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## PART I - ADMINISTRATIVE

### Section 1. General administrative information

#### Title of project

Assessing Genetic Variation Among Columbia Basin White Sturgeon Populations

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**BPA project number:** 9902200  
**Contract renewal date (mm/yyyy):** 1/2000  **Multiple actions?**

**Business name of agency, institution or organization requesting funding**  
University of Idaho

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**Business acronym (if appropriate)** U of I

#### Proposal contact person or principal investigator:

<b>Name</b>	<u>Madison S. Powell</u>
<b>Mailing Address</b>	<u>3059F National Fish Hatchery Road</u>
<b>City, ST Zip</b>	<u>Hagerman, ID 83332</u>
<b>Phone</b>	<u>(208) 837-9096</u>
<b>Fax</b>	<u>(208) 837-6047</u>
<b>Email address</b>	<u>fishdna@micron.net</u>

**NPPC Program Measure Number(s) which this project addresses**  
10.4, 10.4A.1 through 10.4A5, 10.6C, 10.6C1, 10.8B15, and 10.8B16

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**FWS/NMFS Biological Opinion Number(s) which this project addresses**  
USFWS 1994 Biological Opinion on the 1994-1998 Federal Columbia River Power Operation Assessment, USFWS Biological Opinion 1995 1-4-95-F-003 (Kootenai River White Sturgeon), Kootenai River White Sturgeon Aquaculture Program (DOE-EA-1169)

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**Other planning document references**  
Zone 6 Plan Reference of ODFW, WDFW, and CRITFC, 86-50 SOW Task 1.2

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#### Short description

Assessing genetic variation and stock structure among white sturgeon populations in the Columbia Basin using analyses of mitochondrial and nuclear DNA.

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#### Target species

White Sturgeon (*Acipenser transmontanus*)

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## Section 2. Sorting and evaluation

Subbasin  
Systemwide

### ***Evaluation Process Sort***

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

## Section 3. Relationships to other Bonneville projects

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

<b>Project #</b>	<b>Project title/description</b>

### ***Other dependent or critically-related projects***

<b>Project #</b>	<b>Project title/description</b>	<b>Nature of relationship</b>
8605000	White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers	This project will provide genetic information for management and restoration. The 8650 project provides tissue samples for this project.
9409400	Kootenai River ecosystem and fisheries Improvement Study	This project will provide genetic information on an endangered population. The 9449 project provides tissue samples for this project.
8806400	Kootenai River White Sturgeon studies and conservation aquaculture	This project will provide genetic information on an endangered population. The 8864 project provides tissue samples for this

		project.
8806500	Kootenai River fisheries investigations	This project will provide genetic information on an endangered population. The 8865 project provides tissue samples for this project.
9700900	Evaluate Means of Rebuilding White Sturgeon Populations in the Lower Snake	This project will provide genetic information on white sturgeon populations in the lower Snake River. The 8865 project provides tissue samples for this project.
9093	Consumptive Sturgeon Fishery - Hells Canyon and Oxbow Reservoirs	This project will provide genetic information on white sturgeon populations in these two reservoirs.
9502700	Assess Limiting Factors of the Lake Roosevelt White Sturgeon Population	This project will provide genetic information on the Lake Roosevelt population. The 9527 project provides tissue samples for this project when field studies are undertaken.

## Section 4. Objectives, tasks and schedules

### *Past accomplishments*

Year	Accomplishment	Met biological objectives?
1998	Initiation of preliminary analyses (Objective 1)	Funding and coordination from ODFW and other cooperators has resulted in Objective 1 being started in September 1998 and this Objective is currently ahead of schedule

### *Objectives and tasks*

Obj 1,2,3	Objective	Task a,b,c	Task
1	Preliminary assessment of genetic variation among Columbia Basin white sturgeon	a	Mitochondrial D-loop length variation will be described and compared pair-wise between geographically proximate sample locations and among geographically

			separated sample locations
2	Assessment of mitochondrial sequence divergence among Columbia Basin white sturgeon	a	Sequence divergence of a non-repetitive portion of the D-loop will be compared among samples from each location examined in Objective 1.
3	Assessment of nuclear genetic variation among Columbia Basin white sturgeon populations	a	Eight nucleotide primer pairs for microsatellite loci will be used to examine nuclear genetic variation in samples from populations examined in Objective 1.

**Objective schedules and costs**

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	1/1999	12/1999	Preliminary assesment of white sturgeon genetic variation	Project has not offically started but is already ahead of projected schedule	0.00%
2	1/2000	12/2000	Phylogenetic analyses and assessment of white sturgeon mitochondrial variation	Annual report of activities and final report of Objective 1 (Preliminary Assessment)	100.00%
3	1/2001	12/2001	Comprehensive nuclear genetic analyses of white sturgeon	Annual report of activities and final report of both phylogenetic analyses and nuclear DNA analyses	0.00%
				<b>Total</b>	100.00%

**Schedule constraints**

Difficulty in sequencing or equipment failure during automated sequencing may lengthen the time required to complete Objective #2 and Objective #3. Projections for completion are: Objective #1; FY 1999, Objective #2; FY 2000, Objective #3; FY 2001

**Completion date**

## Section 5. Budget

**FY99 project budget (BPA obligated):** \$137,736

### *FY2000 budget by line item*

<b>Item</b>	<b>Note</b>	<b>% of total</b>	<b>FY2000</b>
Personnel	M. Powell, Research Scientist P. Anders, Asst. Research Scientist Scientific Aide Secretary/Bookkeeper	%49	72,108
Fringe benefits	Powell, Anders @ 0.285 Sci Aide, Sec./Bkpr. @ 0.345	%15	21,715
Supplies, materials, non-expendable property	chemicals, pipet tips, gloves, etc.	%9	12,500
Operations & maintenance	equipment calibration and repair, mailing and faxing, long distance calls, Federal Express, etc.	%1	2,100
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Stratagene, 96 well thermal robocycler	%5	7,900
NEPA costs	none	%0	0
Construction-related support	none	%0	0
PIT tags	# of tags: none	%0	0
Travel	2 professional meetings (AFS and ASIH) for one person each and 4 white sturgeon workgroup meetings	%1	2,100
Indirect costs	off campus research indirect cost rate @ 0.258	%19	28,515
Subcontractor	none	%0	0
Other	none	%0	0
<b>TOTAL BPA FY2000 BUDGET REQUEST</b>			<b>\$146,938</b>

### *Cost sharing*

<b>Organization</b>	<b>Item or service provided</b>	<b>% total project cost (incl. BPA)</b>	<b>Amount (\$)</b>
		%0	
		%0	
		%0	

		%0	
<b>Total project cost (including BPA portion)</b>			\$146,938

**Outyear costs**

	<b>FY2001</b>	<b>FY02</b>	<b>FY03</b>	<b>FY04</b>
<b>Total budget</b>	\$152,000	\$0	\$0	\$0

**Section 6. References**

<b>Watershed?</b>	<b>Reference</b>
<input type="checkbox"/>	Avise J.C. 1994. Molecular Markers, Natural History and Evolution. Sinauer Assoc. Sunderland, Mass. 511pp.
<input type="checkbox"/>	Bartley, D.M., G.A.E. Gall, and B. Bently. 1985. Preliminary description of the genetic structure of white sturgeon, <i>Acipenser transmontanus</i> in the pacific Northwest. In: F.P. Binkowski and S.E. Dorshov (eds.) North American Sturgeons. W. Junk Pub., ND.
<input type="checkbox"/>	Beckenbach A.T., 1991. Rapid mtDNA sequence analysis of fish populations using the polymerase chain reaction. <i>Can J. Aquat. Sci.</i> 48:95-98.
<input type="checkbox"/>	Brown, J.R. 1992. Mitochondrial DNA length variation and heteroplasmy in populations of white sturgeon ( <i>Acipenser transmontanus</i> ). <i>Genetics.</i> 132:221-228.
<input type="checkbox"/>	Brown, J.R., A.T. Beckenbach, and M.J. Smith. 1993. Intraspecific DNA sequence variation of the mitochondrial control region of white sturgeon ( <i>Acipenser transmontanus</i> ). <i>Mol. Biol. Evol.</i> 10:326-341.
<input type="checkbox"/>	Brown, J.R., K. Beckenbach, A.T. Beckenbach, and M.J. Smith. 1996. Length variation, heteroplasmy and sequence divergence in the mitochondrial DNA of four species of sturgeon ( <i>Acipenser</i> ). <i>Genetics.</i> 142:525-535.
<input type="checkbox"/>	Buroker, N.E., J.R. Brown, T.A. Gilbert, P.J. O'Hara, A.T. Beckenbach, W.K. Thomas, and M.J. Smith. 1990. Length heteroplasmy of sturgeon mitochondrial DNA: An Illegitimate Elongation Model. <i>Genetics.</i> 124:157-163.
<input type="checkbox"/>	Carvalho, G.R. and T.J. Pitcher. 1995. Molecular Genetics in Fisheries, Chapman and Hall, London, 141pp.
<input type="checkbox"/>	DeVore, J.D. B. Parker, R.C. Beamesderfer, and T.A. Rein. 1997. A review of alternatives for the restoration and management of white sturgeon populations and fisheries in the Columbia River between Bonneville and McNary Dams (Zone 6).
<input type="checkbox"/>	Federal Register Volume 59, No. 171, 1994. March 13, 1997 Draft). WDFW, Battle Ground, WA.
<input type="checkbox"/>	Dizon, A.E., B.L. Taylor, and G.M. O'Corry-Crowe, 1995. Why statistical power is necessary to link analyses . . . In: Evolution and the Aquatic Ecosystem: Defining Unique Units in Population Conservation. Am. Fish. Soc. Bethesda, MD.

<input type="checkbox"/>	May, B., C.C. Krueger, and H.L. Kincaid. 1997. Genetic variation at microsatellite loci in sturgeon: primer sequence homology in <i>Acipenser</i> and <i>Scaphirhynchus</i> . <i>Can. J. Aquat. Sci.</i> 54:1542-1547.
<input type="checkbox"/>	Miracle, A.L. and D.E. Campton. 1995. Tandem repeat sequence variation and length heteroplasmy in the mitochondrial DNA D-loop of the threatened Gulf of Mexico sturgeon, <i>Acipenser oxyrinchus desotoi</i> . <i>J. Hered.</i> 86:22-27.
<input type="checkbox"/>	Setter, A. and E. Brannon. 1992. A summary of stock identification research on white sturgeon of the Columbia River (1985-1990).
<input type="checkbox"/>	Stabile, J., J.R. Waldman, F. Parauka, and I. Wirgin. 1996. Stock structure and homing fidelity in Gulf of Mexico sturgeon based on restriction fragment length polymorphism and sequence analysis of mitochondrial DNA. <i>Genetics.</i> 144:767-775.
<input type="checkbox"/>	Warren, J.J. and L.G. Beckman. 1993. Fishway use by white sturgeon on the Columbia River, Washington Sea Grant Program Publication WSG-AS 93-02.
<input type="checkbox"/>	Zaykin, D.V. and A.I. Pudovkin. 1993. Two programs to estimate significance of X <sup>2</sup> values using pseudo-probability tests. <i>J. Hered.</i> 84:152.

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## PART II - NARRATIVE

### Section 7. Abstract

The genetic relationships of white sturgeon (*Acipenser transmontanus*) populations within the Columbia Basin remain unclear. In 1998 the University of Idaho began a comprehensive genetic assessment of sturgeon populations in the Columbia, Snake and Kootenai River systems using three analytical methods. The objective of this project is to assess inter- and intrapopulational genetic variation among white sturgeon in the Columbia, Snake, and Kootenai River Basins. This project employs both nuclear and mitochondrial DNA analyses to test the null hypothesis; white sturgeon populations in the Columbia Basin represent (a) a single gene pool, and (b) one ESU of the species. This project is critical to most aspects of the Columbia Basin Fish and Wildlife Program and directly addresses section 10.4A "Study and evaluate Sturgeon Populations." The outcome of these analyses will critically effect the management of white sturgeon populations systemwide. Genetically divergent populations will have to be considered for management as significant components of overall white sturgeon diversity, possibly requiring additional measures, such as supplementation, to ensure their long term stability or recovery. This comprehensive genetic assessment, set to officially begin in January of 1999 will require three years to complete but preliminary assessments and more detailed analyses will be disseminated to managers throughout the duration of the project. The results will be reviewed and evaluated by those currently involved in BPA funded white sturgeon research and recovery throughout the Columbia Basin.

### Section 8. Project description

**a. Technical and/or scientific background**

In the Columbia River Basin, white sturgeon constitute an ecologically, economically, and in some cases, a culturally and spiritually important resource. Although the viability of many white sturgeon populations in the Basin is currently unknown, some are declining and one, the Kootenai River population, is listed as endangered and considered at risk of extinction (FR 59: 171). Accordingly, state, federal, tribal, private, and provincial agencies are considering or have initiated protection and restoration measures throughout the Basin to maintain and restore white sturgeon population numbers. While demographic and environmental conditions affect short-term survival of white sturgeon populations, their long-term survival may be adversely affected by a loss of genetic variability (see Avise, 1994 for a general review). Since long-term viability and persistence of fish populations are largely determined by the size and genetic variation within the effective population, research addressing short-term population dynamics and environmental conditions may be inadequate to ensure long-term survival of white sturgeon populations in the Columbia River Basin.

Previous examinations of genetic variation among regional white sturgeon populations using protein electrophoresis conducted at the University of Idaho have demonstrated a loss of genetic variation in the Kootenai River population relative to downstream Columbia River Basin populations (Bartley et al., 1985; Setter and Brannon, 1992). However, the level of genetic variation or the degree which conspecifics in the Columbia and Snake Rivers form genetically distinct populations or evolutionary significant units (ESUs) remains unknown (see Setter and Brannon 1992 to review results of allozyme analysis on white sturgeon populations). To further address questions regarding the genetics and conservation of white sturgeon basin-wide, the Aquaculture Research Institute (ARI) at the University of Idaho initiated a long-term research strategy, as a collaborative project with agencies and Native American Tribes.

Currently, white sturgeon are considered by some to exist potentially as genetically distinct populations separated by hydroelectric dams throughout the Columbia Basin. However considerable white sturgeon migration (and hence gene flow) has been documented among many Columbia River reservoirs. For example, over 3,000 white sturgeon were confirmed moving through The Dalles Dam fish ladders during just a five year period (1986-1991 Fish Passage Center data, in: Warren and Beckman, 1993). Furthermore, the pre-dam highly migratory behavior of white sturgeon, currently exhibited by this species in unimpounded river systems, does not support the existence of unique populations occurring between all dams throughout the Basin.

On the otherhand, the Columbia River Gorge represents a major ichthyofaunal transition zone, an interior populations may share a common ancestry distinct from lower Columbia populations that predates the last glacial era (80,000-10,000 ybp). Thus, a genetically-based defensible definition of evolutionary significant units (populations) is necessary to address these uncertainties. Cost-effective, basin-wide white sturgeon management and conservation mandated in the Council's Fish and Wildlife Program is the framework for the goals and objectives of this project. The project proposed here will advance our basic understanding of the evolutionary and population biology of white sturgeon in the Columbia River Basin and thus allow effective management of genetically defined populations thereby promoting conservation of existing biodiversity.

## **b. Rationale and significance to Regional Programs**

The rationale behind this project is based on important principles of conservation biology. Consistent with FWP objectives, these principles mandate cooperative multi-agency, species-level, research to successfully manage and conserve fragmented populations of widely distributed native fish species, such as white sturgeon. The goal of this project is to establish a critically needed genetic baseline of white sturgeon population structure and definition throughout the entire Columbia Basin using three unique, yet complimentary, genetic analyses (see Objectives, Section 4, and Section 8e). Such a comprehensive baseline is the first required step in defining conservation units for successful management of Columbia River Basin white sturgeon. This definition of conservation units (evolutionary significant units) or populations is also essential for successfully addressing the nine following FWP objectives (measures): 10.4 (Sturgeon mitigation), 10.4A (Study and evaluate sturgeon populations), five white sturgeon sub-measures with individual agency and tribe responsibilities (10.4A.2, BPA; 10.4A.3, Umatilla Tribe; 10.4A.4, Nez Perce Tribe; 10.4A.5, Spokane and Colville Tribes), and Kootenai River white sturgeon measures: (10.8B.15 and 10.8B16, Kootenai Tribe of Idaho; 10.6C and 10.6C.1, BPA). Furthermore, the BPA projects listed in Section 3 depend on continued funding for this project, and vice versa.

Rationale for this project is also mandated by the USFWS Draft Recovery Plan for the Kootenai River white sturgeon populations and by the multi-agency (WDFW, CRITFC, ODFW) program entitled “A Review of Alternatives for the Restoration and Management of White Sturgeon Populations and Fisheries on the Columbia between Bonneville and McNary dams (DeVore et al., 1997). The rationale of this draft plan is to “determine if unique stocks (of white sturgeon) exist, and to describe their geographic range. Such stock identification will allow restoration actions to be shaped to ensure genetic diversity is not lost.” Such a mandate is consistent with the nine previously mentioned FWP objectives (measures), and in general, the science of conservation biology. The University of Idaho has developed a favorable working relationship with all the agencies and tribes mentioned in this proposal, as well as various Canadian fisheries agencies, which is crucial to the successful completion of this project.

The significance of this project to the future of all Columbia River Basin white sturgeon cannot be overemphasized. It is the only project in the entire Columbia Basin that provides the necessary cooperative and comprehensive regional framework within which successful Basin-wide white sturgeon conservation and management is possible.

## **c. Relationships to other projects**

As previously listed in the table in Section 3 and 8b, several BPA projects depend on continued funding for this project, and vice versa. A partial list of Columbia Basin white sturgeon research includes; population abundance work, stock status determination, early life history research, population recruitment evaluation, harvest management, experimental relocation efforts, potential natural production modeling, and assessment of aquaculture. A common requirement of all these projects is an accurate genetic account or evaluation of Basin-wide white sturgeon populations. This is true because long-term

fitness and persistence of fish populations depend their genetic and geographic structuring, and their abilities to adapt to changing environmental conditions based on their genetic variation and phenotypic plasticities. The success of future research and management which may involve conservation or supplementation aquaculture, or relocation, is directly dependent on understanding the genetic structuring within and among affected or involved populations. The success of recruitment, natural production, and therefore harvest management are also directly dependent on the genetic constitution of pertinent white sturgeon populations. To pursue future management and conservation of white sturgeon without knowing what constitutes separate or distinct populations (ESUs) is an illogical and risk filled approach to managing this recreationally, commercially and spiritually important native species.

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

Funding for this project is not scheduled to begin until January 1999. However, Funding in 1998 from the Oregon Department of Fish and Wildlife, contract sponsors under the 860500 project, allowed us to begin the analysis of D-loop variation (Objective 1) among the samples of white sturgeon in our inventory. Currently, we have isolated DNA from and have examined 524 samples from 3 locations in the Columbia River, 2 locations in the Snake River, and 3 locations in the Kootenai River Drainage. These preliminary results will be presented in a white sturgeon work group coordination meeting (sponsored by ODFW) tentatively scheduled in January 1999, the first month of the project. Thus far we have received 953 samples from the following agencies in cooperation with this project: ODFW, WDFW, IPC, BCMELPC, and IDFG.

**e. Proposal objectives**

**Objective 1.** Preliminary assessment of genetic variation among Columbia Basin white Sturgeon based on length variants (VNTRs) of mtDNA. (beginning 1/1999)

**Objective 2.** Assessment of mitochondrial sequence divergence among Columbia Basin white sturgeon. (beginning 1/2000)

**Objective 3.** Assessment of nuclear genetic variation among Columbia Basin white sturgeon. (beginning 1/2001)

Information concerning the genetic relatedness of Columbia Basin white sturgeon is the expected outcome of testing the null hypothesis: "All sturgeon populations with in the Columbia Basin form a genetically continuous group and are not significantly different." Please see the experimental rationale in the section below (Section 8f) for further discussion of objectives/tasks.

**f. Methods**

Non-lethal tissue samples are employed with all laboratory procedures in this project. Collection of white sturgeon tissue is a non-invasive, incidental procedure performed during ongoing research when the fish are caught and present no additional risk to the animal or environment than current agency and tribe research methodology. Participating agencies and tribes have begun archiving white sturgeon tissue samples.

We have previously secured or are currently securing receipt of tissue samples to satisfy the requirements for all objectives of this project. As previously noted we currently have an inventory of 953 tissue samples of white sturgeon which is 61% the following 26 populations to be examined:

<u>Sample Code</u>	<u>Sample Location</u>	<u>Subbasin</u>
LCR	Lower Columbia River	Columbia
BP	Bonneville Pool	
TDP	The Dalles Pool	
JDP	John Day Pool	
MCP	McNary Pool	
PRP	Priest Rapids Pool	
WP	Wanapum Pool	
RIP	Rock Island Pool	
CP	Chelan Pool	
WPP	Wells Point Pool	
CJP	Chief Joseph Pool	
LKR	Lake Roosevelt	
KR	Kootenai River	Kootenai/Kootenay
KL	Kootenay Lake	
DL	Duncan Lake	
IHP	Ice Harbor Pool	Snake
LMP	Lower Monumental Pool	
LGO	Little Goose Pool	
LGR	Lower Granite Reservoir	
HCR	Hells Canyon Reservoir	
OXR	Oxbow Reservoir	
BLR	Brownlee Reservoir	
CJS	C.J. Strike Reservoir	
BLR	Bliss Dam Pool	
FSR	Fraser River	Out of Columbia Basin
SAC	Sacramento River	Out of Columbia Basin

Isolated DNA from tissue samples are amplified using the polymerase chain reaction (PCR) and nucleotide primers specific for the D-loop region of the mitochondrial genome (mtDNA) (Beckenbach, 1991). The D-loop region contains two areas of interest and each are examined using different methods. Additionally, nucleotide primers for eight microsatellite loci will also be used with the polymerase chain reaction to amplify the intervening sequences between the primers. The microsatellite data will provide genetic information about the nuclear genome in contrast to mitochondrial (maternal lineage) information provided by the other objectives.

**Objective 1.** Length variation arises in the D-loop of white sturgeon as a consequence of a gain or loss of 1-5 perfectly repeated tandem 78-82 bp sequences (see Brown et al., 1992, 1996; Buroker et al., 1990). Length variation (or polymorphisms) in the D-loop has been previously examined in a phylogenetic context in white sturgeon of the Columbia Basin (Brown et al., 1992, 1993) but has not been explored as a means of

delineating stock structure throughout the Basin. Length variation in amplified mtDNA sequences will be quantified using gel electrophoresis and documented using a computer scanner and image analysis software (SigmaScan/Image). Length variation in amplified D-loop sequences are being examined from as many as 60 individuals per population (provided 60 samples are logistically possible from each population). Thus, allowing 95% confidence limits on the detection of haplotypes that occur in the population at a frequency of 5% or greater in the population under study. Detailed methodologies for this type of analysis is summarized and reviewed by Carvalho and Pitcher (1995) and Avise (1994) and references therein.

Interpopulational differences in mitochondrial D-loop length variation is being assessed, pair-wise, in geographically proximate white sturgeon populations throughout the Columbia Basin these populations include samples from; the Columbia River below Bonneville Dam (LCR), pools and reservoirs behind each Columbia River Dam and each Snake River Dam up to Shoshone Falls, the Kootenai River, Duncan Reservoir, and Kootenai River (24 populations/1440 samples total).

Interpopulational differences in mitochondrial D-loop length variation is being assessed, pair-wise, in geographically separate white sturgeon populations.

**Objective 2.** An approximate 600 bp segment of the hypervariable, non-repetitive portion of the D-loop region will be sequenced from 10 individuals from each population in Objective 1 to assess the nucleotide divergence in this rapidly evolving portion of the mitochondrial genome. For methodologies using sturgeon see Brown et al. (1996), Stabile et al (1996), Miracle and Campton (1995), and Buroker et al. (1990). An automated DNA sequencer and nucleotide primers specific for this region will be used in this task. Samples from white sturgeon populations of the Fraser and Sacramento Rivers will be added to give a geographical perspective to the analysis and an “outgroup(s)” for systematic comparisons ( $\leq 120$  additional samples). **This objective is projected as the primary goal for FY 2000.** It is expected that Objective 1 will have been completed by this time. The completion of power analyses using sample data from Objective 1 will be used to assure that the number of individuals sequenced in this objective are statistically robust.

**Objective 3.** Nucleotide primer pairs for eight separate microsatellite loci will be used to PCR amplify the intervening sequences between primers. All microsatellite primers have been used to previously amplify polymorphic loci in white sturgeon samples (May et al. 1997).

**Experimental Rationale/Data Analysis:** The first objective is intended to provide a rudimentary overall examination of genetic variance among white sturgeon in the Columbia Basin and expedite the dissemination of at least some baseline genetic information for resource and fisheries managers. Currently we are ahead of our projected completion for Objective 1. The first objective is also intended to serve as a rough guide for the two other objectives, essentially a “power test” (see Dizon et al. 1995 for a review) for increasing the confidence of determining of how many samples need to be examined using the other two comprehensive methods. In this context, the scope of the other objectives may change. In Objective 1, frequency differences in length variants

between sturgeon populations will be tested (Chi-square analysis and similar “Goodness of Fit” tests; Zaykin and Pudovkin, 1993). The range of variants has already been surveyed (i.e. the number of classes or families of length variants) as well as the general frequencies of each class, see Brown et al. (1992, 1996). The first objective is simply an extrapolation of this published information to a much larger data set. The second objective will provide information on the rates of nucleotide divergence in the clonally derived, non-recombinatory, maternally inherited mitochondrial genome. The third objective provides genetic information on the nuclear genome. Specifically, eight separate loci of rapidly evolving non-coding portions of nuclear DNA. Together, the information produced from both Objective 2 and 3 provide separate data sets enabling evaluation of the congruence and dissimilarities of each. This approach provides a statistically powerful evaluation of relatedness among white sturgeon populations.

This project is scheduled for completion in FY 2001. However, the personnel involved realize the importance and utility of temporal genetic analyses (as mentioned in the FY1999 review). We have not requested funding past FY 2001 and will delay any plans to continue at a reduced “monitoring level” past FY 2001 until the genetic data generated from this project has been analyzed and discussed with the other sturgeon project coordinators.

#### **g. Facilities and equipment**

The Aquaculture Research Institute (ARI) at the University of Idaho directed by Dr. E. Brannon, maintains a fisheries genetics laboratory. This facility has two full time lab technicians, a full time research scientist ( Dr. M. Powell), a half time doctoral research assistant (P. Anders), and contains all the equipment necessary to collect, generate, and analyze molecular genetic data necessary for the ongoing project. This includes all laboratory equipment, and data analysis software. The University of Idaho’s Hagerman Fish Culture Experiment Station (HFCES), with funding from the National Science Foundation (NSF EPSCoR # EPS-9632684), created the Salmonid and Freshwater Fish Research Laboratory. This laboratory is primarily a molecular genetics facility and in conjunction with the ARI fisheries genetics laboratory has already completed preliminary examinations of mitochondrial DNA and karyotypic variation among Kootenai River white sturgeon. Genetic analyses will be divided between the two facilities to expedite the completion of this project. The majority of the nuclear DNA analysis and mitochondrial DNA sequencing will be conducted at the HFCES Salmonid and Freshwater Fish Research Laboratory. The remaining mitochondrial DNA analysis will be performed at the ARI genetics facility. Dr. D. Campton of the USFWS and a member of the University of Idaho/ARI affiliate faculty will assist with data analysis and interpretation of results.

No field equipment costs or tissue collection is necessary during this project. All tissue samples required have already been collected by coordinating agencies (CRITFC, ODFW, WDFW, IDFG, USGS-BRD, KTOI, NPT, BCMELP, Idaho Power Company, and CSI) or are listed for collection this fiscal year (1999) under their current budgets. Other than personnel and expendible supplies cost, the only requested equipment is an additional PCR machine (Stratagene robocycler) necessary to amplify additional samples and increase productivity.

The University of Idaho's Aquaculture Research Institute, specifically the fisheries genetics laboratories, function as a central clearinghouse for comprehensive molecular systematic evaluation of fisheries and provides necessary population genetic data for the benefit of all managers, agencies, and tribes.

**h. Budget**

Budgetary requirements for the second year of this three year project include continued funding for key personnel (Dr. Powell and P. Anders) as well as an additional part-time laboratory assistant. The continued funding for key personnel represents a university mandated 5% yearly salary increase for employees. Other personnel added to the budget include a minor part-time position for a secretary/bookkeeper to handle inventories of chemicals and supplies, update accounts, and general clerical assignments for publications. Fringe benefit rates remain constant at 0.285 for Dr. Powell and P. Anders and 0.345 for other personnel. Supplies and Operations and Maintenance have decreased this year due in part to funds received prior to the start of this project from ODFW in FY 1998. Capital acquisitions include an additional PCR machine to handle increased numbers of samples. There are no NEPA, construction, or PIT tag costs associated with this project. Travel cost include presentations of Objective 1 data generated by this project at white sturgeon workgroup meetings and two national meetings, American Fisheries Society and the American Society of Ichthyologists and Herpetologists. Indirect costs for the second objective of this project will be designated as an off campus rate (@0.258) because the majority of the work associated with Objective 2 will require the use of equipment in place at the Hagerman laboratory.

**Section 9. Key personnel**

<b>Name</b>	<b>Employer</b>	<b>Title</b>	<b>FTE/hours</b>
Madison S. Powell	Univ. of Idaho	Principle Investigator	0.5/2080
Ernest L. Brannon	Univ. of Idaho	Co-Principle Investigator	0
Donald E. Campton	USFWS	Co-Principle Investigator	0
Paul J. Anders	Univ. of Idaho	Research Support Scientist	0.75/1560

**Duties for this project and qualifications for the ongoing work:**

All of the key personnel involved in this project have previously worked with sturgeon genetics. Dr. Brannon has previously published on genetic variaton in white sturgeon using allozyme analysis. Drs. Powell and Brannon are supported with funding from an NSF grant to examine Kootenai River white sturgeon until June 1999. All the procedures to be used in this project are either currently being employed (mitochondrial D-loop variation and sequences variation) or will be employed (microsatellite analysis) by the termination of that contract. This project is simply a greatly expanded version (in sample size and scope) of the current examination of Kootenai River sturgeon. Dr. Campton has previously published on sturgeon genetic variation using essentially the same mitochondrial DNA techniques and is highly competent in the analysis of that type and other types of genetic data. Mr. Anders is currently a Ph.D. student under the

direction of Dr. Brannon and laboratory guidance of Dr. Powell and is responsible for a majority of the laboratory work completed under the NSF contract. Mr. Anders, prior to his admission to the University of Idaho, was previously employed as a sturgeon biologist for the Kootenai Tribe of Idaho and the USFWS, and is extremely familiar with white sturgeon biology. Dr. Powell and Mr. Anders will conduct a majority of the laboratory work and will be assisted by an additional, part-time laboratory aide. Drs. Brannon and Campton will assist in analysis of the data generated and interpretation of the results as they apply to white sturgeon management and conservation.

Curriculum vitae for key personnel follow:

## MADISON S. POWELL

### Education:

Ph.D., 1995, Texas Tech University

M.S., 1990, University of Idaho

B.S., 1985, University of Idaho

**Current employer:** University of Idaho, Hagerman Fish Culture Experiment Station

3059 F National Fish Hatchery Road, Hagerman, ID 83332, (208) 837-9096

FAX: (208) 837-6047, email [fishdna@micron.net](mailto:fishdna@micron.net)

**Current Responsibilities:** Research scientist; supervise fisheries genetics laboratories and lab personnel at the Aquaculture Research Institute and the Hagerman Fish Culture Experiment Station.

### Previous employment:

1997-present	Research Scientist, Hagerman Fish Culture Experiment Station, University of Idaho, Hagerman, Idaho
1996-1997	Research Scientist, Aquaculture Research Institute, University of Idaho, Moscow, Idaho
1995-1996	Postdoctoral Fellow, Aquaculture Research Institute, University of Idaho, Moscow, Idaho
1995	Ph.D., Zoology, Texas Tech University
1990	M.S., Zoology, University of Idaho
1985	B.S., Zoology/Biology, University of Idaho

### Technical experience:

DNA and RNA isolation, molecular cloning, genomic libraries, DNA fingerprinting, automated sequencing, PCR amplification, RFLP analysis, RAPD analysis, *in vitro* transcription, fluorescence *in situ* hybridization, karyotyping, cell and tissue culture, nucleotide and protein electrophoresis, liquid chromatography, HPLC analysis, small animal surgery, field collection, and identification.

### Five publication closely related to this project:

Anders, P., and M. Powell. 1998. Comprehensive management and conservation of Columbia Basin white sturgeon (*Acipenser transmontanus*): A zoogeographic approach. In: Proceedings of Ecosystem Based Management in the Upper Columbia River Basin: Pp. 53-54.

Williams, R.N., M.S. Powell, R.P. Evans, and D.K. Shiozawa. 1998. Genetic Analysis of Putative Yellowstone Cutthroat Trout samples from the Henry's Fork Subbasin. Center for Salmonid and Freshwater Species at Risk, University of Idaho. Technical Report. Pp 1-9.

Powell, M.S. V.L. Paragamian, and J.C. Faler. 1988. Genetic characteristics of burbot in the Kootenai River drainage of Montana, Idaho, and British Columbia. Proceedings of the International Congress on the Biology of Fish. Burbot Symposium. Pp. 1-4.

Anders, P., and M. Powell. Karyotypic analysis of an endangered and geographically isolated population of white sturgeon (*Acipenser transmontanus*), In preparation. *Genetica*

Paragamian, V.L., M.S. Powell, J.C. Faler, and S. Snelson. (accepted for publication) Mitochondrial DNA analysis of burbot *Lota lota* stocks in the Kootenai River Basin of British Columbia, Montana, and Idaho. *Trans. Amer. Fish. Soc.*

## PAUL J. ANDERS

### Education:

Ph.D. Student (7/96 - Present) University of Idaho; Conservation Genetics, white sturgeon

M.S., 1991, Eastern Washington University, Biology, white sturgeon

B.S., 1983, Saint Norbert College

**Current employer:** University of Idaho, Aquaculture Research Institute, Fish Genetics Lab, Moscow, ID 83844-2260, (208) 885-5830 FAX: (208) 885-5968, email: ande9662@uidaho.edu

**Current responsibilities:** Oversee and participate in all aspects of mitochondrial DNA analyses of white sturgeon from ID, OR, WA, and BC, Canada. Perform nuclear and mtDNA analyses on salmonid and cyprinid fish species as needed. Prepare scientific reports and manuscripts.

### Previous employment:

1996-present:	Ph.D. Research Assistant, University of Idaho, Aquaculture Research Institute, Fish Genetics Lab, Moscow, ID
1993-1996	Fisheries Program Administrator/Fishery Biologist, Kootenai Tribe of Idaho, Bonners Ferry, Idaho
1993	Fishery Biologist, Kootenai Tribe of Idaho, Bonners Ferry, ID
1990-1993	Fishery Biologist U.S. Fish and Wildlife Service, Columbia River Field Station, Cook, WA
1989-1991	M.S. Graduate Research Assistant, Eastern Washington University, Cheney, WA

**Expertise:** I have been professionally involved in research and management of white sturgeon in the Columbia River Basin for 10 years. I have published more than 20 scientific reports and articles on research and management of Columbia River Basin white sturgeon populations, and given dozens of professional presentations of this work. Since 1996, I have been studying conservation genetics and performing genetic analyses of white sturgeon from throughout the Columbia River Basin, in order to develop a basin-wide, species level conservation and management plan for white sturgeon.

### Five publications closely related to the proposed project:

Anders, P., and M. Powell. 1998. Comprehensive management and conservation of Columbia Basin white sturgeon (*Acipenser transmontanus*): A zoogeographic approach. In: Proceedings of Ecosystem Based Management in the Upper Columbia River Basin: Pp. 53-54.

Anders, P.J. Conservation aquaculture and endangered species: Can objective science prevail over risk anxiety? 1988. *Fisheries* Vol. 23(11): 28-31.

S. Duke, Anders, P., G. Ennis, R. Hallock, J. Laufle, R. Lauzier, L. Lockard, B. Marotz, V. Paragamian, and R. Westerhof. 1998. White Sturgeon: Kootenai River Population. Final Draft Recovery Plan. Prepared by Region 1, U.S. Fish and Wildlife Service, Portland OR. USA.

Anders, P. and D. Richards. 1996. Implications of Ecosystem Collapse on White Sturgeon (*Acipenser transmontanus*) in the Kootenai River, Idaho, Montana, and British Columbia. In: Proceedings of the International Congress on the Biology of Fishes, San Francisco State University, CA. July 14-18, 1996. pp. 27-40.

Anders, P., and R. Westerhof. 1996. Conservation Aquaculture of Endangered White Sturgeon (*Acipenser transmontanus*) from the Kootenai River, Idaho. In: Proceedings of the International Congress on the Biology of Fishes, San Francisco State University, CA. July 14-18, 1996. pp. 51-62.

## ERNEST L. BRANNON

### Education:

Ph.D., 1973, Fisheries, University of Washington

B.S., 1959, Fisheries, University of Washington

### Current Employer/Responsibilities:

Director, Aquaculture Research Institute, University of Idaho

State Aquaculture Extension Specialists

Professor of Fish and Wildlife Resources

Professor of Animal and Veterinary Sciences

### Professional experience:

1988-present: Director, Aquaculture Institute, University of Idaho, Moscow, Idaho

1984-1988: Professor, School of Fisheries, College of Ocean and Fisheries Sciences, University of Washington, Seattle

1974-1983: Director, Finfish Aquaculture Program, College of Fisheries, University of Washington, Seattle, Washington

1973-1975: Assistant Professor, College of Fisheries, University of Washington, Seattle

1971-1972: Chief Biologist, International Pacific Salmon Fisheries Commission (IPSFC), New Westminster,

B.C., Canada

1969-1971: Supervisor, Sockeye Management Research, IPSFC, New Westminster, B.C., Canada

1959-1969: Research Biologist, Fisheries Management, Artificial Propagation, Spawning Channel Development and Fish Culture, IPSFC, New Westminster, B.C., Canada

1953-1959: Field Management, IPSFC, New Westminster, B.C., Canada

### Five publications closely related to the proposed project

Schelling, G.T., R.A. Roeder, E.L. Brannon, J.C. Byatt, and R.E. Rompala. 1998. Choline and betaine supplementation to rainbow trout administered bovine somatotropin. Proceedings of the Triennial Meeting of the World Aquaculture Society, February 15-19, 1998, Las Vegas.

Brannon, E.L. 1998. Columbia River downstream migrant passage and habitat recovery. *Pages 193 - 199 in E.L. Brannon and W.C. Kinsel, editors. Proceedings of the Columbia River anadromous salmonid rehabilitation and passage symposium (June 5-7, 1995, Richland, WA). Sponsored by the University of Idaho and Washington State University. Aquaculture Research Institute, Moscow, Idaho.*

Brannon, E.L. and A.W. Maki. 1996. The *Exxon Valdez* Oil Spill: Analysis of Impacts on the Prince William Sound Pink Salmon. *Reviews in Fisheries Science* 4(4):289-337.

Thorgaard, G.H., P. Spruell, S.A. Cummings, A.S. Peek, and E.L. Brannon. 1995. Mixed DNA fingerprint analysis differentiates sockeye salmon populations. *Pages 295-303 in J.L. Nielsen and D.A. Powers, editors. Evolution and the aquatic ecosystem: Defining unique units in population conservation. Proceedings of the American Fisheries Society symposium 17 (May 23-25, 1994, Monterey, CA).*

Brannon, E. and A. Setter. 1992. Movements of white sturgeon in Lake Roosevelt (1988-1991). Final Report, Contract # DE-BI79-89BP7298, Project # 89-44, to the US Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Portland, OR. 35 pp.

## DONALD E. CAMPTON

### Education:

Ph.D., 1986, University of California, Davis, Genetics  
M.S., 1981, University of Washington, Seattle, Fisheries  
B.S., 1974, University of California, Berkeley, Genetics

**Current employer:** Abernathy Salmon Technology Center, U.S. Fish & Wildlife Service, 1440 Abernathy Creek Road, Longview, WA 98632, (360) 425-6072, FAX (360) 636-1855, email: Don\_Campton@mail.fws.gov

**Current responsibilities:** Serve as regional fish geneticist and program manager for the U.S. Fish & Wildlife Service on technical matters related to the conservation and management of indigenous fish species and associated fishery resources in the Pacific Northwest including California and Nevada. Genetically characterize hatchery and wild populations, develop regional policies and guidelines to protect genetic resources, establish and maintain information data bases on genetic variation, life history data, and population dynamics of hatchery and wild fish populations.

### Professional experience:

1997-present Fish Geneticist, U.S. Fish & Wildlife Service, Longview, Washington  
1992-1997: Assoc. Prof., Dept. of Fisheries & Aquatic Sciences, Univ. of Florida, Gainesville  
1986-1992: Asst. Prof., Dept. of Fisheries & Aquatic Sciences, U.F.  
1981-1986: Graduate Research/Teaching Assistant, University of California, Davis  
1978-1980: Fishery Research Biologist, Washington Dept. of Game, Olympia, Washington

**Expertise:** Population and quantitative genetics of fish: molecular methods for studying population structures, evolutionary relationships, and introgressive hybridization; statistical/breeding methods for quantifying genetic variation for quantitative characters, and the effects of hatcheries and artificial propagation on the genetic constitution of hatchery and wild populations of salmonid fishes.

### Five publications closely related to the proposed project:

- Campton, D.E. 1987. Natural hybridization and introgression in fishes: methods of detection and genetic interpretations, p. 161-192. *IN:* N. Ryman and F. Utter (eds.), *Population Genetics and Fishery Management*, University of Washington Press, Seattle.
- Campton, D.E., F.W. Allendorf, R.J. Behnke, and F.M. Utter; M.W. Chilcote, S.A. Leider, and J.J. Loch, 1991. Reproductive success of hatchery and wild steelhead. *Trans. Am. Fish. Soc.* 120:816-827.
- Miracle, A.L., and D.E. Campton. 1995. Tandem repeat sequence variation and length heteroplasmy in the mitochondrial DNA D-loop of the threatened Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*, *J. Heredity* 86:22-27.
- Campton, D.E. 1995. Genetic effects of hatcheries on wild populations of Pacific salmon and steelhead: What do we really know?, p. 337-353. *IN:* R.G. Piper and H.L. Schramm, Jr. (eds.), *Uses and Effects of Cultured Fishes in Aquatic Ecosystems*, American Fisheries Society, Bethesda, Maryland.
- Campton, D.E., A.I. Garcia, B.W. Bowen, and F.A. Chapman. Genetic distinction of pallid and shovelnose sturgeon (*Scaphirhynchus albus* and *S. platyrhynchus*) based on mitochondrial DNA control region sequences (in prep. for *Cons. Biol.*)

## **Section 10. Information/technology transfer**

Information generated by this project will be published as peer-reviewed publications and BPA annual reports. Information will also be updated and presented at future Sturgeon Summit Meetings, Kootenai River white sturgeon committee meetings, American Fisheries Society conferences, and BPA project summary conferences. It is critically important for white sturgeon management that information from this project be distributed so that the implications of the results and conclusions can be thoroughly discussed and reviewed.

**Congratulations!**