionals Meeting, Fort Collins, Colorado.

Caudill, C.C., A. Chung-MacCoubrey, and D. Hughson. 2008. Establishing a long term monitoring plan for aquatic resources of the National Park Service Mojave Desert Network (poster). 2008 National Park Service Aquatic Professionals Meeting, Fort Collins, Colorado and the 56th Annual Meeting of the North American Benthological Society, Salt Lake City, Utah.

Caudill, C.C., T.S. Clabough, G.P. Naughton, C.A. Peery, and B.J. Burke. 2007. Temperature gradients in fish ladders associated with slowed dam passage by adult Chinook salmon and steelhead. American Fisheries Society Annual Meeting, San Francisco, California.

Peery, C.A., M.L. Keefer, C.C. Caudill, and B.J. Burke. 2007. Using telemetry for conducting basin-wide assessment of long-distance migrants. American Fisheries Society Annual Meeting, San Francisco, California.

Keefer, M.L., C.A. Peery, M.J. Heinrich, C.C. Caudill, and T.C. Bjornn. 2007. Evidence for late-season, condition dependent migration mortality in endangered Snake River sockeye salmon adults. American Fisheries Society Annual Meeting, San Francisco, California.

Caudill, C.C. 2007. An approach to long-term water resource [for National Parks in the Mojave Network of the NPS Inventory & Monitoring program]. Mojave Network I&M annual meeting, Lake Mead, Nevada (meeting of > 100 NPS Park Superintendents, Scientists, and Resource Managers).

Naughton, G.P., T.S. Clabough, C.C. Caudill, M.A. Jepson, C.A. Peery, and B.J. Burke. 2006. Preliminary evaluation of fishway modification on the passage of adult Chinook salmon and steelhead at Lower Granite Dam. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Anderson, C., C.A. Peery, C.C. Caudill. 2006. An evaluation of reproductive success of summer Chinook Salmon relative to hydrosystem passage in 2006. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Keefer, M.A., C.A. Peery, C.C. Caudill, and C.T. Boggs. 2006. Distribution, behavior, and survival of adult steelhead overwintering in the Columbia-Snake hydrosystem. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland, OR.

Caudill, C.C, W.D. Daigle, C.A. Peery, and B.J. Burke. 2005. Effects of passage times on passage success of adult salmon and steelhead through the Columbia River hydrosystem in relation to environmental and operational conditions. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla, Walla, WA.

Caudill, C.C., G.P. Naughton, and T. Clabough. 2005. Relationship between ladder temperature and passage behavior for adult Chinook salmon and steelhead. Meeting of the U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla, Walla, WA.

Caudill, C.C., M.L. Keefer, C.A. Peery, W.D. Daigle, T. Clabough, and C. Boggs. 2005. Migration behavior, thermal exposure, and migration success in adult salmon ascending the Columbia and Snake Rivers. American Fisheries Society Annual Meeting, Anchorage, Alaska.

Keefer, M.L., C.C. Caudill, C. Peery, S.R. Lee, B.J. Burke, and M.L. Moser. 2005. Which way home? Effects of juvenile transportation on adult migration of Snake River salmon and steelhead. (poster). American Fisheries Society Annual Meeting, Anchorage, Alaska.

Caudill, C.C. 2005. Wet or dry? Migration phenomena in aquatic insects and potential population consequences. Ecological Society of America, 90th Annual Meeting, Montreal, Quebec, Canada.

Caudill, C.C., C.A. Peery, T.C. Bjornn, C.T. Boggs, W.D. Daigle, T. Clabough, M. Heinrich, M.L. Keefer, M. Jepson, S.R. Lee, G.P. Naughton, R. Ringe, K. Tolotti, L. Struenberg, and B.J. Burke. 2005. Migration success of adult salmon ascending an altered migration corridor. Ecological Society of America, 90th Annual Meeting, Montreal, Quebec, Canada.

Peery, C.A., and C.C. Caudill. 2005. Direct and indirect effects acting on migrating Pacific salmon in the Columbia River. Ecological Society of America, 90th Annual Meeting, Montreal, Quebec, Canada.

FUNDING & AWARDS

Awarded:

Evaluation of adult Pacific lamprey passage success at McNary and Ice Harbor dams, 2010. Caudill, C.C. and M.L. Moser. $187,595 awarded to UI. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla Walla District.

Condition and spawning success of adult spring Chinook salmon in the Willamette River-2010. Caudill, C.C., C.B. Schreck, and M. Kent. $119,748 awarded to UI. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Video monitoring of adult fish ladder modifications to improve Pacific lamprey passage at the McNary Dam Oregon shore fishway. Caudill, C.C. and F. Loge. $56,405 awarded to UI. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla Walla District.

Evaluation of adult Pacific lamprey behavior and fate in Columbia River reservoirs using acoustic telemetry, 2010. $89,088 awarded to UI. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Improving adult Pacific lamprey passage and survival at lower Columbia River dams, 2010. Caudill, C.C., and M.L. Moser. $230,308 awarded to UI. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Comparative survival of reservoir reared and reservoir bypassed spring Chinook salmon in the Willamette River basin: Phase 1: Use of otolith and scale analyses to characterize life history variation in spring Chinook salmon in three Willamette Valley Project reservoirs and tributaries. Caudill, C.C. and B.P. Kennedy. $146,680 awarded to UI. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Evaluation of adult salmon and steelhead delay and fallback at Snake and Columbia river dams, 2010. Caudill, C.C., and B.J. Burke. $518,301 awarded to U.I. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Migration of adult Chinook salmon and Steelhead in Hood River, Oregon, 2010. C.C. Caudill. $41,631. Confederated Tribes of the Warm Springs Reservation of Oregon.

Juvenile fall Chinook telemetry monitoring (continuation of Telemetry evaluation of habitat use by juvenile Snake River Fall Chinook salmon in reservoirs). Caudill, C.C. $177,530. U.S. Army Corps of Engineers, Walla Walla District.

Condition and spawning success of adult spring Chinook salmon in the Willamette River-2009. Caudill, C.C., C.B. Schreck, and M. Kent. $156,501 awarded to U.I. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Evaluation of adult salmon and steelhead delay and fallback at Snake and Columbia river dams, 2009. Caudill, C.C., and B.J. Burke; $306,260 awarded to U.I. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Improving adult Pacific lamprey passage and survival at lower Columbia River dams, 2009. Caudill, C.C., and M.L. Moser. $314,943. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Portland District.

Evaluation of adult Pacific lamprey passage success at McNary and Ice Harbor dams, 2009. Caudill, C.C. and M.L. Moser. $221,608. U.S. Army Corps of Engineers Anadromous Fish Evaluation Program, Walla Walla District.

Telemetry evaluation of habitat use by juvenile Snake River Fall Chinook salmon in reservoirs as part of Aquatic Monitoring of Navigation Channel Maintenance Sites, Snake River, WA. 2008-9. Caudill, C.C. & D. Bennett. $292,034. U.S. Army Corps of Engineers, Walla Walla District.

Improvement in estimates of Columbia River fall Chinook salmon (*Oncorhynchus tshawytscha*) escapements. $70,218 (FY2009-2010). Collaborative with Columbia River Inter-tribal Fisheries Commission (S.-Y. Hyun, lead CRITFC P.I.), funded by Pacific Salmon Commission.

Development of a long-term water quality monitoring plan and protocol for the Mojave Network. Caudill, C.C. National Park Service. $320,764 (2007-2011). Development of sample design, statistical analysis, and initial implementation of a long term monitoring plan for groundwater, spring, lake, and stream resources for seven national park units covering 3,292,732 hectares (8,136,518 acres) as part of the NPS Vital Signs program (http://science.nature.nps.gov/im/units/mojn/).

Development and implementation of water quality monitoring protocols for the National Park Service I&M program: Upper Columbia Basin Network (UCBN). Caudill, C.C., $109,100 (FY 2005- 2007).

Ecology and distribution of migratory fishes in the Mekong River. Hogan, Z, G.P. Naughton, C.A. Peery, and C.C. Caudill. 2005. $70,000, IUCN World Conservation Union Mekong Wetlands Biodiversity Program.

Habitat use and migration behavior of adult salmon in the Columbia River Estuary as a test of the National Marine and Estuary Classification. C. Peery, N. Wright, and C.C. Caudill. 2004-2006. $196,000, NOAA Coastal Services Program.

National Science Foundation Dissertation Improvement Grant. 1998-2000. $9,000.

Research and travel grants during Ph.D. training, 1996-2000. Fifteen awards totaling $6,856. Sources: Sigma Xi Grants-in-Aid of Research (National and Cornell Chapters), North American Benthological Society

Student Travel Award, Cornell University Rawlins Endowment, Cornell University Griswold Endowment, Cornell Graduate School, RMBL Lee R.G. Synder Fund.

Research and travel grants during M.S. training, 1993-1995. Four awards totaling $2,400. Sources: University of New Hampshire Center for Marine Biology and UNH Graduate School.

Fellowships:

National Science Foundation IGERT Post-doctoral fellowship 2002-3, Georgia Institute of Technology Program in Aquatic Chemical Signaling Ecology.

Cornell University Department of Entomology Palmer Research Assistantship, Spring, 2000.

Edna Bailey Sussman Environmental Research Internship, Fall, 1998.

NSF Research for Experience for Undergraduates (REU) Fellowship, University of Maryland Horn Point Biological Laboratory, Horn Point, Maryland, Summer, 1991.

RECENT MENTORING ACTIVITIES

Post-doctoral advisor to Geoff Moret, 2009-present. Project title: Developing long term monitoring protocols for aquatic resources in the Mojave Network of the NPS Inventory and Monitoring Program.

Graduate advisor to Ben Ho and Brian McIlraith, M.S. students, U.I. Fish and Wildlife.

Member of Karen Laitala's M.S. (U. I. Plant Science) thesis committee. Thesis title: Efficacy of benthic barriers as a control mechanism for eurasian watermilfoil (*Myriophyllum spicatum* L.). Defense date: 24 September, 2007.

U.I. Environmental Sciences/NSF REU mentor, summer 2007 for Robert Hogg (Southern Oregon University). Project title: Association between recent ocean growth history and energetic condition in returning adult American shad of the Columbia and Snake rivers.

U.I. McNair Scholar Program mentor (with Ed Galindo and Aaron Haines) for Eva Sebesta. Project title: Habitat components associated with beaver site selection in central and southern Idaho.

PROFESSIONAL SERVICE AND ACTIVITIES

Scientific:

Participant, Lamprey Technical Work Group and Lamprey Passage Metrics Standards Subcommittee, both subcommittees of the Columbia Basin Fish and Wildlife Authority's Anadromous Fish Advisory Committee, 2009-present.

Co-organized and moderated "Overview of shad in the Columbia Basin: history and current status". 2008 American Fisheries Society Western Division Annual Meeting, Portland Oregon.

Organized and moderated "Migration in a Changing World" Evening Session at 2005 Ecological Society Meetings, Montreal, Quebec.

Manuscript reviewer for *Ecology, Ecological Applications, Hydrobiologia, Journal of Animal Ecology, Journal of Applied Ecology, Journal of the North American Benthological Society*, *North American Journal of Fisheries Management, Oikos, Transactions of the American Fisheries Society, and USGS.*

Proposal reviewer for the National Science Foundation.

Member, Ecological Society of America, American Fisheries Society, Society for Conservation Biology, and the North American Benthological Society.

Outreach, Education, News and Other:

"They're not pretty, or good swimmers, but we need lamprey" 14 September, 2008 The Oregonian http://www.oregonlive.com/news/index.ssf/2008/09/theyre_not_pretty_or_very_good.html

Participant in first University of Idaho "Palouse Project: Faculty Workshop to Infuse Sustainability Across the Curriculum". 4-5 January, 2007, University of Idaho.

"Idaho researchers document impacts of cool water releases" 11 August 2006 Columbia Basin Fish and Wildlife News Bulletin. http://cbbulletin.com/Free/177327.aspx

"Research looks at aspects of adult salmon homing behavior" 15 December 2006 Columbia Basin Fish and Wildlife News Bulletin. http://cbbulletin.com/Free/195744.aspx

"Study compares homing rates for in-river, barged fish" 21 December 2006 Columbia Basin Fish and Wildlife News Bulletin. http://cbbulletin.com/Free/196582.aspx

Panelist for a forum following a screening of "An Inconvenient Truth", Kenworthy Theater, Moscow, ID, 1 October 2006.

Presented "Swimming upstream: A (un)natural history of salmon migration in the Columbia Basin" to the Palouse Audubon Society, 20 September 2006, 1912 Center, Moscow, Idaho.

Panelist for a public forum "After *The Day After Tomorrow:* Meet the Scientists and Get the Real Scoop on Climate Change". 3 June 2004. 1912 Center, Moscow, Idaho.

Board Member, Moscow Food Co-op, an organic and whole foods cooperative employing ~100 with an annual budget of ~$6M, 2007-2009.

Scientific advisor, Earth and Sky Radio Show, Austin Texas.

Instructor, RMBL, Summer 1999. Elderhostel course on water resources, aquatic biota, and water quality monitoring using macroinvertebrates.

REFERENCES

Ian Billick
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Rocky Mountain Biological Laboratory
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CURRICULUM VITAE
University of Idaho

NAME: Scarnecchia, Dennis L.

DATE: July 17, 2010

RANK OR TITLE: Professor of Fish and Wildlife Resources

DEPARTMENT AND CAMPUS ZIP: Fish and Wildlife Resources, 1136

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EMAIL: scar@uidaho.edu

DATE OF FIRST EMPLOYMENT AT UI: July 1, 1990

DATE OF TENURE: 1990

DATE OF PRESENT RANK OR TITLE: July 1, 1998

EDUCATION BEYOND HIGH SCHOOL:

Degrees:

Ph.D., Fisheries, 1983, Colorado State University
M.S., Fisheries, 1979, Oregon State University
B.S., Physics, 1976, University of Arizona

EXPERIENCE:

Teaching and Research Appointments:

July 1998-present, Professor, Department of Fish and Wildlife Resources, University of Idaho
1990-June 1998, Associate Professor, Department of Fish and Wildlife Resources, University of Idaho
1985-90, Assistant Professor, Department of Animal Ecology, Iowa State University
1986-87, Visiting Assistant Professor, Iowa Lakeside Laboratory
1982-83, Fishery Research Biologist, Institute of Freshwater Fisheries, Reykjavik, Iceland
1981-82, Fulbright Scholar, Atlantic salmon population dynamics, Institute of Freshwater Fisheries, Reykjavik, Iceland
1978-81, Graduate Research Assistant, Colorado Cooperative Fishery Research Unit, Colorado State University, Fort Collins, Colorado
1976-78, Graduate Research Assistant, Oregon Cooperative Fishery Research Unit, Oregon State University, Corvallis, Oregon

Non-Academic Employment:

1984-85, Program Leader, Ocean Salmon Management, Oregon Department of Fish and Wildlife, Newport, Oregon. Duties: Participated in fisheries research and management planning at state and interagency levels. Supervised 4-person data processing staff and 30-person creel sampling program for ocean sport and troll salmon fisheries.
1983-84, Project Leader, Columbia River Research, Oregon Department of Fish and Wildlife, Clackamas, Oregon. Duties: Assessment of biological characteristic of salmon and steelhead stocks in the Columbia River basin. Coordination of research project with Washington and Idaho state fish and wildlife agencies.

TEACHING ACCOMPLISHMENTS:

Areas of Specialization:

Paddlefish and sturgeon, large river fisheries, population dynamics, ecology and management, Missouri River fisheries research, salmon, trout and charr research, Icelandic fisheries research.

Courses Taught:

University of Idaho:
Fish 418, Fisheries Management, 4 credit semester course, 1993-2009
Fish 495, Fisheries Seminar (Fisheries Topics), 1992-1993; 1996-1998; 2002-2010
Fish 390, Fish and Wildlife Ecology, 1/2 of semester course, 1990, 1991
Fish 514, Fish Population Dynamics, 1/2 of 3-credit semester course, 1992
Fish 102, The Fisheries Profession, 1 credit, 1992, 1993, 1996
Fish 501, Graduate Fisheries Seminar, 1996, 1997
Fish 290, Principles of Fish Biology and Management, 2 credit semester course, 1993, 1994
Fish 515, Large River Fisheries, 2 credit graduate course, 1999, 2004, 2009
Fish 415, Limnology, semester 5 credit course, 1990, 1991

Iowa Lakeside laboratory:
A ECL 520, Fish Ecology, summer field course, 1986, 1987

Iowa State University:
A ECL 543, Advanced Fishery Management, semester course, 1985, 1987, 1989
A ECL 500, Issues in World Marine Fisheries, seminar coordinator, 1989
A ECL 231, Wildlife Resource Conservation, semester course, 1986, 1987, 1988, 1989, 1990
A ECL 441, Fisheries and Limnological Techniques, semester course, coordinator, 1986, 1987, 1988, 1989
A ECL 500, Evolution of Fish Life Histories, seminar coordinator, 1987
A ECL 511, Population Ecology. Participant in team-taught course, 1986

Students Advised:

30 graduated graduate students (2 M.S. at Iowa State, 23 M.S. and 4 Ph.D. at University of Idaho)
Iowa State University graduates: C. Moen, M. Bryan
University of Idaho graduates:
M.S.: J. Bonneau, P. Saffel, R. Spangler, C. Parken, L. Kruzic, J. Fredericks, S. Patterson, S. Everett, J. Bailey, G. Kruse, J. Kozfkay, J. Venard, W. Young, D. Hogen, E. Martinson, B. Bowersox J. Bednarski, C. Watry, R. Kreiner, E. Van Dyke. S. Miller, C Gidley, B. Stephens, J. Erhardt
Ph.D.: B. Roper, J. Bonneau, T. Welker, J. Firehammer
Advisor to 8-20 undergraduate students at University of Idaho, 1990-present
Advisor to 30-35 students at Iowa State University, 1985-90
Advisor to 3 graduate students (D. Holecek, T Watson) University of Idaho, 2008

PUBLICATIONS:

Refereed Publications:

VanDyke, E.S., D.L. Scarnecchia, B.C. Jonasson and R.W. Carmichael. In Press. Ecology of winter concealment behavior of juvenile spring Chinook salmon in the Grande Ronde River basin, Oregon. *Northwest Science.*

Miller, S.E., D.L. Scarnecchia and S.R. Fain. In Press. Paddlefish egg deposition in the Lower Yellowstone River, Montana. *Prairie Naturalist.*

Gudjonsson, S. and D.L. Scarnecchia. 2009. "Even the evil need a place to live": wild salmon, salmon culture, and zoning of the Icelandic coastline. *Fisheries* 34:477-486.

Martinson, E.C., J.H. Helle, D.L. Scarnecchia and H.H. Stokes. 2009. Growth and survival of sockeye s salmon (*Oncorhynchus nerka*) from Karluk Lake and River, Alaska, in relation to climate and oceanic

regimes. *Fishery Bulletin* 107:488-500.

Van Dyke, E.S., D.L. Scarnecchia, B.C. Jonasson and R.W. Carmichael. 2009. Relationship of winter concealment habitat quality on pool use by juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the Grande Ronde River Basin, Oregon, USA. *Hydrobiologia* 625:27-42. pdf

Scarnecchia, D.L., L.F. Ryckman, Y. Lim, S.E. Miller, B.J. Schmitz, G.J. Power, and S.A. Shefstad. 2009. Riverine and reservoir influences on year class strength and growth of upper Great Plains paddlefish. *Reviews in Fisheries Science* 17:241-266.

Martinson E. C., J. H. Helle, D. L. Scarnecchia and H. H. Stokes. 2008. Density-dependent growth of Alaska sockeye salmon in relation to climate-oceanic regimes, population abundance, and body size, 1925 to 1998. Mar. Ecol. Prog. Ser. 370:1-18.

Bednarski, J., S.E. Miller and D.L. Scarnecchia. 2008. Larval fish catches in the Milk River, Montana in relation to timing and magnitude of spring discharge. *River Research and Applications* 24:844-851.

Patterson, S.D., D.L. Scarnecchia, and J.L. Congleton. 2008. Sexual maturation in kokanee O*ncorhynchus nerka. Northwest Science.* 82:30-47.

Miller, S.E. and D.L. Scarnecchia. 2008. Adult paddlefish migrations in relation to spring river conditions of the Yellowstone and Missouri Rivers, Montana and North Dakota, USA. *Journal of Applied Ichthyology.* 24:221-228.

Watry, C.B. and D.L. Scarnecchia. 2007. Adfluvial and fluvial life history variations and migratory patterns of a relict charr, *Salvelinus confluentus*, stock in west-central Idaho, USA. *Ecology of Freshwater fish. 17:231-243.*

Scarnecchia, D. L., L. F. Ryckman, Y. Lim, G. Power, B. J. Schmitz, and J. A. Firehammer 2007. Life history and the costs of reproduction in northern Great Plains paddlefish (*Polyodon spathula*) as a potential framework for other Acipenseriform fishes. *Reviews in Fisheries Science.* 15:211-263..

Firehammer, J. A., and D. L. Scarnecchia. 2007. The influence of discharge on duration, ascent distance, and fidelity of the spawning migration for paddlefish of the Yellowstone-Sakakawea stock, Montana and North Dakota, USA. *Environmental Biology of Fishes.* 78:23-36.

Scarnecchia, D. L., L. F. Ryckman, Y. Lim, G. Power, B. Schmitz, and V. Riggs. 2006. A long-term program for validation and verification of dentaries for age estimation in the Yellowstone-Sakakawea paddlefish stock. *Transactions of the American Fisheries Society* 135:1086-1094.

Firehammer, J. A., and D. L. Scarnecchia. 2006. Spring migratory movements by paddlefish in natural and regulated river segments of the Missouri and Yellowstone rivers, North Dakota and Montana. *Transactions of the American Fisheries Society* 135:200-217.

Firehammer, J. A, D. L. Scarnecchia, and S. R. Fain. 2006. Modification of a passive gear to sample paddlefish eggs in sand-bed reaches of the Lower Yellowstone River. *North American Journal of Fisheries Management.* 26:94-103.

Hogen, D. M., and D. L. Scarnecchia. 2006. Distinct fluvial and adfluvial migration patterns of a relict charr, *Salvelinus confluentus,* stock in a mountainous watershed, Idaho, USA. *Ecology of Freshwater Fish.* 15:376-387.

Welker, T. and D. L. Scarnecchia. 2006. River alteration and niche overlap among three native minnows in the Missouri River hydrosystem. *Journal of Fish Biology.* 68:1530-1550.

Bednarski, J., and D. L. Scarnecchia. 2006. Age structure and reproductive activity of the blue sucker in the

Milk River, Missouri River Drainage, Montana. *Prairie Naturalist* 38(3): 167-182.

Kruzic, L.M., D.L. Scarnecchia, and B.B. Roper. 2005. Effects of electroshocking on macroinvertebrate drift in three coldwater streams. *Hydrobiologia*. 539:57-67.

Venard, J.A., and D. L. Scarnecchia. 2005. Seasonally dependent movement of Lake trout between two North Idaho lakes. *Transactions of the American Fisheries Society* 25:635-639.

Young, W., and D.L. Scarnecchia. 2005. Habitat use of juvenile white sturgeon in the Kootenai River, Idaho and British Columbia. *Hydrobiologia*. 537:265-271.

Everett, S., D.L. Scarnecchia and F. Ryckman. 2004. Distribution, abundance and habitat use of sturgeon chub and sicklefin chub in the Missouri and Yellowstone Rivers, North Dakota. *Hydrobiologia.* 527:183-193.

Welker, T.L., and D.L. Scarnecchia. 2004. Habitat use and population structure of four native minnows (family Cyprinidae) in the upper Missouri and Lower Yellowstone River, North Dakota (USA) *Ecology of Freshwater Fish.*13:8-22.

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Everett, S., D.L. Scarnecchia, G. Power, and C.J. Williams. 2003. Comparison of age and growth of shovelnose sturgeon in the Missouri and Yellowstone Rivers. *North American Journal of Fisheries Management,* 23:230-240.

Bonneau, J., and D.L. Scarnecchia. 2002. Spawning-season homing of common carp and river carpsucker. *Prairie Naturalist*, 34:13-20.

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Parken, C., and D.L. Scarnecchia. 2002. Predation on age-0 paddlefish by walleye ands sauger in a Great Plains reservoir. *North American Journal of Fisheries Management.* 22:750-759.

Kozfkay, J.R. and D.L. Scarnecchia. 2002. Year-class strength and feeding ecology of age-0 and age-1 paddlefish (*Polyodon spathula*) in Fort Peck Lake, Montana, USA. *Journal of Applied Ichthyology*. 18:601-607.

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Bonneau, J., and D.L. Scarnecchia. 2001. Tests of a rotenone-impregnated bait for controlling common carp. *Proceedings of the Iowa Academy of Sciences* 108(1):6-7.

Kruzic, L.M., D.L. Scarnecchia, and B.B. Roper. 2001. Comparison of mid-summer survival and growth of age-0 hatchery coho salmon held in pools and riffles. *Transactions of the American Fisheries Society* 130:147-154.

Roper, B.B., and D.L. Scarnecchia. 2001. Patterns of vertebrate diversity, density and biomass in ten small streams along a North American river continuum. *Northwest Science* 75(2):168-175.

Spangler, R., and D.L. Scarnecchia. 2001. Distribution, density and biology of bull trout and cutthroat trout in two small wilderness streams, Idaho, USA. *Hydrobiologia* 452:145-154.

Scarnecchia, D.L., K. Gilge, and P.A. Stewart. 2000. Profile of recreational paddlefish snaggers on the Upper Missouri River, Montana. *Intermountain Journal of Sciences* 6:68-77.

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Scarnecchia, D.L., and P.A. Stewart. 1997. Implementation and evaluation of a catch-and-release fishery for paddlefish. *North American Journal of Fisheries Management* 17:795-799.

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Scarnecchia, D.L. 1992. A reappraisal of gars and bowfins in fishery management. *Fisheries* 17:6-12.

Scarnecchia, D.L, and J.R. Wahl. 1992. Fifty years of fisheries management in an obstinate prairie lake. *Journal of the Iowa Academy of Science* 99:7-14.

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Scarnecchia, D.L., A. Isaksson, and S.E. White. 1989. New and revised yield forecasts for two-sea-winter Atlantic salmon (*Salmo salar*) in Icelandic rivers. *J. Appl. Ichthyology* (Berlin) 5:101-110.

Scarnecchia, D.L., T.W. Gengerke, and C.T. Moen. 1989. Rationale for a harvest slot limit for paddlefish (*Polyodon spathula*) on the Upper Mississippi River. *North American Journal of Fisheries Management* 9:477-487.

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Scarnecchia, D.L. 1988. Salmon management and the search for values. *Can. J. Fish. Aquat. Sci*. 45:2042-2050.

Scarnecchia, D.L. 1988. The importance of streamlining in influencing fish community structure in channelized and unchannelized reaches of a prairie stream. *Regulated Rivers: Research and*

Management 2:155-166.

Scarnecchia, D.L. 1988. Evaluation of fish eradication and game fish restocking in a central Iowa pond. *Journal of the Iowa Academy of Science* 95:55-59.

Scarnecchia, D.L. 1987. Rapid removal of otoliths from salmonids. *North American Journal of Fisheries Management* 7:312-313.

Scarnecchia, D.L., and E.P. Bergersen. 1987. Trout production and standing crop in Colorado's small streams, as related to environmental features. *North American Journal of Fisheries Management* 7:314-329.

Scarnecchia, D.L., and E.P. Bergersen. 1986. Production and habitat of threatened Greenback and Colorado River cutthroat trouts. *Transactions of the American Fisheries Society* 115:382-391.

Scarnecchia, D.L. 1984. Climatic and oceanic variations affecting yield of Icelandic stocks of Atlantic salmon (*Salmo salar*). *Can. J. Fish. Aquat. Sci*. 41:917-935.

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Scarnecchia, D.L. 1983. Age at sexual maturity in Icelandic stocks of Atlantic salmon (*Salmo salar*). *Can. J. Fish. Aquat. Sci*. 40:1456-1468.

Scarnecchia, D.L. 1981. Effects of streamflow and upwelling on yield of wild coho salmon in Oregon. *Can. J. Fish. Aquat. Sci*. 38: 471-475.

Scarnecchia, D.L., and H.H. Wagner. 1980. Contribution of wild and hatchery-reared coho salmon, *Oncorhynchus kisutch*, to the Oregon ocean sport fishery. *NOAA Fishery Bulletin* 77(3):617-623.

Scarnecchia, D.L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. *Progressive Fish Culturist* 41(3): 132-135.

Other Reports:

Scarnecchia, D. L., and six others. 2008. Management Plan for the North Dakota and Montana paddlefish stocks and fisheries. North Dakota Game and Fish Department and Montana Department of Fish, Wildlife and Parks. Bismarck and Billings.

Scarnecchia, D.L. 2000. The importance of ecosystem effects in sturgeon introduction and culture in Florida. Pages 39-47 in K. Metcalf and P. Zajicek, editors, Proceedings of the Florida Sturgeon Risk Assessment Workshop. April 6-7, 2000, Sarasota, Florida. Florida Department of Agriculture and Consumer Services, Tallahassee.

Scarnecchia, D.L. 2000. An assessment of the environmental impact of introducing grass carp into Montana. Montana Department of Fish, Wildlife and Parks, Helena.

Scarnecchia, D.L., P. Stewart, and L.F. Ryckman. 1995. Management plan for the paddlefish stocks in the Yellowstone River, Upper Missouri River, and Lake Sakakawea. North Dakota Game and Fish Department and Montana Department of Fish, Wildlife and Parks. Bismarck and Helena.

Backes, K.M., W.M. Gardner, D. Scarnecchia and P.A. Stewart. 1992. Lower Yellowstone River pallid sturgeon study II and Missouri River pallid sturgeon creel survey. Montana Department of Fish, Wildlife, and Parks, Mile City, Montana.

Howell, P.K., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortman. 1985. Stock assessment of

Columbia River anadromous salmonids. 2 vol. Bonneville Power Administration. 1032 pp.

Popular Articles:

Scarnecchia, D.L., J. Hendrickson, and R. Hiltner. 2005. Walleye for the ages. *North Dakota Outdoors*. 67(10):17-20.

Kozfkay, J., D. Scarnecchia, K. Gilge and B. Wiedenheft. 2002. Solving the puzzle of Peck's young paddlefish. *Montana Outdoors*. 33(2):26-31.

Scarnecchia, D., S. Everett, T. Welker and F. Ryckman. 2002. Missouri River fishes: big changes in the Big Muddy. *North Dakota Outdoors*. 64(8):10-13

Firehammer, J., D. Scarnecchia and F. Ryckman. 2001 Paddlefish left and right. *North Dakota Outdoors*. 64(1):4-6.

Scarnecchia, D., T. Welker, and F. Ryckman. 1998. Teaming up on the mighty Mo. The Missouri River Benthic Fish Study. *North Dakota Outdoors* 61(4):5-7.

Scarnecchia, D., and F. Ryckman. 1998. Tagging young paddlefish for the twenty-first century. *North Dakota Outdoors* 60(10):7-9.

Scarnecchia, D.L., and P.A. Stewart. 1996. Managing Montana's paddlefish: new approaches. *Montana Outdoors* 27(3):10-14.

Bonneau, J., D. Scarnecchia, and E. Berard. 1995. Better fishing means less carping at Bowman-Haley reservoir. *North Dakota Outdoors* 57(10):18-20.

Scarnecchia, D., J. Fredericks, and F. Ryckman. 1995. Unlocking the secrets of Lake Sakakawea's young paddlefish. *North Dakota Outdoors* 57(9):10-13.

Selected Professional Meeting Papers:

Scarnecchia, D. L., L. F Ryckman, and B. R. Schmitz. 2006. Key aspects of the biology and ecology of the Yellowstone-Sakakawea stock. Invited presentation, Midwest Fish and Wildlife Conference, Omaha. NE

Scarnecchia, D. L. 2005. Age validation in paddlefish. MICRA Meeting, St. Louis, MO.

Bonnean, J. and D. Scarnecchia. 2001. Impacts of common carp on reservoir ecology and implications for lake and watershed restoration efforts. Sixty-third Midwest Fish and Wildlife Conference, Des Moines, Iowa.

Scarnecchia, D.L. 2001. Research and management of paddlefish under the North Dakota and Montana Cooperative Paddlefish Management Plan. Fourth International Symposium on Sturgeon. July 8-13, 2001, Oshkosh, Wisconsin.

Everett, S.R., D.L. Scarnecchia and G.J. Power. 2001. Age and growth contrast in shovelnose sturgeon in differentially altered segments of the middle Missouri river, North Dakota and Lower Yellowstone River, Montana. Fourth International Symposium on Sturgeon, July 8-13, 2001, Oshkosh, Wisconsin.

Kruse, G.O. and D. Scarnecchia. 2001. Potential effects of environmental contaminants on adult and juvenile Kootenai River white sturgeon. Poster. Fourth International Symposium on Sturgeon, July 8-13, 2001, Oshkosh, Wisconsin.

Firehammer, J. and D. Scarnecchia. 2001. Seasonal movements of adult paddlefish, *Polyodon spathula*, in the Yellowstone and Missouri rivers. Poster. Fourth International Symposium on Sturgeon, July 8-13, 2001, Oshkosh, Wisconsin.

Kozfkay, J. and D.L. Scarnecchia. 2001. Ecology of age-0 and age-1 paddlefish in Upper Fort Peck Lake, Montana. Poster. Fourth International Symposium on Sturgeon, July 8-13, 2001, Oshkosh, Wisconsin.

Young, W.T., and D.L. Scarnecchia. 2001. Physical habitat characteristics of juvenile white sturgeon in the Kootenai River. Poster. Fourth International Symposium on Sturgeon, July 8-13, 2001, Oshkosh, Wisconsin.

Scarnecchia, D.L., P. Stewart, and G. Power. 1994. Paddlefish management plan. Invited paper, 1994 Montana Chapter, American Fisheries Society, Billings, Montana, February 1994.

Scarnecchia, D.L., and P. Stewart. 1992. Paddlefish research and management on the Yellowstone River. Invited paper, American Fisheries Society Annual Meeting, Rapid City, South Dakota, September 1992.

Scarnecchia, D.L., T.W. Gengerke, and C.T. Moen. 1989. Rationale for a harvest slot limit for paddlefish in the Upper Mississippi River. Presented at Symposium on Fish Population Biology, University of Aberdeen, Scotland (also presented at the Symposium on Floodplain Rivers, Baton Rouge, Louisiana, April 1990).

Scarnecchia, D.L., A. Isaksson, and S.E. White. 1989. Oceanic and riverine influences on variations in yield among Icelandic stocks of Atlantic salmon. Poster Session, Symposium on Fish Population Biology, University of Aberdeen, Scotland.

Scarnecchia, D.L., T.W. Gengerke, and C.T. Moen. 1989. Harvest regulations for paddlefish. Presented at Mississippi River Research Consortium, Upper Mississippi River Conservation Committee and Paddlefish Workshop.

Scarnecchia, D.L., A. Isaksson, and S.E. White. 1988. Effects of Faroese long-line fishery, other oceanic fisheries, and oceanic variations on age at maturity of Icelandic north coast stocks of Atlantic salmon (*Salmo salar*). Presented by co-author at Meeting of International Council for the Exploration of the Sea, Bergen, Norway.

Scarnecchia, D.L., A. Isaksson, and S.E. White. 1988. Effects of oceanic variations and the West Greenland fishery on age at maturity of Icelandic west coast stocks of Atlantic salmon (*Salmo salar*). Presented by co-author at October Meeting of International Council for the Exploration of the Sea, Bergen, Norway.

Scarnecchia, D.L., and E.P. Bergersen. 1986. Models of salmonid production in Colorado's small streams." Poster Session, American Fisheries Society Annual Meeting, 1986 (also presented by co-author at the International Symposium on Trout in Streams and Lakes, Madrid, Spain, September 1987).

Scarnecchia, D.L. 1984. Climatic and oceanic variations affecting yields of Icelandic stocks of Atlantic salmon. American Fisheries Society Annual Meeting, Ithaca, New York.

Scarnecchia, D.L. 1983. Age and sexual maturity in Icelandic salmon. Icelandic Natural History Society, Reykjavik, Iceland.

Other:

Scarnecchia, D.L. 1980. Sampling stream fishes with portable electrofishing equipment." 12 minute Instructional Video. Colorado Cooperative Fisheries Research Unit, Ft. Collins, Colorado.

Scarnecchia, D.L., and P.A. Stewart. Paddlefish: a unique and valuable resource. Kiosk display at Intake, Montana, and Miles City, Montana.

Grants and Contracts (sole principal investigator)

Approximately 3.5 million dollars in grants and contracts (sole investigator) since 1990. Projects include (not a complete list):

Yellowstone River paddlefish investigations, Montana Department of Fish, Wildlife and Parks, $570,000, 1991-2009.

Paddlefish stock dynamics, North Dakota Game and Fish Department, $400,000, 1996-2009.

Paddlefish stock assessment, Oklahoma Department of wildlife Conservation, $70,000 2008,2009.

Mann Lake Redband trout fishery, Idaho fish and Gems, $70,000 2007-2009

Yellowstone River water withdrawals, North Dakota Game and Fish, $15,000 2007, 2008.

Dworshak Bull trout, Idaho fish and Game, $ 50,000 2007-2008.

Yellowstone River Water withdrawals, WAPA, $135,000, 2007-2009.

Culverts and native fish. Dakota Prairie Grasslands, $30,000, 2006.

Salt tolerance of native fish. Dakota Prairie Grasslands $25,000 2009

Bull trout, Clearwater- Dworshak system. Idaho Fish and Game, $30,000, 2006

Bull Trout in the Secesh River, U.S. Forest Service $55,000, 2003-04

Milk River native fish ecology, Montana Department of Fish, Wildlife and Parks $100,000, 2002-04

Paddlefish habitat use, Montana Department of Fish, Wildlife and Parks, $55,000, 2002-03

Chum and Pink Salmon ecology, National Maine Fisheries Science, $8,000, 2001-02

Lake Clark, Alaska fisheries studies, $29,000, 2004

Sockeye salmon studies, Alaska. $15,000, 2004

Little Missouri River Studies, U.S. Forest Service (National Grasslands), $17,500, 2001; $25,000, 2004

Walleye age and growth. North Dakota Game and Fish Department, $4,000, 2000, 2003-04

Kootenai River white sturgeon studies, Montana Department of Fish, Wildlife and Parks, $40,000, 1999-2000

Priest Lake salmonid studies, Idaho Fish and Game, $45,000, 1999, 2000

Paddlefish investigation, North Dakota Game and Fish Department, $3,000, 1998-2008

Bull Trout investigations, U.S. Forest Service, Idaho Fish and Game, $100,000, 1998-99; $50,000, 2003-2004

Ft. Peck paddlefish investigations, Montana Department of Fish, Wildlife and Parks, $230,000, 1997-2008

Kootenai white sturgeon investigations, Idaho Fish and Game, $45,000, 1997-99

Paddlefish stock assessment, Northwest Area Foundation, $45,000, 1997-99

Intake dam entrainment study, U.S. Bureau of Reclamation, $12,000, 1997

Missouri River benthic fishes study, U.S. Army Corps of Engineers, $258,000, 1996-98

Coho salmon ecology in the Umpqua River, U.S. Forest Service, $20,000, 1995-96.

Sicklefin and sturgeon chub investigations, North Dakota Game and Fish Department, $23,000, 1995.

Predators on paddlefish, North Dakota Game and Fish Department, $75,000, 1994-96.

Control of undesirable fishes in Bowman-Haley Reservoir, North Dakota Game and Fish Department, $100,000, 1993-95.

Kokanee maturation in Idaho lakes, Idaho Fish and Game, $21,000 (with J. Congleton), 1992-93.

Bull trout investigations, N. Idaho, U.S. Forest Service, $65,000, 1992-93.

Ecology of bull trout in Nez Perce forest, U.S. Forest Service, Idaho, $23,000, 1992-93.

Life history and ecology of paddlefish in Lake Sakakawea, North Dakota Game and Fish Department, $79,000, 1992-93.

Life history and ecology of Umpqua River, Oregon, spring chinook salmon, U.S. Forest Service, $140,000, 1991-94.

Thor Thors Research Grant, American Scandinavian Foundation, $2,000, 1989.

Fish and vegetation relationships in Spirit Lake, Iowa, Iowa Science Foundation, $3,600, 1988.

Fish and vegetation relationships in Spirit Lake, Iowa, Max McGraw Wildlife Foundation, $950, 1988.

Spawning and early life history of paddlefish and shovelnose sturgeon in the Upper Mississippi River, Iowa Department of Natural Resources/Natural Marine Fisheries Service, $80,000, 1987-90.

Life history strategies of Icelandic salmon, North Atlantic Treaty Organization, 1986, $5,000; 1988, $4,500.

Annual variations in age at maturity in Icelandic stocks of Atlantic salmon, ISU Research Initiation Grant, $2,250, 1986.

Trout production in Colorado's small streams. Sport Fishing Institute, $2,500, 1980.

Honors and Awards:

Honor Society of Phi Kappa Phi, Distinguished Faculty Member Award, 2000
Outstanding Research Award, College of Forestry, Wildlife and Range Sciences, University of Idaho, 1996
Outstanding Paper, Dakota Chapter, American Fisheries Society Annual Meeting, 1994 (with J. Fredericks)
Professional Achievement Award for Outstanding Progress in Career Development from Colorado State University College of Forestry and Natural Resources Alumni Association, 1988
Icelandic Science Foundation, Research Fellowship, 1982
Fulbright Scholarship to Iceland for study of Atlantic population dynamics, 1981-82
National Wildlife Federation Fellowship, 1980

SERVICE:

Major Committee Assignments:

College of Natural Resources Scholarship Committee, 2000-09
University Borah Foundation Committee, 1997-99 (Chair, 1999)
University Research Committee, 2000-03

Professional and Scholarly Organizations:

American Fisheries Society
Management Section; Idaho, Montana, Dakota Chapters
American Society of Ichthyologists and Herpetologists
Fisheries Society of the British Isles
Icelandic Natural History Society
North Dakota Natural Science Society
Northwest Scientific Association

Outreach Service:

IUCN Activities, 2001-present
IUCN Sturgeon Specialist Group, 2000-present
Northwest Power and Conservation Council, ISRP participation 2006; 2010-present Independent Scientific Advisory Board Member 2008-present (River/estuary/ocean issues)
Paddlefish Management Plan, development coordinator, 1992-present
Paddlefish Working Group, 1991-present
Paddlefish Extension, Intake, Montana, and Confluence, North Dakota, 1991-present
Fisheries/Forestry interactions - Workshop lecturer, 1990
Fisheries and Wildlife Biology Club Faculty Advisor, 1986-89
Instructor in fish ecology for Weekend Public Natural History Courses, Iowa Lakeside Laboratory, 1986-89
Numerous manuscript and grant proposal reviews and book reviews