Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal

Section 1. General administrative information

Monitor Reproductive Physiology Of Columbia River White Sturgeon

Bonneville project number, if an ongoing project 9019

Business name of agency, institution or organization requesting funding
Oregon State University

Business acronym (if appropriate)

Proposal contact person or principal investigator:

Name	Martin S. Fitzpatrick
Mailing Address	Department of Fisheries & Wildlife, 104 Nash Hall
City, ST Zip	Corvallis, OR 97331-3803
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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name

NPPC Program Measure Number(s) which this project addresses.
10.4A.2, 10.4A.7, 10.4A.8

NMFS Biological Opinion Number(s) which this project addresses.

Other planning document references.

Subbasin.
Lower Columbia River

Short description.
Develop a method for identifying sex in white sturgeon to aid agencies in management, rehabilitation, and enhancement; determine if physiological differences exist in white sturgeon between Columbia River reservoirs and free-flowing portion of the river.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		Watershed
+	Resident fish		O & M		Biodiversity/genetics
	Wildlife		Production		Population dynamics
	Oceans/estuaries	X	Research	X	Ecosystems
	Climate		Monitoring/eval.		Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.
reproduction, steroids, vitellogenin, sex

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	To determine how plasma sex steroids and vitellogenin levels vary at different stages of maturation	a	Take physiological samples from white sturgeon harvested in the commercial and sport fishery and from white sturgeon sampled by regional agency biologists
		b	Measure the levels of testosterone

			(T), 11-ketotestosterone (KT), and estradiol (E2), and vitellogenin (Vg) in plasma samples
		c	Assess the stage of development of white sturgeon gonadal samples with histology
2	To distinguish between the sexes of white sturgeon by measuring plasma steroid and vitellogenin levels	a	same as Objective 1
3	To determine if the gonadosomatic index, plasma steroid levels, and vitellogenin levels in white sturgeon from impounded portions of the Columbia River differ from those from the unimpounded portions of the river	a	same as Objective 1

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	10/1998	9/2001	60.00%
2	10/1998	9/2001	20.00%
3	10/1998	9/2001	20.00%
			TOTAL 100.00%

Schedule constraints.

Completion date.
2001

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel	Fitzpatrick (PI), Feist (Res. Asst), Graduate Research Assistant	$43,896

Fringe benefits		$14,956
Supplies, materials, non-expendable property	steroid and vitellogenin assays, histology, sampling supplies, communications	$8,400
Operations & maintenance		
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		$ 0
PIT tags	# of tags: 0	$ 0
Travel	1 professional meeting; sampling trips	$1,000
Indirect costs	42.5%	$29,007
Subcontracts		$ 0
Other	tuition	$6,623
TOTAL		$103,882

Outyear costs

Outyear costs	**FY2000**	**FY01**	**FY02**	**FY03**
Total budget	$107,859	$113,391		
O&M as % of total				

Section 6. Abstract

The goal of this project is to enhance the management of white sturgeon in the Columbia River. We propose to develop more efficient methods to identify females and males, to develop physiological predictors of maturation, and to determine if physiological differences exist in white sturgeon from impounded and unimpounded portions of the Columbia River that may be useful in explaining variable reproductive success. Such methods may have dramatic effects on making white sturgeon management more effective by: 1) replacing a highly invasive procedure (surgery) with a less-invasive method (blood sampling) for the identification of sex that may decrease potentially damaging stress on females; 2) developing a physiological predictor of maturation that may aid fishery managers in estimating future reproductive success in white sturgeon; and 3) determining if the reduced reproductive success of white sturgeon in certain impounded parts of the Columbia River can be explained by variation in physiological measures. Reproduction in fish consists of an integrated system of tissues and hormones, which direct developmental events necessary for maturation. Once gonadal sex differentiation occurs, ovaries and testes commence secretion of steroids which at the proper age become sexually distinctive in their circulating levels. The specific objectives of this project are to determine if these sexually distinctive patterns of circulatory steroids are consistent enough to replace surgery as the method of choice for identifying sex,

to develop endocrine profiles that can be used to model if and when an individual is likely to mature, and to use physiological measures to focus in on potential reproductive problems in white sturgeon found in particular parts of the Columbia River. This work is significant because it will provide a simple tool that can be immediately put to use in sturgeon management. In addition, the technology developed in this project may have broad application in aquaculture and in recovery efforts for endangered wild sturgeon.

Section 7. Project description

a. Technical and/or scientific background.

Wild white sturgeon are of vital interest to communities throughout the Pacific Northwest; however, relatively little is known about reproduction in this species within the Columbia River Basin. Since reproductive success is essential for the persistence of any species, management efforts will be enhanced by gaining an understanding of white sturgeon reproductive physiology. The white sturgeon fishery constitutes the largest recreational fishery within the Columbia River basin (DeVore et al. 1995). In addition, the Columbia River also supports an active commercial and tribal fishery on white sturgeon. However, most of the harvest is limited to the free-flowing portion of the river because the upper reservoirs have demonstrated as yet unexplained poor productivity.

The life history of white sturgeon which is characterized by slow growth and delayed maturation may make this species particularly susceptible to adverse impacts associated with alterations in river flow due to dam impoundment. In the wild, males have been reported to reach first sexual maturity at 10-12 years of age and females at 15-32 years (Doroshov et al. 1997). After reaching first maturation, females have been estimated to undergo spawning only once every two to four years (Chapman et al. 1996). Such low reproductive potential in the face of increased fishing pressures means that any additional reproductive burden, such as disruption of the reproductive cycle by inadequate habitat, toxicants, or disease, could push populations to the brink of collapse.

The most recent estimates of mature-sized white sturgeon varies widely between the proposed areas of study: 8,500 individuals in the free-flowing portion, 600 in the Bonneville reservoir, 900 in The Dalles reservoir, and 500 in the John Day reservoir (Beamesderfer et al. 1995; DeVore et al. 1995). The reason for such low numbers of potentially reproductively active individuals in the reservoirs remains unknown. The proposed research will compare the reproductive endocrine systems of individuals harvested from the reservoirs with those of individuals in the free-flowing portion of the river. The data can then be used to estimate population parameters such as number of reproductively active individuals, and may also be useful in pinpointing particular problem areas with regard to reproduction.

In addition, measurements of reproductive hormones or the egg protein vitellogenin in plasma from white sturgeon may provide a quick method for assessment of sex and maturity--parameters essential for assessment of the reproductive potential in current populations and of responses to enhancement efforts. Reproduction in vertebrates depends on an integrated system of tissues and biomolecules which act in concert to bring about reproductive functions at appropriate stages of development and/or in appropriate environmental conditions. Hormones provide the communication between the tissues to direct developmental events essential for reproduction, such as gonadal differentiation and maturation (Redding and Patiño 1993). Thus, the entire cycle of development in fishes, from fertilized egg to deposition of the yolk protein (vitellogenin) in the developing eggs to final maturation, relies on proper functioning of the endocrine system. This also suggests that measuring plasma hormone levels and vitellogenin provides a means for monitoring the endocrine status of individual animals, including identification of sex and maturity.

White sturgeon exhibit no external signs of sexual dimorphism or maturity; therefore, in order to separate fish by sex and to assess maturational status, surgical methods have been developed in which gonads are biopsied through a small abdominal incision (Doroshov *et al.* 1994). Currently, biologists perform such surgery on sturgeon sampled in the field and this procedure can be difficult to perform. The accuracy of the results is limited due to the very small gonads in non-reproductively active individuals, which can lead to biopsying the wrong tissue or misidentification of the sex (Ruth Farr, Oregon Department of Fish and Wildlife, pers. comm.). Although the survival rate from surgery is estimated to be high, the effect on continued reproductive development is unknown. Severe stress to maturing fish has been shown to adversely affect a number of reproductive parameters in some species (Campbell *et al.* 1992). Each surgery requires a minimum of 20 minutes per fish (Tom Rien, Oregon Department of Fish and Wildlife, pers. comm.), which limits the number of fish that can be sampled. A simple, fast procedure for determining sex and maturity of white sturgeon would benefit agency biologists by allowing for a more accurate assessment of population status and future reproductive potential of white sturgeon. Measurement of plasma sex steroid levels, which tend to be sexually distinctive and correlated to maturity status in most fish species (including other species of sturgeon, see Pelissero and LeMenn 1991, Cuisset et al. 1994), may provide for the necessary accuracy and sampling utility.

For the past year two years, we have collected samples from adult white sturgeon harvested in either the commercial or sport fishery. In addition, plasma samples from adult white sturgeon were provided to us by biologists from the Oregon Department of Fish and Wildlife. Plasma levels of testosterone, 11-ketotestosterone, and estradiol-17β were measured by radioimmunoassay (Fitzpatrick et al. 1986) in samples from over 300 white sturgeon. In the commercial- and sport-caught sturgeon, males had significantly higher levels of testosterone and 11-ketotestosterone than females; however, estradiol was similar between the sexes and the levels were much lower than those reported from females undergoing vitellogenesis (Doroshov et al. 1994). The mean concentration of estradiol from 59 non-mature females sampled in the commercial and sport fishery was

0.28 ± 0.04 ng/ml in comparison to 14.7 ± 5.2 ng/ml in three mature females (plasma samples provided to us by Oregon Department of Fish and Wildlife). Despite these promising preliminary results, further information is absolutely necessary to determine 1) if the differences between sexes in steroid levels are consistent throughout all portions of the Columbia River, 2) if there are differences in reproductive condition in white sturgeon between different portions of the Columbia River; 3) if the differences are maintained at different parts of the year, and 4) if the differences are maintained in fish sampled at different stages of maturity.

b. Proposal objectives.

The goal of this study is to increase the productivity of white sturgeon in the Columbia Basin. This goal will be attained by expanding the understanding of the reproductive physiology of white sturgeon, thus providing agencies with more precise information concerning the sex and reproductive status of managed populations. To develop an understanding of reproductive parameters in Columbia River white sturgeon as they relate to the enhancement efforts currently underway by state, federal, and tribal managers, the following objectives will be met:

1) To determine how plasma sex steroids and vitellogenin levels vary at different stages of maturation in order to develop predictive indices for the timing of sturgeon final maturation.
2) To distinguish between the sexes of white sturgeon by measuring plasma steroid and vitellogenin levels.
3) To determine if the gonadosomatic index, plasma steroid levels, and vitellogenin levels (female only) in white sturgeon in impounded portions of the Columbia River differ from those in the unimpounded portions of the river.

c. Rationale and significance to Regional Programs.

Despite the ecological, economic, and cultural importance of white sturgeon within the Columbia River Basin, little is known about the reproductive physiology of this species. Currently, research efforts have focused on the status of white sturgeon populations in the different parts of the river, with the implication that impoundment by dams has caused habitat changes which have negatively influenced reproductive success. In particular, populations of sturgeon in reservoirs behind the first four dams show little evidence of successful reproduction. Future efforts to manage Columbia River basin white sturgeon by state and federal biologists will focus on 1) enhancement to make up for lost production in some of the impounded portions of the river; 2) evaluation of spawning habitat; and 3) population assessment monitoring to examine responses to fishing

pressures. Reproductive success is essential for the persistence of any species and gaining an understanding of white sturgeon reproductive physiology will provide agencies with more precise information concerning the sex and reproductive status of managed populations. This information is critical for understanding the current problems with white sturgeon populations in the Columbia River basin, and for monitoring the success of enhancement efforts.

The proposed research area falls within the priorities for Columbia River Basin Resident Fish as listed by the Northwest Power Planning Council (Section 10)--namely, the rebuilding of "weak, but recoverable, native populations injured by the hydropower system," (highest priority) and "populations that support important fisheries" (high priority). Specifically, the proposed research would fit within Sturgeon Mitigation Measure 10.4A.2 for determining "the impact of development and operation of the hydropower system on sturgeon in the Columbia River Basin." In addition, this research would be relevant to Measure 10.4A.7 ("development and maintenance of operations and facilities to enhance white sturgeon production by supplementation for depressed populations in the impounded portions of the Columbia and Snake rivers") and Measure 10.4A.8 ("development and maintenance of an experimental white sturgeon research facility for research on contaminants, reproduction, and genetics of white sturgeon") should these measures be implemented.

In order to implement restoration of sturgeon populations in impounded portions of the river, accurate information on the sex and maturational status of individuals must be assessed. An understanding of the reproductive physiology of white sturgeon can provide measurable endpoints that will be useful for population modeling and potential restocking efforts by verifying data on sex ratios and predicting numbers of fish likely to mature from populations in the impounded and unimpounded portions of the river. In addition, other factors such as the impact of contaminants or disease loads have not been examined relative to the variable reproductive success of white sturgeon populations. Therefore, there is a great need to generate baseline information on the physiological status of white sturgeon within the Columbia River. Such information could be used in models to predict the number of female sturgeon that will spawn and to assess the quality and reproductive performance of white sturgeon in the various portions of the Columbia River. Through comparisons of the reproductive steroid profiles for female sturgeon at different stages of egg development and from different sections of the river, model predictions could be generated to forecast number of spawning individuals under defined river conditions. This would complement information generated from research conducted by agency biologists interested in the most effective management of white sturgeon.

The information generated by this project can be used by agencies throughout the Columbia Basin concerned with white sturgeon management through inclusion of sex ratio and maturational status data into population models used to set fishing limits. In addition, efforts within the Columbia River Basin to restore populations of white sturgeon in the impounded portions of the River would benefit from knowing if sturgeon from the impounded portions of the river demonstrate 1) skewed sex ratios; 2) delayed or accelerated maturity; and 3) variable duration between maturation cycles.

The proposed studies will examine field data from samples collected from white sturgeon between the estuary and the first four impounded portions of the river. In this way, baseline reproductive physiological information will be gathered that can be used to assess the current status of white sturgeon as well as the success of management plans aimed at enhancing white sturgeon populations within the Columbia River Basin.

If measurement of plasma steroid levels and vitellogenin proves to be an accurate tool for distinguishing sex and maturational status, then biologists from agencies involved in white sturgeon management can immediately switch from surgical examination of gonads to blood collection, and thus collect more information in less time and with less risk to the fish. If white sturgeon sampled at the same time of year in different parts of the river vary considerably in their gonadsomatic index, steroid and vitellogenin levels, then that information may suggest particular problem areas that require greater focus by managers.

d. Project history

e. Methods.

For all objectives, adult sturgeon will be obtained from both commercial and recreational fisheries and also by coordination with agency biologists from the Oregon Department of Fish and Wildlife and the Washington Department of Fish and Wildlife. We have collaborated with these agencies in the past to collect the samples described above in the preliminary results. Monitoring of sturgeon will be conducted in each of the three years of the study in order to determine variation in physiological parameters in relation to major ecosystem factors such as river flow and water temperature. Field studies will take place at a variety of locations on the Columbia River. Stretches of the river from the estuary to Bonneville Dam contain large numbers of reproductively viable adults while portions of the river above the dam contain considerably fewer active breeding adults. Samples will be obtained from the estuary and in Bonneville, the Dalles, John Day and McNary reservoirs.

1) To determine how plasma sex steroids and vitellogenin levels vary at different stages of maturation in order to develop predictive indices for the timing of sturgeon final maturation.

Hypotheses: Plasma levels of testosterone (T), 11-ketotestosterone (KT), estradiol (E2), as well as plasma levels of the yolk protein vitellogenin (Vg) in white sturgeon females vary with stage of gonad development, and plasma levels of T and KT in white sturgeon males will vary with stage of gonad development.

2) To distinguish between the sexes of white sturgeon by measuring plasma steroid and vitellogenin levels.

Hypotheses: Female sturgeon will differ from male sturgeon in the plasma levels of T, KT, E2 and Vg;

3) To determine if the gonadosomatic index, plasma steroid levels, and vitellogenin levels (female only) in white sturgeon in impounded portions of the Columbia River differ from those in the unimpounded portions of the river.

Hypotheses: Sturgeon from the unimpounded portion of the Columbia River will differ from sturgeon in the impounded portions of the river in the levels of T, KT, and E2, as well as Vg; and sturgeon from the unimpounded portion will differ from sturgeon in the impounded portions in gonadal histology.

Adult white sturgeon will be sampled seasonally during the commercial and sport harvest; approximately 200 fish will be sampled in each of the three years of the study from the unimpounded portion of the river and from the reservoirs behind the first four dams. This will ensure that animals will be collected at various stages of maturation, under varying major ecosystem conditions of river flow and water temperature, and from various locations within the river. On each sampling date and at each site, a minimum of 10 animals will be collected and then measured for body size (weight and fork length) and gonad weight, and sampled for gonads, and blood plasma.

Plasma samples will be analyzed for the sex steroids responsible for maturation (testosterone, 11-ketotestosterone, and estradiol-17β) by radioimmunoassay (Fitzpatrick et al. 1986). Each radioimmunoassay will utilize polyclonal antisera specific for each steroid. Vitellogenin will be measured in plasma by enzyme immunoassay (EIA; Linares-Casenave, 1994). Gonads will be fixed in buffered formalin and embedded in paraffin. Serial sections (4 µm) will be taken sagittally and stained with hematoxylin and eosin. Descriptions of gametogenesis of white sturgeon, outlined by Doroshov et al. (1991; 1997) and Conte et al. (1988), will be used to identify stages of germ cell maturity. Gonadal samples will also be analyzed for sex ratios and possible intersex fish. Concentrations of vitellogenin and all steroids will be compared over time and between locations, and between sexes of fish by using analysis of variance. Discriminant analysis of the data will also be performed to generate a general model for distinguishing between sexes and maturity states.

f. Facilities and equipment.

Dr. Fitzpatrick and Mr. Feist are part of the Oregon Cooperative Fishery Research Unit which has three (3) laboratories on the campus of Oregon State University equipped with a Beckman L8-60M Ultracentrifuge, Beckman TJ-6 Benchtop Centrifuge, Beckman LS 1800 Liquid Scintillation Counter, Beckman DU-64 Spectrophotometer, IBM LC/9533 Ternary Gradient Liquid Chromatograph (HPLC), incubators, three ultralow freezers, cryostat and automated histology apparatus, fraction collector, seven (7) microcomputers, and standard laboratory equipment (homogenizers, glassware, pipets, etc.). All equipment and facilities are available for use in conducting the radioimmunoassays and histology.

g. References.

Beamesderfer, R.C.P., T.A. Rien, A.A. Nigro (1995). Differences in the dynamics and potential of impounded and unimpounded white sturgeon populations in the Lower Columbia River. Trans. Am. Fish. Soc. 124, 857-872.

Campbell P.M., T.G. Pottinger, and J.P. Sumpter (1992). Stress reduces the quality of gametes produced by rainbow trout. *Biol. Reprod.* 47, 1140-1150.

Chapman, F.A., J.P. Van Eenennaam, and S.I Doroshov (1996). The reproductive condition of white sturgeon, Acipenser transmontanus, in San Francisco Bay, California. Fish. Bulletin 94, 628-634.

Conte, F.S., S.I. Doroshov, P.B. Lutes and E.M. Strange. (1988). Hatchery manual for the white sturgeon. Publication #3322, University of California Press, Oakland. 104 pp.

Cuisset, B., P. Pradelles, D.E. Kime, E.R. Kühn, P. Babin, S. Davail, and F. Le Menn (1994). Enzyme immunoassay for 11-ketotestosterone using acetylcholinesterase as label: application to the measurement of 11-ketotestosterone in plasma of Siberian sturgeon. *Comp. Biochem. Physiol.* 108C, 229-241.

DeVore, J.D., B.W. James, C.A. Tracy, and D.A. Hale (1995). Dynamics and potential production of white sturgeon in the unimpounded Lower Columbia River. Trans. Am. Fish. Soc. 124, 845-856.

Doroshov, J.N., J.P. Van Eenennaam, F.A. Chapman and S.I. Doroshov. (1991) Histological study of the ovarian development in wild white sturgeon, Acipenser transmontanus. pp. 129-135. In: P. Williot (ed.) Acipenser, CEMAGREF Publ., Bordeaux.

Doroshov, S.I., G.P. Moberg, and J.P. Van Eenennaam (1997). Observations on the reproductive cycle of cultured white sturgeon, *Acipenser transmontanus*. *Env. Biol. Fish.*, 48: 265-278.

Doroshov, S.I., J.P. Van Eenennaam, and G.P. Moberg (1994). Reproductive management of cultured white sturgeon (*Acipenser transmontanus*). In: High Performance Fish (D.D Mackinlay, ed.), pp. 156-161, Fish Physiology Association, Vancouver, Canada.

Fitzpatrick, M.S., G. Van Der Kraak, and C.B. Schreck (1986). Profiles of plasma sex steroids and gonadotropin in coho salmon, Oncorhynchus kisutch, during final maturation. Gen. Comp. Endocrinol. 62: 437-451.

Linares-Casenave, J., K.J. Kroll, J.P. Van Eenennaam and S.I. Doroshov. (1994). Development and application of an enzyme linked immunosorbent assay (ELISA) for the detection of plasma vitellogenin in white sturgeon (Acipenser transmontanus). pp 165-169. In: D.D. Mackinlay (ed.) High Performance Fish, Proceedings of an International Fish Physiology Symposium, July 1994, Fish Physiology Association, Vancouver.

Pelissero, C. and F. LeMenn (1991). Evolution of sex steroid levels in males and first time maturing females of the Siberian sturgeon (Acipenser baeri) reared in a French fish farm. In: P. Willot (ed.) Acipenser, CEMAGREF Publ., Bordeaux.

Redding, J.M. and R. Patiño (1993). Reproductive physiology. *In:* The Physiology of Fishes (D.H. Evans, ed.), p. 503-534, CRC Press, Boca Raton, FL.

Section 8. Relationships to other projects

We have worked cooperatively with the Oregon Department of Fish & Wildlife, Washington Department of Fish & Game, and the U.S. Geological Survey Biological Resources Division (Cook WA) during our initial studies of sex identification of Columbia River sturgeon. Our work would benefit the sturgeon projects for these agencies. Specifically, the proposed work would provide useful information for the the BPA Project # 860-5000 titled "White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers Upstream from Bonneville Dam".

Section 9. Key personnel

MARTIN STONE FITZPATRICK (0.25 FTE for proposed project)
Assistant Professor
Department of Fisheries & Wildlife
Oregon State University
Corvallis, OR 97331
Ph: 541-737-1086

EDUCATION:

B.A.	Harvard University 1980, Biology, cum laude
M.S.	Oregon State University, 1985, Physiology/Fisheries
Ph.D.	Oregon State University, 1990, Physiology/Fisheries

PROFESSIONAL EXPERIENCE:

1991 - present	Assistant Professor, Department of Fisheries and Wildlife, Oregon State University
1993 - 1994	Consultant, Microsoft Corporation, Redmond, Washington
1990 - 1991	Faculty Research Associate, Post-Doctoral Position, Department of Fisheries and Wildlife, Oregon State University
1989 - 1990	Faculty Research Assistant, Department of Fisheries and Wildlife, Oregon State University
1981 - 1989	Graduate Research Assistant, Department of Fisheries and Wildlife, Oregon State University
1979 - 1980	Curatorial Assistant, Harvard Museum of Comparative Zoology, Cambridge, Massachusetts

GRANTS IN LAST FIVE YEARS
USAID, 1996-98, $145,697 to M.S. Fitzpatrick
Confederated Tribes of the Umatilla, 1996-7, $120,885 to M.S. Fitzpatrick
Western Regional Law Center, 1995-97, $140,000 to M.S. Fitzpatrick
US Army Corps of Engineers, 1995, $17,727 to M.S. Fitzpatrick
Berkeley Antibody Company, 1993, $10,000 to M.S. Fitzpatrick
Great Lakes Fishery Commission, 1993-95, $65,000 to M.S. Fitzpatrick
USAID, 1992-95, $102,000 to M.S. Fitzpatrick

EUGENE FOSTER JR. (0.10 FTE for the proposed project--no salary requested)

Environmental Toxicologist
Oregon Department of Environmental Quality
Water Quality Division
811 S.W. 6th Avenue
Portland, OR 97204
(503)-229-5358
FAX (503)-229-6124

Education
1979 B.S. Fisheries & Wildlife: University Missouri-Columbia
1996 PhD. Toxicology: Oregon State University

Teaching Experience
Ecological Toxicology ESR 425/610. Portland State University. Winter Quarter 1996 & 1997.

Endocrine Disruptors in Fish & Wildlife: FW407. Oregon State University. Fall Quarter 1996.

Appointments
Adjunct Assistant Professor of Environmental Science, Portland State University. 1996-1997.

Work Experience
1994 to Present: Oregon Department of Environmental Quality: EnvironmentalToxicologist: Responsibilities: Administer the water quality toxics programwhich includes investigation of toxic pollutant effects on fish physiology,reproduction, and development; evaluate risks to aquatic life and human health; standards development; aquatic toxicity and bioaccumulation potential for contaminated sediments.

1992 to 1994: Oregon State University: Graduate Research Assistantship: Concurrent part-time employment with the Oregon Department of EnvironmentalQuality during this time.

1989 to 1994: Oregon Department of Environmental Quality: Aquatic Resource Specialist.

1987 to 1989: Oregon Department of Environmental Quality: Senior Technician.

1986 to 1987: Roy F. Weston, Inc.: Technical Assistance Team (TAT).

1984 to 1986: Environmental Science & Engineering, Inc.: Aquatic Scientist.

1982 to 1984: Environmental Science & Engineering, Inc.: Senior Technician.

1980 to 1982: Environmental Science & Engineering, Inc. Technician.

GRANT WILLIAM FEIST (0.75 FTE for proposed project)

EDUCATION:

Secondary	Middleton High School, Middleton, Wisconsin.
B.S.	University of Wisconsin 1983, Zoology
M.S.	Oregon State University, 1988, Physiology/Fisheries
Ph.D.	Oregon State University, 1997 (expected), Physiology/Fisheries

LABORATORY EXPERIENCE:

January, 1996-present
Research Assistant, Oregon State University. Involved with a project investigating the effects of bleached kraft pulp mill effluent on reproductive dysfunction of adult chinook salmon and white sturgeon in the Columbia river and development of enzyme immunoassays for sex steroids.

September, 1984-December, 1995
Graduate Research Assistant, Oregon State University (MS received in 1988, currently working on a Ph.D.). Research was concerned with examining endocrine system control over the process of sexual differentiation in salmon.

February, 1984-August, 1984

Research Assistant, University of Wisconsin-Madison, McArdle Laboratory for Cancer Research. Duties included; setting up, maintaining and operating automated equipment for the synthesis of DNA, sequencing of proteins and data collecting computer system.

June, 1983-February, 1984

Student Researcher, Lab Aide. University of Wisconsin-Madison, Biochemistry Department. Study consisted of the isolation of a Rhizobium with photosynthetic ability and determining the structure of the modifying group of the iron protein of Rhodospirillum rubrum nitrogenase.

March, 1981-May ,1983

Animal Handler, Lab Aide. University of Wisconsin-Madison, Pathology Department. Study consisted of the effects of PCB, PBB and TCDD on the reproductive system and infants of rhesus monkeys.

Section 10. Information/technology transfer

Results of this project will be made available to agency managers and the scientific community through publication in peer-reviewed journals (2 journal articles estimated). In addition, project personnel will participate in regional workshops on white sturgeon management in which the results of the project can be presented and discussed.