

**Bonneville Power Administration  
Fish and Wildlife Program FY99 Proposal**

**Section 1. General administrative information**

**Preserve Cryogenically the Gametes of selected  
Mid-Columbia Salmonid stocks**

**Bonneville project number, if an ongoing project** 9153

**Business name of agency, institution or organization requesting funding**  
Columbia River Inter-Tribal Fish Commission

**Business acronym (if appropriate)** CRITFC

**Proposal contact person or principal investigator:**

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**Subcontractors.** List other agencies or entities that will receive funding under this project, either through sub-contracts managed by the project sponsor or, where multiple agencies are involved as joint sponsors, through primary contracts managed by Bonneville. If another entity will be responsible for the long term maintenance of the project, identify them here.

List one subcontractor per row; to add more rows, press Alt-Insert from within this table

<b>Organization</b>	<b>Mailing Address</b>	<b>City, ST Zip</b>	<b>Contact Name</b>
Yakama Indian Nation	P.O. Box 151	Toppenish, WA. 98948	George Lee
Confederated Tribes of the Warm Springs Reservation	P.O. Box C	Warm Springs, OR. 97761	(The participation of the Warm Spring Tribe is not yet determined)

**NPPC Program Measure Number(s) which this project addresses.**

Section 7.4.E.1 calls for applications of Cryopreservation technology to restore and preserve depleted populations. Section 7.4.E.2 calls for demonstrations of cryopreservation identified in the coordinated habitat and production process.

Section 7 of the 1994 Columbia River Basin Fish and Wildlife Program calls for immediate efforts to gather data on wild and naturally spawning stocks. The title and goal of Section 7.1 is to "Ensure Biodiversity". Biodiversity being the variety of, and variability in living organisms with respect to genetics, life history, behavior and other fundamental characteristics.

The Council may have envisioned a cryogenic preservation as a technique for gathering data on wild and naturally spawning stocks. The gametes (eggs and sperm) of spawning salmon contain a vast amount of genetic information about the fish. This genetic information is coded in the deoxyribonucleic acid molecule (DNA). That portion of genetic information contained in the haploid chromosomes of salmon sperm cells can be gathered without impact on spawning salmon stocks. Cryogenic preservation of such "genetic data" is safe (the information is stored without a loss in fidelity) and inexpensive. After collection it is proposed that this material be transferred to an internationally recognized salmonid gene bank facility.

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

**Other planning document references.**

*Wy Kan Ush Me Wa Kush Wit*, the Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs and Yakama tribes calls for the reintroduction of salmon to watersheds from which they have been extirpated. While not explicitly cited as a technique of reintroduction, cryogenically preserved gametes predating the loss of a salmon stock in the wild would be a logical choice for use in a reintroduction effort. The National Marine Fisheries Service, as condition IX to required ESA permits for handling listed Snake River Salmon, requires a written statement indicating a "Willingness to Cooperate in a Cooperative Breeding Program". Cryogenic preservation is a component of Snake River salmon restoration efforts.

**Subbasin.** List subbasin(s) where work is performed. Use commas to separate multiple subbasins. Coordination projects or those not affecting particular subbasins may omit this field.

Upper Columbia, The Deschutes and possibly others

**Short description.** Collect and cryogenically preserve the gametes of fall chinook and/or steelhead from the Upper Columbia and possibly the Deschute River. Transfer these gametes to a recognized qualified salmon gene banking facility.

**Section 2. Key words**

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
x	Anadromous fish	_____	Construction	_____	Watershed

_____ Resident fish	_____ O & M	_____ x Biodiversity/genetics
_____ Wildlife	_____ Production	_____ Population dynamics
_____ Oceans/estuaries	_____ Research	_____ Ecosystems
_____ Climate	_____ Monitoring/eval.	_____ Flow/survival
_____ Other	_____ x Resource mgmt	_____ Fish disease
	_____ Planning/admin.	_____ * Supplementation
	_____ Enforcement	_____ Wildlife habitat en-
	_____ Acquisitions	_____ hancement/restoration

**Other keywords.** Cryogenic preservation (or Cryopreservation), DNA, gametes, spermatozoa genetic diversity, fish germ plasm, gene banking.

### Section 3. Relationships to other Bonneville projects

n.a.

### Section 4. Objectives, tasks and schedules

#### *Objectives and tasks*

Obj 1,2,3	Objective	Task a,b,c	Task
1	Coordinate initial steelhead and chinook salmon gamete preservation efforts with management agencies and Tribes in the Mid-Columbia region.	a	Coordinate planned chinook salmon gamete preservation activities with state and Tribal management agencies.
		b	Request and integrate agency and Tribal input into the selection of chinook and steelhead populations abundant enough to assure the success of Objective 4.
		c	Coordinate with ongoing cryopreservation research and sampling activities.
2	Define cryopreservation project goals for gene banking of gametes from healthy chinook and steelhead populations in the Mid-Columbia region.	a	Determine chinook and steelhead populations for germplasm sampling.
		b	Review the literature and apply finding to adjust the sample sizes of Task 3.1 to those required to preserve a representative sample of

			the genetic diversity within the selected populations.
		c	Assess the shortening of the range of time (years) needed to complete cryopreservation collections so that sufficient directly non-related individual genetic material is preserved.
3	Apply cryopreservation techniques to chinook and steelhead salmon conservation units at high and or mid levels of abundance.	a	Follow adult sampling protocols and cryopreservation techniques for the collection, preservation, storage and inventory of male salmon germplasm. Initial goals are to preserve the gametes of 500 individual salmon from the mainstem Columbia River (Hanford Reach), and possibly the Klickitat, and the Deschutes. Collect detailed biological information on the source individuals which provide the cyropreserved materials.
		b	Cryopreserve adult male chinook salmon gametes from conservation units identified as being at high levels of abundance. Assess the quality of the collections by conducting fertility tests.
		c	To securely store the collected materials, contract with interim, and then permanent recognized salmonid gene banks in at least two independent locations.
		d	Preserve gamete samples on-site or at the identified independent locations.
4	Transfer of Technology.	a	Subcontract for the participation of two tribal fish agencies in the collection of salmon milt in the field. Encourage other fish agencies to visit and assess the applications of these techniques in other areas. Prepare and provide annual reports summarizing all activities associated with cryopreservation sample

		collection, preservation and storage.
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**Objective schedules and costs**

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	04/1999	04/2000	10%
2	04/1999	04/2000	5%
3	08/1999	03/2000	80%
4	04/1999	04/2000	5%

**Schedule constraints.**

The window of opportunity for collecting milt from adult salmon is narrow. The design of this proposal is to take milt from males which have already naturally spawned (note that the volumes of necessary for cryopreservation are small, and that spent males remain an adequate source of milt for this purpose). It is envisioned that a consensus process will determine which stocks this project will ultimately select, stocks will be dropped from consideration if there are any concerns about their abundance. Of the initial list, a range of schedule constraints exists:

Deschutes fall chinook spawning is estimated to occur from late September to mid-December. Spring chinook surveys in the Warm Springs river indicates that spawning begins in mid- to late August and is completed by the last week in September (Lindsay et al. 1989). The inclusion of the Deschute River in this project has not been determined.

Fall chinook in the Hanford Reach spawn from late October, peak in mid to late November, and taper off into December.

Another candidate basin is the Klickitat. Spring chinook spawning in the Klickitat peaks in late August and early September. Winter Steelhead spawning in the Klickitat occurs from March through June. Summer steelhead, if selected, spawn from January through March. Preparation for this field work should commence early in 1999.

**Completion date.** Enter the last year that the project is expected to require funding.

This work is not envisioned as requiring funding past 2001. A second field season should complete the training of agency staff. It is envisioned that this work would be continue by individual agencies as a special component of future spawning surveys.

**Section 5. Budget**

***FY99 budget by line item***

Item	Note	FY99
Personnel	Fishery Scientist, .25 FTE	\$9,897
	Fishery Scientist, .1 FTE	\$3,299

Fringe benefits	@ 31.5%	\$4,157
Supplies, materials, non-expendable property		\$9,000
Operations & maintenance		\$600
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		
Travel		\$2469
Indirect costs	@ 37.9% of \$29,423	\$11,151
Subcontracts	YIN, WS?, U of I	\$49,000
Other		
<b>TOTAL</b>		<b>\$89,573</b>

**Outyear costs**

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	\$89,573	\$75,000	0	0
O&M as % of total	1%	1%		

**Section 6. Abstract**

The world faces changing environmental and political conditions, and these conditions do not always maintain native fish stocks at levels which maintain genetic diversity. Detrimental conditions causing the decreases in salmon stocks can be improved in some cases, but time is required. The 1994 Columbia Basin Fish and Wildlife Program calls for demonstrations of cryopreservation identified in the coordinated habitat and production process, as well as ensuring biodiversity.

Cryopreservation of sperm is a proven technique for preserving fish germ plasm for extended periods of time (200+ years), and therefore can serve as a partial insurance against the loss of genetic diversity. Cryopreservation is already in use in programs designed to store rare fish germ plasm, but it is unapplied in the regions proposed. Biologists working with endangered stocks urge that the collection and storage of salmon gametes be conducted when stocks are at healthy levels. The end product of these approaches differ in that collections made on endangered stocks genetically sample a subset of the few individuals left in a population. The goal of this project is to demonstrate that representative genetic samples of the biodiversity from healthy populations may be economically made and preserved. This project may be monitored and evaluated based upon an assessment of the representativeness of the collections made and fertility evaluations of the stored product. Cryopreservation programs do not address habitat problems, but they are the simplest and most economical means to store genetic information contained in the DNA of male salmon from today's stocks.

**Section 7. Project description**

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

The 1994 Columbia Basin Fish and Wildlife Program calls for demonstrations of cryopreservation identified in the coordinated habitat and production process, as well as ensuring biodiversity. This technique has been reported as successful for over 20 years with many fish species including steelhead, chinook, coho, chum salmon, pink salmon, sockeye, Atlantic salmon, Pacific herring, Atlantic halibut, grey mullet, black porgy, brown trout, channel catfish, black grouper, Atlantic croaker, common carp, marine puffer, milkfish, barramundi, and summer whiting.

Cryopreservation is already in use in portions of the Snake River. Since 1992 the Nez Perce Tribe (NPT) has contributed 222 cryopreserved samples in a local gene banking effort. The NPT was funded in 1997 by the Bonneville Power Administration to coordinate and initiate gene banking of adult male gametes from listed spring and summer chinook in the Snake River basin. The WDFW is making collections of salmon from Snake River tributaries. These collections are stored in duplicate at two separate facilities, the University of Idaho and Washington State University. These gene banking efforts have not been without application. In 1997 ODFW sought and received NMFS approval for the transfer of some of the NPT cryopreserved sperm samples to their Snake River spring/summer chinook captive broodstock program.

The products of this project may, at some point in the future be used to mitigate losses of native salmon in place and in kind. A proposal to do this is not being made (and hopefully will never be). Cryopreservation is a partial "saving of the pieces" to insure against the failure of society to protect localized salmon populations.

This project is a logical component of the work called for in the conference titled "The Establishment of a Germ Plasm Repository for Threatened and Endangered Fish". This conference was hosted July 23, 1997 by the University of Idaho and supported by Washington Sea Grant Program and the University of Idaho. Speakers at this conference represented the Smithsonian Institute, the USGS, the NPT, IDFG, Louisiana State University and WSU.

**b. Proposal objectives.**

The following tasks are patterned after the NPT's "Listed Stock Chinook Salmon Gamete Preservation project.

**OBJECTIVE 1.** Coordinate initial steelhead and chinook salmon gamete preservation efforts with management agencies and Tribes in the Mid-Columbia region.

Task 1.1 Coordinate planned chinook salmon gamete preservation activities with state and Tribal management agencies.

Task 1.2 Request and integrate agency and Tribal input into the selection of chinook and steelhead populations abundant enough to assure the success of Objective 4.

Task 1.3 Coordinate with ongoing cryopreservation research and sampling activities.

**OBJECTIVE 2.** Define cryopreservation project goals for gene banking of gametes from healthy chinook and steelhead populations in the Mid-Columbia region.

Task 2.1 Determine chinook and steelhead populations for germplasm sampling.

Task 2.2 Review the literature and apply finding to adjust the sample sizes of Task 3.1 to those required to preserve a representative sample of the genetic diversity within the selected populations.

Task 2.3 Assess the shortening of the range of time (years) needed to complete cryopreservation collections so that sufficient directly non-related individual genetic material is preserved.

OBJECTIVE 3. Apply cryopreservation techniques to chinook and steelhead salmon conservation units at high and or mid levels of abundance.

Task 3.1 Follow adult sampling protocols and cryopreservation techniques for the collection, preservation, storage and inventory of male salmon germplasm. Initial goals are to preserve the gametes of 500 individual salmon from the mainstem Columbia River (Hanford Reach), and possibly the Deschutes and the Klickitat. Collect detailed biological information on the source individuals which provide the cyropreserved materials.

Task 3.2 Cryopreserve adult male chinook salmon gametes from conservation units identified as being at low levels of abundance and high risk of extirpation. Assess the quality of the collections by conducting fertility tests.

Task 3.3 To securely store the collected materials, contract with interim, and then permanent recognized salmonid gene banks in at least two independent locations.

Task 3.4 Preserve gamete samples on-site or at the identified independent locations.

OBJECTIVE 4. Transfer of Technology.

Task 4.1 Subcontract for the participation of a (two?) tribal fish agency (agencies) in the collection of salmon milt in the field. Encourage other fish agencies to visit and assess the applications of these techniques in other areas. Prepare and provide annual reports summarizing all activities associated with cryopreservation sample collection, preservation and storage.

**c. Rationale and significance to Regional Programs.**

The objective of this project is to create an inventory of male salmon germplasm from the Mid-Columbia region. Initial goals are for sampling 500 individual salmon from the mainstem Columbia (Hanford Reach), and possibly the Klickitat and the Deschutes Rivers. Detailed biological information on the source individuals which provide the cyropreserved materials will also be collected. Because the conservation units identified will be at high levels of abundance, these collections will be less expensively obtained than those made on listed species. These materials will eventually be maintained at permanent recognized salmonid gene banks in at least two independent locations.

Snake River cryogenic programs have focused on **listed** salmon stocks since 1992. A different approach to gene banking program involves the preservation of abundant stocks of salmon. Such a program has been ongoing for many years with sockeye salmon in the Fraser River, B.C, (though some of the stocks have also been rare). This ongoing program is sampling about a dozen stocks, targeting a level of 50 individuals per stock. These samples are preserved at the World Fisheries Trust in Victoria B.C. (Dave Moore,

personal communication). A national gene banking effort is ongoing with Atlantic Salmon in Norway. The Norwegian program seeks to preserve gametes from 50 individuals from each of over 100 stocks. The Norwegian approach appears to have an economy of scale, the cost of collecting and preserving one sperm sample was estimated to be \$123 in 1990 (Cloud and Thorgaard, 1993).

**d. Project history** n.a.

**e. Methods.**

The numbers of fish proposed for collection are similar to those of other salmonid gene banking projects (50 individuals/river or large tributary). However the sample size will be revisited and justified based on what is known about the regions proposed.

Fish handling protocol training will be provided to all personnel prior to collection and handling of adult male salmon to minimize handling stress. Each team member will be assigned a specific duty to improve the efficiency of sample collection. All adult male salmon sampled were collected by hand or net. Pre-measured MS-222 will be used to anaesthetize all adult salmon, along with a sodium bicarbonate buffering compound to buffer the acidic effect of the MS-222. Extra care will be taken during milt collection to ensure the quality of preserved samples. The abdomen of the anesthetized male salmon will be thoroughly dried and stripped gently to reduce or eliminate contamination of the semen samples.

Fish biological information (length, general condition, external marks) will be recorded following semen collection. Caudal fin tissue may be collected for genetic (DNA) analysis. Scales will be taken for scale pattern analysis to determine wild or hatchery origin and age classes. Following sampling and data collection the anesthetized salmon will be immediately returned to a slow water area and assisted until recovered. Concurrently, the semen samples will be placed in two separately labeled Whirl Pak7 bags, oxygenated, and placed in a covered insulated cooler on wet ice on top of newspaper. Cryopreservation will occur within a 24 period, followed by shipping and storage at independent repositories. The duplicate repositories will serve as a safeguard against a catastrophic event that could destroy all germ plasm samples if they were stored at one facility.

Sperm evaluation is an important component of the cryopreservation program in order to cull poor quality sperm samples prior to freezing, and to estimate the fertility of the stored sperm post-thaw. Fertility will be evaluated by:

\*fertilization rate - proportion of eggs fertilized by a given number of spermatozoa;

\*sperm motility - percentage of motile sperm following the addition of a sperm activating solution (Mounib 1978).

There are four stages in the cooling sequence of cryopreservation of cells:

1) cooling cells to the point of ice formation - This does not appear to be a critical factor in the cryopreservation of salmonid sperm;

2) the formation of ice - The goal at this stage is to have ice form near the freezing point of the extracellular solution;

3) cooling through the critical period - During this phase, there is a net movement of water out of the cells as the temperature is constantly being reduced. The cooling rate during this phase needs to be slow enough to allow water to move out of the cells, but it must be fast enough to protect the intercellular environment from the effect of the high salt concentrations. The success of cryopreservation is dependent upon required cryoprotectants (such as DMSO) in the freezing solution. These small compounds enter the cells and protect the cells during dehydration. The rate at which the sperm is cooled is a critical factor in the success of the cryopreservation process; For salmonid sperm, cooling rates of -20 to -30°C/minute appear to be optimal (Stoss 1980), down to approximately -79°C.

4) reduction to liquid nitrogen temperature - The frozen milt is then plunged into liquid nitrogen at -196°C.

The amount of sperm cryopreserved varies greatly by individual fish. Many of the fish sampled have been actively spawning for several days and sometimes very little or no sperm is available. A 2 ml sample can fertilize up to 1000 eggs (Cloud and Thorgaard, 1993).

Safety considerations from the handling of liquid nitrogen have been considered. The practices recommended by the National Research Council (1995) will be followed, as published in their "Prudent Practices in the Laboratory Handling and Disposal of Chemicals".

*An objective assessment of factors that may limit success of the project and/or critical linkages of the proposal with other work.*

The success of a cryogenic preservation project has two parts. The first is the successful collection and storage of representative samples of a population. The training of technicians to freeze milt has been demonstrated and is feasible. The trickier part of this process lies in the hands of those who, in the future will need to thaw this milt and fertilize eggs in future field situations. In nature salmonid sperm swim for 30 seconds after deposition. In short, time is of the essence, and low fertilization rates will be the consequence of any unpolished procedures.

#### **f. Facilities and equipment.**

The office facilities and office equipment for coordinating this work already exist at CRITFC. The vehicle needs of this project will be met by sharing the costs of maintaining annually leased vehicles with other projects. Cryopreservation has specialized equipment requirements. The amount of hardware required depends on whether or not fish samples are frozen in the field, or shipped live to a lab for storage. Objective 4 (technological transfer), dictates that demonstrations of freezing techniques be made. Therefore at a minimum the following items will be required:

Liquid Nitrogen container, Liquid Nitrogen Dry shipper, Liquid Nitrogen Vapor Freezer, Microscope, Cryopreservation database software, and label printing. None of these individual items exceeds \$1,600.

**g. References.**

Ashwood-Smith, M.J. (1980). Low temperature preservation of cells, tissue, and organs. In: *Low Temperature Preservation in Medicine and Biology*. M.J. Ashwood-Smith and J. Farrant, eds. Pitman Medical Limited, Turnbridge Wells, Kent, Eng. pp. 19-44.

Cloud, J. G., and C. Osborne. 1997. Cryopreservation of salmonid sperm. Department of Biological Sciences, University of Idaho. Moscow, ID.

Cloud, J. G. and G. H. Thorgaard, editors. 1993. *Genetic Conservation of Salmonid Fishes*. Series A: Vol. 248, NATO Advanced Science Institute Series, Plenum Press, New York and London

Jonasson B. C. and R. B. Lindsay. 1988. Fall chinook salmon in the Deschutes River, Oregon. Information Reports (Fish) 88-6 of Oregon Department of Fish and Wildlife, Research and Development Section, Portland, Oregon.

Moore, D. Fisheries Director, Shuswap Nation Fisheries Commission. 355 Yellowhead Hwy, Kamloops, B.C. V2H1H1

Mounib, M.S. 1978. Cryogenic preservation of fish and mammalian spermatozoa. *Journal of Reproductive Fertilization*, 53: 13-18.

National Research Council. (1995). *Prudent Practices in the Laboratory Handling and Disposal of Chemicals*. National Academy Press. Washington, D.C. pp. 128-129.

Northwest Power Planning Council. 1994. *Columbia River Basin Fish and Wildlife Program*. Portland, OR.

Stoss, J. 1983. Fish gamete preservation and spermatozoan physiology. In: *Fish physiology* Vol. 9 Part B. Hoar, W.S., D.J. Randall, and E.M. Donaldson eds. Academic Press, New York. pp. 305-350.

Whittingham, D.G. 1980. Principles of embryo preservation. In: *Low Temperature Preservation in Medicine and Biology*. M.J. Ashwood-Smith and J. Farrant, eds. Pitman Medical Limited, Turnbridge Wells, Kent, Eng. pp. 65-83.

## **Section 8. Relationships to other projects**

Relationship with The Nez Perce Fisheries Resources Management Department.

The Nez Perce Tribe is one of four tribes which direct the Columbia River Inter-Tribal Fish Commission. The Nez Perce Fisheries Resources Management Department has been collecting milt from threatened or endangered spring and summer chinook salmon in

Idaho since 1992. This agencies staff has provided valuable advice based on their years of experience with the procedures involved. Their staff also have been encouraging of this project's timing (i.e., that such work be preformed while stocks are abundant). Two advantages come from such timing. Abundant stocks are logistically easier and less expensively sampled, and larger collections made on an abundant population may better represent that population genetically.

#### Relationship with Confederated Tribes and Bands of The Yakama Indian Nation, Fisheries Program

The Yakama Indian Nation is one of four tribes which direct the Columbia River Inter-Tribal Fish Commission. The YIN Fisheries program offers an excellent infrastructure under which this project may be implemented. Supervisory staff and technicians are geographically situated to sample the Klickitat and Hanford Reach with minimal logistical complications. Their supervisor staff and crews are familiar with the river, and they are willing to participate in the pilot project.

The Warm Springs Tribe is one of four tribes which direct the Columbia River Inter-Tribal Fish Commission. The Warm Springs Tribe's fisheries program offers an excellent infrastucture under which this project may be implemented. The participation of the Warm Springs Tribe has not been determined at this writting. Supervisory staff and technicians are geographically situated to sample the Deschutes River with minimal logistical complications. Their supervisor staff and crews are familiar with the river, and they are willing to participate in the pilot project.

### **Section 9. Key personnel**

Include names, titles, FTE/hours, and one-page resumes for key personnel (i.e. principal investigator, project manager), and describe their duties on the project. Emphasize qualifications for the proposed work. Resumes should include name, degrees earned (with school and date), certification status, current employer, current responsibilities, list of recent previous employment, a paragraph describing expertise, and up to five recent or especially relevant publications or job completions.

Keith Hatch will be the Project Leader at CRITFC, devoting 1/4 FTE to the project. His duties will be to see that Tasks 1-3 are completed on budget. Mr. Hatch has an MS in Fisheries from OSU. His studied the genetic structure of coastal Oregon steelhead using electrophoresis, and publishing the thesis titled "Phenotypic Comparison of Thirty-eight Steelhead (*Oncorhynchus mykiss*) populations form Coastal Oregon". He edited the five volume "Stock Summary Reports for Columbia River Anadromous Salmonids", published in 1992 by the BPA. He has received training in the freezing of milt, it's thawing, and it's use in fertilizing eggs by completion of the University of Idaho's Cryopreservation of Salmonid Sperm workshop in 1997.

Andre Talbot is a Fishery Scientist at CRITFC. He will be devoting one month to the project, mainly in the statistical analysis of the adequacy of the sampling program. Dr. Talbot has a broad expertise in biostatistics, population dynamics and quantitative genetics in an international development framework since 1980. Dr. Talbot has worked

on the genetic maintenance of common carp (*Cyprinus carpio*) and Tilapia (*Oreochromis spp.*) stocks, several of their individual projects involved the cryopreservation of sperm.

Dr. Talbot has a particularly strong background in linking environmental data with variability in production, producing habitat-based predictive models of fish production for major rivers in Eastern Canada. His research education and experience provide the necessary skills for a critical appraisal of methodologies employed in sampling designs, monitoring systems, research programs and resource management. He has extensive experience in length-based analytical and statistical fisheries methods. From the design of experiments to data collection to statistical analysis, he has assisted tropical and temperate research teams to develop research programs and management plans in fisheries and aquaculture. He has experience in teaching, through workshops and university courses. Dr. Talbot held an Associate Scientist position at the University of Québec at Chicoutimi, directing a firm specializing in international development, with particular interest in fisheries resource monitoring, population dynamics, aquaculture and genetics.

George Lee is a Supervisory Biologist with the YIN. He will be devoting 1/4 FTE to the project during the spawning season. He will provide field support and work on the technology transfer aspects of the project within the YIN and with other fish agencies.

WS?

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

How will technology or technical information obtained from the project be distributed or otherwise implemented? Methods can include publication, holding of workshops, incorporation in agency standards or facilities, and commercialization.

The knowledge of how to perform the collection of salmon milt in the field, how it is frozen, and how to transport it will be transferred to the tribes and local fish agencies by way of its direct demonstration. Objective 4 (technology transfer) is a minor budgetary portion of this project, but it is one of the bigger goals of the whole project. Personnel unfamiliar with cryopreservation work will be trained in a short course held at the U of I. Staff from other fishery agencies will be encouraged to visit and assess the applications of these techniques. Presentations on the project will be made at relevant professional society meetings (for example, The Native American Fish and Wildlife Society). The target audience for this technology transfer is specific in that it is limited to fishery biologists and fishery managers. It is not the intent of this project to inform the general public about the need for, or even the existence of gene banking programs. A low public profile for this gene banking initiative is proposed. This is to prevent it from being cited by that segment of society that rationalizes salmon habitat destruction.