PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Adaptive Management Of White Sturgeons

BPA project number: 20062
Contract renewal date (mm/yyyy): ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
US Geological Survey, Biological Resources Division, Columbia River Research Laboratory

Business acronym (if appropriate) USGS

Proposal contact person or principal investigator:

Name	Michael J. Parsley
Mailing Address	5501A Cook-Underwood Road
City, ST Zip	Cook, WA 98605
Phone	(509) 538-2299
Fax	(509) 538-2843
Email address	michael_parsley@usgs.gov

NPPC Program Measure Number(s) which this project addresses
10.4

FWS/NMFS Biological Opinion Number(s) which this project addresses

Other planning document references
Wy-Kan-Ush-Mi Wa-Kish-Wit calls for increasing sturgeon populations to naturally sustainable levels that support tribal harvest. A technical recommendation to achieve this is to "Develop artificial propogation and management strategies for white sturgeon populations above Bonneville Dam".

Short description
Improve on an existing model for population viability analyses of white sturgeons and identify costs and benefits of alternative adaptive management actions, including supplementation and harvest management.

Target species
White sturgeon (Acipenser transmontanus)

Section 2. Sorting and evaluation

Subbasin
Systemwide

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☐ Anadromous fish ☒ Resident fish ☐ Wildlife	☒ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☐ Operation & maintenance ☐ New construction ☒ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
8605000	White sturgeon mitigation and restoration in the Columbia and Snake Rivers	Population and harvest characteristics measured by 8605000 will be necessary for this proposed project.
8806500	Kootenai River Fisheries Investigations	Population characteristics measured by 8806500 wil be necessary for this project.
9084	Assessing Genetic Variation Among Columbia Basin White Sturgeon Populations	Results of genetic analyses will be crucial to modeling gene flow among populations.
9700900	Evaluate means of rebuilding white sturgeon populations in the Snake	Stock assessment activities will provide population characteristics for

	River	our use.
9800401	Assessment of the Impacts of Development and Operation of Columbia River ..	Analyses of physical habitat differences that exist among reservoirs will rely on data from this ongoing project.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Integrate basin-wide information on white sturgeon habitat, growth and status for use in a Population Viability Analysis (PVA) model.	a	Identify and obtain data from various agencies. Summarize habitat during critical time periods and for different hydrologic year types.
		b	Modify and calibrate the white sturgeon PVA model for the Snake River to Columbia River reservoirs.
2	Use the model to design adaptive policies (e.g., supplementation and harvest management) that raise long-term population densities of white sturgeon in the Columbia River basin.	a	Formulate the adaptive policy as an optimization problem with feedbacks between monitored population demography and genetics and future policy.
		b	Interact with agencies to fine-tune management objectives and to evaluate model predictions.
		c	Publish results.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	10/1999	10/2000		PVA model	100.00%

				calibrated	
2	10/2000	9/2001		Draft manuscript	0.00%
				Total	100.00%

Schedule constraints
None

Completion date
2001

Section 5. Budget

FY99 project budget (BPA obligated):

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	USGS - $8,328 ORNL - $42,624	%28	50,952
Fringe benefits	USGS - $2,498 ORNL - $9,377	%6	11,875
Supplies, materials, non-expendable property	ORNL	%3	6,000
Operations & maintenance	ORNL	%4	8,000
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%0	
NEPA costs		%0	
Construction-related support		%0	
PIT tags	# of tags:	%0	
Travel	USGS- $1,000 ORNL - $20,000	%11	21,000
Indirect costs	USGS - $11, 826 ORNL - $75,021	%47	86,847
Subcontractor		%0	
Other		%0	
TOTAL BPA FY2000 BUDGET REQUEST			$184,674

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
Electric Power Research Institute	Model development	%18	40,000
		%0	
		%0	
		%0	
Total project cost (including BPA portion)			$224,674

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	$200,000	$0	$0	$0

Section 6. References

Watershed?	Reference
☐	Anders, P. J. 1998. Conservation aquaculture and endangered species. Fisheries 23(11): 28-31.
☐	Beamesderfer, R. C. P., and R. A. Farr. 1997. Alternatives for the protection and restoration of sturgeons and their habitat. Environmental Biology of Fishes 48(1-4): 407-417.
☐	Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes 48(1-4): 399-405.
☐	Hansen, M. M., and V. Loeschcke. 1994. Effects of releasing hatchery-reared brown trout to wild trout populations. IN V. Loeschcke, J. Tomiuk, and S. K. Jain, eds.,Conservation Genetics, Birkhauser Verlag, Basel, Switzerland.
☐	Hanski, I., and M. E. Gilpin. 1991. Metapopulation dynamics: brief history and conceptual domain. 3-16 IN I. Hanski and M. E. Gilpin, eds., Metapopulation Dynamics, Academic Press, London.
☐	Hilborn, R. 1992. Hatcheries and the future of salmon in the Northwest. Fisheries 17(1): 5-8.
☐	Jager, H. I., H.E. Cardwell, M. J. Sale, M. S. Bevelhimer, C. C. Coutant, and W. Van Winkle. 1997. Modelling the linkages between flow management and salmon recruitment in streams. Ecological Modelling 103: 171-191.
☐	Jager, H. I., W. Van Winkle, K. Lepla, and J. Chandler. in prep. A population viability analysis of white sturgeon. TBA.
☐	Jager, H. I., W. Van Winkle, K. Lepla, and J. Chandler. in prep. B Are white sturgeon dammed? -- Population viability of white sturgeon in a fragmented river habitat. Conservation Biology.
☐	Ludwig, D., R. Hilborn, and C.J. Walters 1993. Uncertainty, resource exploitation, and conservation: Lessons from history. Science 260: 17-36.
☐	Moring, J.R. 1993. Effect of angling effort on catch rate of wild salmonids in

	streams stocked with catchable-size trout. North Am. J. Fish. Manage. 13: 234-237.
☐	Parent, S., and L. M. Schrimi. 1995. A model for the determination of fish species at risk based upon life-history traits and ecological data. Can. J. Fish. Aquat. Sci. 52: 1768-1781.
☐	Parsley, M.J. 1992. Use of a raster-structured GIS in fisheries research activities on the Columbia River. Pages 74-81 in Proceedings, Third National US Fish and Wildlife Servide Geographic Information Systems Workshop. Onalaska, Wisconsin.
☐	Parsley, M.J., and L.G. Beckman. 1994. White sturgeon spawning and rearing habitat in the lower Columbia River. North American Journal of Fisheries Management 14:812-827.
☐	Policansky, D. and J.J. Magnuson. 1998. Genetics, metapopulations, and ecosystem management of fisheries. Ecological Applications 8(1 (Supplement): S119-S123.
☐	Van Winkle, W., et al. 1997. Uncertainty and instream flow standards: perspectives based on research and assessment experience. Fisheries 21: 21-22.
☐	Vincent, E.R. 1987. Effects of stocking catchable-size hatchery rainbow trout on two wild trout species in the Madison River and O'Dell Creek, Montana. North Am. J. Fish. Manage. 7: 91-105.
☐	Walters, C. 1986. Adaptive Management of Renewable Resources, MacMillan Publishing Company, New York.
☐	Waples, R.. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Can. J. Fish. Aquat. Sci. 48 (Supplement 1): 124-133.

PART II - NARRATIVE

Section 7. Abstract

We propose developing an adaptive management tool to answer the question: "What combination of supplementation, broodstock management, and harvest policies lead to improved viability of white sturgeon in all river sections?" We will expand an existing population viability analysis model that has been developed for the middle Snake River through the combined efforts of Idaho Power, the Electric Power Research Institute, and Oak Ridge National Laboratory. The expanded analysis will include white sturgeon populations in the lower Snake River and in the Columbia River reservoirs.

The goal of this effort will be to integrate information on white sturgeon population status and genetic diversity with information on habitat availability for the isolated populations to quantify the costs and benefits of alternative adaptive strategies. Information on white sturgeon population size structure, age composition, population estimates and habitat data from a larger number of river segments should permit us to

develop relationships relating individual growth and maturation to temperature and habitat availability.

Section 8. Project description

a. Technical and/or scientific background

White sturgeon populations in the Columbia River basin have declined, raising concerns about the long-term viability in the highly modified river environment. The life history of this species is similar to that of many species that have already been lost or are currently endangered (Parent and Schrimi 1995; Beamesderfer and Farr 1997; Boreman 1997). In particular, anadromy, late maturation, and a long interval between subsequent spawning are characteristics that put white sturgeons at risk. Changes in river habitat associated with impoundment and hydropower operations contribute to concerns over white sturgeon persistence in the Columbia River Basin.

It may be possible to improve long-term prospects for this species through effective resource management. Understanding the value of mitigation policies employed by resource agencies in a complex ecosystem will be aided by a population modeling analysis that simulates alternative policies. Because decisions about supplementation are imminent, this study will focus on hatchery supplementation. In particular, we propose developing this model as an adaptive management tool to answer the question: “How can population monitoring information be used to design adaptive policies for supplementation and harvest management that will enable Columbia River Basin white sturgeon populations to thrive?”

Integration

One role that this project will serve is to integrate data from various studies that have been conducted along the Columbia River for use in the population model. We have developed a general population model to assess the viability of white sturgeon in the Lower Snake River (Jager et al. in prep. B). Because the Snake River is only one part of the larger Columbia River system, it is logical to expand the scope to include a comprehensive basin-wide analysis. Thus, one goal of the modeling effort will be to integrate information on population status, habitat availability, and genetic diversity in each section of the Columbia River.

River sections differ in a number of ways, including the following three; the amount of free-flowing habitat available for spawning is higher in some reaches than in others, thermal regimes follow a longitudinal gradient, becoming warmer inland, and harvest regulations change, with only catch-and-release fishing allowed in the Snake River upstream from Lower Granite Dam and in the Columbia River upstream from Priest Rapids Dam. Size, age, population estimates and habitat data from a larger number of river segments will permit us to develop relationships relating individual growth and maturation to temperature and habitat availability.

We envision using the genetic component of this model in combination with basin-wide genetics studies to understand regional patterns in genetic diversity and levels of migration between river segments. This component will require collaboration with researchers studying genetic variation among white sturgeon populations in the Columbia Basin.

Feedback between Monitoring and Policy

Adaptive management seeks to understand causal relationships between resources (populations) and the environment or human impacts by experimenting (Walters 1984). Models, to guide understanding and identify uncertainties, can play an important role (Van Winkle et al. 1997). Here, we use the term to refer to a policy that is adjusted periodically in response to monitoring information. We envision improving an existing model for population viability analysis of white sturgeon (Jager et al., in prep. A) and identifying the costs and benefits to white sturgeon populations of alternative adaptive policies.

Hatchery supplementation has the potential to boost white sturgeon populations in the Columbia River. In theory, supplementation can protect a population from extinction by simulating the "rescue effects" associated with a normally functioning meta-population that experiences both upstream and downstream migration (Hanski and Gilpin 1991). We propose that monitoring programs to evaluate the status of white sturgeon populations can provide feedback to resource managers to fine-tune supplementation and fishing policies. Our model can simulate the demographic and genetic consequences of alternative policies. We envision an interactive process in the second year. We would simulate alternative adaptive policies, share these with resource managers, and solicit feedback on management objectives or model/input improvements. Ultimately, our collective goal would be to design policy adjustments in response to monitored population status.

Typically, the decision to supplement is viewed as a trade-off between the demographic benefit of a rescue effect and the genetic dangers associated with planting inbred hatchery fish or fish produced by a broodstock that is not locally adapted (Waples 1991). As Anders (1998) recently pointed out, broodstock management policies that follow conservation guidelines may not impose any genetic risks. Our simulations to understand fragmentation effects on white sturgeon concur with the idea that maintaining a reasonable effective population size can prevent loss of genetic diversity (Jager et al. unpublished). In addition to these undisputed benefits of supplementation, we will design the model to consider the following three risks:

1. There is evidence that stocking can lead to over-exploitation because of a density-dependent response of fisherman to increased fish densities (Vincent 1987; Moring 1993). When this occurs, stocking is counter-productive. We can address this concern by simulating a response of anglers to fish density (e.g., Van Winkle et al. 1998). In addition, uncertainty in population status can result in over-exploitation (Ludwig et al. 1993).

2. Second, hatchery supplementation can lead to replacement of natural populations with individuals adapted to the hatchery setting rather than local conditions (Policanski and Magnuson 1998; Waples 1991). This can potentially lead to population decline over time. In addition, some broodstock management practices can lead to inbreeding and inbreeding depression, although inbreeding depression in white sturgeon has not yet been studied.

3. Despite demographic improvements provided by supplementation, terminating the practice may lead to a high risk of extinction. Detractors of supplementation argue that the time horizon for management policies is too short to guarantee long-term persistence. Without fundamental improvements of habitat and passage, species declining under current conditions are doomed (Hansen and Loeschcke 1994).

b. Rationale and significance to Regional Programs

The Northwest Power Planning Council's Fish and Wildlife Program seeks to provide a healthy Columbia River Basin that supports human activities and the long-term sustainablity of native fishes. In achieving this goal, it's recognized that a variety of activities, including altering hydropower system operations, supplementation, and carefully orchestrated harvest management will be necessary. Measure 10.4 of the Fish and Wildlife Program and its sub-measures deal directly with actions to restore white sturgeon populations and mitigate for losses to the populations caused by hydropower system development and operation. This proposed work seeks to pull together results from activities that are currently underway by several State, Tribal, private, and Federal entities. Measure 10.4A calls for the study and evaluation of white sturgeon populations. Several stock assessment projects have been or will soon be completed in a number of impounded areas in Columbia, Kootenai, and Snake rivers. However, no attempt has been made to investigate why differences in population characteristics (growth rates, densities, annual mortality) exist among reservoirs and basins. Fishery managers are setting biological objectives for recovery and using population characteristics of the population from the umimpounded Columbia River downstream from Bonneville Dam as goals that should be acheived. However, it should be recognized that that population has access to marine environments and that the physical habitat characteristics of that river reach are substantially different from other reaches, with the exception of the Bonneville Reservoir. Parsley (1992) showed that the four riverine segments between the mouth and McNary Dam differ substantially in bathymetry and substrate, and Parsley and Beckman (1994) describe the differences in rearing habitats for white sturgeons among these areas. Thus, it's conceivable that we should expect to see differences in population characteristics among impounded areas within the Columbia River Basin. This proposed project will investigate the effects that differing physical habitat among areas has on population characteristics.

Supplementation of white sturgeon populations is currently being done under the auspicies of measures 10.4A2 and 10.4A3 of the Northwest Power Planning Council's Fish and Wildlife Program, Wy-Kan-Us-Mi Wa-Kish-Wit developed by the Umatilla, Yakima, Warm Springs, and Nez Perce tribes, and the U.S Fish and Wildlife Service's Recovery Plan for Kootenai River White Sturgeon. Supplementation activities include trawl and haul activities, artificial supplementation, and conservation aquaculture. These efforts are following sound broodstock management protocols that seek to avoid genetic risks. Our proposed project is unique in that it will seek to provide a better understanding of three risks associated with supplementation of white sturgeon populations, including the risk that supplementation could lead to over-exploitation, the risk that supplementation could lead to replacement of natural populations with individuals adapted to hatchery conditions rather than natural environments, and the consequences of terminating a supplementation program.

c. Relationships to other projects

Relevant projects include several currently being funded by BPA and several being undertaken by private entities, including Idaho Power and Grant County PUD. Project 8605000 (White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers) has generated a wealth of information on stock status and population characteristics from 11 reservoirs on the Columbia and Snake rivers. Idaho Power has collected similar information from several reseroirs upstream from Hells Canyon Dam, and Grant County PUD is currently undertaking studies to assess fisheries in the Priest Rapids Dam Complex. The Oak Ridge National Laboratory has been and is currently involved in a study funded jointly by Idaho Power Company and the Electric Power Research Institute to develop a white sturgeon population model and conduct a population viability analysis (PVA) for populations upstream from Lower Granite Dam. This proposed study would build on the existing PVA model and include both the Snake and Columbia Rivers.

The BPA is currently funding a genetics study, Assessing Genetic Variation Among Columbia Basin White Sturgeon Populations, Project Number 9084, and we are proposing a greater coordination between the genetic information obtained system-wide as a part of that study and the PVA modeling effort being done for Idaho Power and the Electric Power Research Institute.

The BPA is currently funding a project "Assessment of the Impacts of Development and Operation of the Columbia River Hydroelectric System on Mainstem Riverine Processes and Habitats". The results from that project should allow us to compare physical differences in habitat that exist among reservoirs with population characteristics of the white sturgeon populations found within them.

d. **Project history** (for ongoing projects)

This is a new project.

e. Proposal objectives

This proposal seeks mainly to address the question:
"How can population monitoring information be used to design adaptive policies for supplementation and harvest management that will enable Columbia River Basin white sturgeon populations to thrive?" We will pursue this question by expanding the application of an existing population viability model and addressing these two objectives:

Objective 1. Integrate basin-wide information on white sturgeon habitat, growth and status for use in a Population Viability Analysis model.

Objective 2. Use the model to design adaptive policies (e.g., supplementation and harvest management) that raise long-term population densities of white sturgeon in the Columbia River basin.

In addition, we have identified several corollary questions that will be answered along the way as part of the effort to tailor the model:

1. To what extent can we explain longitudinal differences in maturation and growth of female white sturgeon in the Columbia and Snake Rivers by variables that summarize water temperature on an annual basis?
2. What levels of downstream and upstream migration are indicated by the regional genetic analysis and the model?
3. How significant are each of the three risks associated with supplementation and under what conditions are they of concern?
4. What types of population monitoring data and what time intervals for monitoring are needed to provide policy makers with feedback?

f. Methods

Objective 1. Integrate basin-wide information on white sturgeon habitat, growth and status for use in a Population Viability Analysis (PVA) model.

Task a. Contact agencies to identify and assemble data and reports needed to describe physical habitat in the white sturgeon model. Summarize physical habitat, growth rates, and population estimates among reservoirs.

Task b. Modify and calibrate the white sturgeon PVA model developed by ORNL with funding from the Electric Power Research Institute and Idaho Power Co. for the Snake River.
a) Modify the PVA model to simulate growth and calibrate growth based on temperature and age-growth relationships in each segment of the Columbia and Snake Rivers.
b) Collaborate with P. Anders and M. Powell (BPA Project 9084) to ensure that we can compare theoretical model results with their genetic analysis.
c) Add fishing mortality to the model, including response of anglers to fish density and regulations.
d) Add supplementation, either from artificial propogation or enhanced passage (trawl-and-haul) to the model, including annual numbers released and degree of genetic relationship among released fish.

Objective 2. Use the model to design adaptive policies (e.g., supplementation and harvest management) that raise long-term population densities of white sturgeon in the Columbia River basin.

Task a. Develop a general function to represent feedback between population status (genetic and demographic) and future policy. Parameters should include (1) the time lag between information describing population status and policy adjustment; (2) slot limits for fishing; (3) annual harvesting limit per angler; (4) total number of planted sturgeon juveniles; and (5) genetic diversity of juveniles. Population status will be described by density and the fixation index in each segment. We will consider adding a fixed error term to represent the use of uncertain information about population status.

Task b. Implement optimization methods to identify parameters in this feedback function for adaptive management that best protects white sturgeon populations. Define an objective function in collaboration with resource managers. For example, maximizing the likelihood of white sturgeon persistence, minimizing inbreeding, maximizing harvesting yield, and other objectives identified by state agencies.

g. Facilities and equipment

Field work will not be conducted on this project. The US Geological Survey and the Oak Ridge National Laboratory have adequate computers and equipment needed to complete this task.

h. Budget

Costs associated with this project are primarily for salaries, administrative overhead, and travel. Operation and maintenance costs include purchasing new software and computer maintenance. Oak Ridge National Laboratory indirect costs include costs for laboratory and division support.

Section 9. Key personnel

Michael J. Parsley
Research Fishery Biologist - Project Leader 0.20 FTE

School	Degree	Date
Iowa State University	B.S. Fisheries & Wildlife Biology	1982
University of Wisconsin at Stevens Point	M. S. Fisheries	1984

Certified by the American Fisheries Society as a Fisheries Scientist in 1990

Current Employer: U.S. Geological Survey **-** Biological Resources Division

Current Responsibilities: I serve as project leader for studies done by staff at our facility on the early life history and habitat use of white sturgeons in the Columbia River. The studies have included the use of biotelemetry to ascertain habitat use by juvenile and adult white sturgeons, laboratory experiments to determine the effects of gas supersaturation on developing embryos, and the use of trawls to estimate recruitment to young of the year. My role is to coordinate our research activities on white sturgeons with the activities and needs of the tribes, states, and other governmental agencies. I oversee the work of several biologists and technicians who collect and analyze data pertaining to our studies to ensure that our work is of the highest quality and that it is done in accordance with established standards and protocols, such as the Good Laboratory Practices Act.

I also serve as the geospatial technology coordinator for the Western Fisheries Research Center.

Recent Previous Employment: Research Fisheries Biologist, U.S. Geological Survey, Biological Resources Division, Columbia River Research Laboratory, 1984 **-** present.

Expertise: My area of expertise is Fisheries Research, and I'm considered an expert on the ecology and biology of white sturgeons. In 1993 I organized and co-chaired a day-long symposium called "Biology and Management of North American Sturgeons" that was held at the Annual Meeting of the American Fisheries Society, Portland, Oregon, 1993. I'm also knowledgeable in methods to quantify habitat in large rivers using remote sensing and geographic information systems.

Selected Relevant Publications:
Parsley, M. J., L. G. Beckman, and G. T. McCabe. 1993. Spawning and rearing habitat use by white sturgeons in the Columbia River downstream from McNary Dam. Transactions of the American Fisheries Society 122:217-227.

Parsley, M. J., and L. G. Beckman. 1994. White sturgeon spawning and rearing habitat in the lower Columbia River. North American Journal of Fisheries Management 14:812-827.

Counihan, T.D., A.I. Miller, M.G. Mesa, and M.J. Parsley. 1998. The effects of dissolved gas supersaturation on white sturgeon larvae. Transactions of the American Fisheries Society. 127:316-322.

Counihan, T.D., A.I. Miller, and M.J Parsley. In press. Indexing the relative abundance of young-of-the-year white sturgeon in an impoundment of the lower Columbia River from highly skewed trawling data. North American Journal of Fisheries Management.

Henriette I. Jager
Research Associate 0.50 FTE

School	Degree	Date
Franklin Pierce College	B.A. Biology	1979
University of Tennessee at Knoxville	M.S. Ecology	1984
University of Tennessee at Knoxville	PhD Candidate Ecology and Evolutionary Biology	

Current Employer: Oak Ridge National Laboratory, Oak Ridge, TN

Current Responsibilities: As part of my responsibilities, I conduct applied ecological research on fish population dynamics. One main thrust of our research has been to use individual-based population models to understand the relationship between streamflow and population dynamics of stream fishes with different life histories. In the past several years, I have had the opportunity to enter the area of conservation biology and genetics. I am currently conducting population viability analyses of white sturgeon in the Snake River, Idaho and of fall-run chinook salmon in the Tuolumne River, California. My role is to define research objectives in coordination with sponsors and colleagues, to develop population models, to design and conduct simulation experiments, and to publish, or otherwise communicate, results.

Recent Previous Experience: Research Associate, Oak Ridge National Laboratory, Oak Ridge, TN, 1988 - present.

Expertise: My expertise is in theoretical and quantitative ecology. In the past, I have contributed to research and published papers in diverse areas, including food web ecology, the application of spatial statistics to regional-scale environmental problems, and the effects of flow and temperature on stream fishes.

Selected Relevant Publications:

Jager, H.I., W. Van Winkle, B.D. Holcomb, and S.F. Railsback. accepted. Would hydrologic climate changes in Sierra-Nevada streams influence trout persistence? Trans. Am. Fish. Soc.

Jager, H.I., H.E. Cardwell, M.J. Sale, M.J. Bevelhimer, C.C. Coutant, and W. Van Winkle. 1997. Modelling the linkages between flow management and salmon recruitment in streams. Ecological Modelling 103: 171-191.

Jager, H.I. and E.J. Pert. 1997. Comment: Testing the Independence of Microhabitat Preferences and Flow. Trans. Am. Fish. Soc. 126: 537-540.

Cardwell, H., H.I. Jager, and M.J. Sale. 1996. Designing instream flows to satisfy fish and human water needs. ASCE J. of Water Res. Planning and Mgmt. 122(5): 356-363.

Jager, H.I., D.L. DeAngelis, M.J. Sale, W. VanWinkle, D.D. Schmoyer, M.J. Sabo, D.J. Orth, and J.A. Lukas. 1993. An individual-based model of smallmouth bass reproduction and young-of-year dynamics in streams. Rivers 4: 91-113.

Mark S. Bevelhimer
Research Staff Member 0.15 FTE

School	Degree	Date
Wabash College (Crawfordsville, IN)	B.A., Biology	1979
The Ohio State University (Columbus)	M.S., Zoology	1983
The University of Tennessee (Knoxville)	Ph.D., Ecology	1990

Current Employer: Oak Ridge National Laboratory (ORNL), Oak Ridge, TN

Current Responsibilities: I am the project manager for the EPRI-funded individual-based modeling work performed at ORNL. I perform hydropower assessments for the Federal Energy Regulatory Commission and am also responsible for pursuing funding opportunities for other fisheries assessment work.

Recent Previous Experience:
1997-present: Research Staff Member, Environmental Sciences Division, ORNL.
1993-1996: Research Associate, Environmental Sciences Division, ORNL.

Expertise: I have fifteen years experience in aquatic ecology/fisheries biology ranging from basic research to management activities to environmental assessment. My work has been a combination of field observation, laboratory experimentation, and computer modeling. Modeling experience includes examining various aspects of fish movement, growth, food consumption and contaminant uptake. I have extensive experience with the development and use of (1) bioenergetic models to investigate fish growth and movement, (2) individual-based models to evaluate population-level effects, and (3) hydrological models to assess stream flow and temperature interactions. Recently I have been using these skills to investigate ecological impacts of hydropower operations and the transport and fate of environmental contaminants.

Selected Relevant Publications:

Bevelhimer, M.S., V. Alavian, B. Miller, and G. Hauser. 1997. Modeling Thermal Effects of Operational and Structural Modifications at a Hydropower Facility on a Premier Trout Stream in Southwestern Montana. *WaterPower 97: Proceedings of the International Conference on Hydropower* 1997(1):40-49.

Bevelhimer, M. S. 1996. Relative Importance of Temperature, Food, and Physical Structure to Habitat Choice by Smallmouth Bass in the Field and Laboratory. *Transactions of the American Fisheries Society* 125:274-283.

Bevelhimer, M. S. 1996. Smallmouth Bass Habitat Use and Movement Patterns with Respect to Reservoir Thermal Structure. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* 49:240-249.

Cada, G. F., M. D. Deacon, S. V. Mitz, and M. S. Bevelhimer. 1997. Effects of Water Velocity on the Survival of Downstream-migrating Juvenile Salmon and Steelhead: Review with Emphasis on the Columbia River Basin. *Reviews in Fisheries Science* 5(2):131-183.

Sale, M.J., et al. 1996. Reservoir Release Requirements for Fish at the New Don Pedro Project, California. FERC/EIS-0081F, FERC, Washington, DC.

Webster Van Winkle, Jr.   0.10 FTE

Education: Oberlin College B. A., History 1961
Rutgers University Ph.D., Zoology 1967

Current Status: Contract with EPRI for part-time professional services including (1) technical support to ORNL staff on tasks for the Idaho Power Company-ORNL-EPRI project on population viability analysis of white sturgeon in the Snake River; (2) technical support to ORNL staff on tasks for the ORNL-EPRI CompMech Program; and (3) assistance to the EPRI Project Manager involving technical workshops, publications, program planning and statements of work.

Relevant Previous Experience: Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN (1972-retired Sep 1998). Broad range of experiences as P.I., Group Leader, and Section Head. P.I. (1987-1998) for the EPRI-funded project on Compensatory Mechanisms in Fish Populations (CompMech). Most publications (> 90) fall under the umbrella heading of analysis, modeling, and assessment of the effects of stresses on fish populations and aquatic ecosystems.

Selected Relevant Publications:

Van Winkle, W., and V. H. Dale. 1998. Model interactions: a reply to Aber. Bulletin of the Ecological Society of America, Vol. 79(October): 169-170.

Dale, V. H., and W. Van Winkle. 1998. Models provide understanding, not belief. Ecological Society of America, Vol. 79(2): 129-139.

Van Winkle, W., H. I. Jager, and B. D. Holcomb. 1998. Individual-based instream flow model for sympatric populations of brown and rainbow trout: model description and calibration. Ecological Modelling 110: 175-207.

Van Winkle, W., C. C. Coutant, H. I. Jager, J. S. Mattice, D. J. Orth, R. G. Otto, S. F. Railsback, and M. J. Sale. 1997. Uncertainty and instream flow standards: Perspectives based on hydropower research and assessment. Fisheries 22(7): 21-22.

Van Winkle, W., K. A. Rose, B. J. Shuter, H. I. Jager, and B. D. Holcomb. 1997. Effects of climatic temperature change on growth, survival, and reproduction of rainbow trout: predictions from a simulation model. Canadian Journal of Fisheries and Aquatic Sciences 54: 2526-2542.

Van Winkle, W., K. A. Rose, and R. C. Chambers. 1993. Individual-based approach to fish population dynamics: an overview. Transactions of the American Fisheries Society 122: 397-403.

Van Winkle, W., K. A. Rose, K. O. Winemiller, D. L. DeAngelis, S. W. Christensen, and R. G. Otto. 1993. Linking life history theory and individual-based modeling to compare responses of different fish species to disturbance. Transactions of the American Fisheries Society 122: 459-466.

Van Winkle, W. (editor). 1977. Assessing the Effects of Power-Plant-Induced Mortality on Fish Populations. Pergamon Press, New York. 380 p.

Section 10. Information/technology transfer

Results from this analysis will be presented to the public through participation in scientific meetings and workshops, and by publishing the findings in peer-reviewed journals. The USGS is mandated to provide information on it's products and data via the Web-based National Biological Information Infrastructure.

Congratulations!