Moses Lake Fishery Restoration Project

Factors Affecting the Recreational Fishery in Moses Lake Washington

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Factors Affecting the Recreational Fishery in Moses Lake, Washington

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PREFACE

This annual report is a precursor to the final technical report we will be writing the next contract period. Consequently, this report, covering the period between September 27, 2002, and September 26, 2003, represents a progress report towards the final technical report we anticipate completing by September 26, 2004. Sample analysis and field work have progressed well and we anticipate no further delays.

Objective 1. To quantify secondary production in Moses Lake.

Task 1.1- To sample zooplankton during the rearing season for game fishes in Moses Lake.

Task 1.2- To quantify the size composition of zooplankters that are consumed by game fishes in Moses Lake.

Task 1.3- To sample the benthic macroinvertebrate community during the rearing season for game fishes in Moses Lake.

The collection of samples and field work has been completed for tasks 1.1-1.2 and we are currently in the process of finishing the sample analysis. Due to the high productivity of Moses Lake, the majority of our zooplankton samples are large and would take considerable time to totally process. Consequently, we are implementing a statistically valid sub-sampling protocol, also used by Dr. Bennett and members of his staff from the University of Idaho in their Lake Pend Oreille studies. We are considering the following prior to collecting a sub-sample: the total sample is homogenously distributed to ensure a representative sub-sample; the volume of the sub-sample is carefully identified, which will enable us to extrapolate counts of all species / L for the entire sample (i.e. the number of *Daphnia pulex* / L). The techniques used to sub-sample will maximize our efficiency without quantitatively and qualitatively sacrificing information.

The sample collection for task 1.3 has been completed. We will finish the analysis of the benthic macroinvertebrate samples during the forthcoming contract period.

Objective 2. To quantify the influence of predation on target fishes in Moses Lake.

Task 2.1- To estimate the abundance of predatory fishes (smallmouth bass, largemouth bass and walleye).

Task 2.2- To estimate diet composition of predatory fishes in Moses Lake.

Task 2.3- To estimate fish consumption by predatory fishes and assess predatory inertia in Moses Lake.

Task 2.1 began in April with the tagging of walleye that we captured during their spawning migration. Since the initial tagging event we have tagged other predatory fishes such as smallmouth and largemouth bass during our June sampling event and tournaments. During this time we have noticed our most successful method of tagging a large number of fish is at angler fishing tournaments. Consequently, we have implemented a sampling event with local anglers to capture walleye and bass to be tagged and released. A final recapture event is scheduled for October during the fall walleye index netting (FWIN). Thus, collection of data for Objective 2, task 2.1 will be completed by the end of October.

Since the tagging of walleye and bass began, we have marked over 1300 walleye and 180 bass of both species. Furthermore, we saw many of these tagged fish in our creel survey concurrently conducted on Moses Lake. Interestingly, we also have received reports of two Moses Lake tagged walleye recaptured in Potholes Reservoir, immediately downstream. Entrainment will be discussed in much greater detail in Objective 3, task 3.6.

The majority of samples for tasks 2.2 and 2.3 are processed and will be completed by the end of October 2003 (Table 1 a-f). *Daphnia* spp. was a major prey item of several fishes during all seasons sampled. Addressing predatory inertia as outlined in task 2.3 will be completed during the forthcoming contract period.

Table 1(a) Percent by weight of prey items consumed by fishes[1] collected during fall 2000.

Prey Item	BG	YP	BC	LMB	SMB	WAL	RBT	PS
Bluegill		78.0554		6.1436		48.5962	1.0011	
Unknown non-salmonid		0.0827		1.4824		0.7891	0.0096	
Cottus spp.				3.7426				
Largemouth Bass								
Yellow Perch				82.4799				
Ameiurus spp.								
Micropterus spp.								
Burbot								
Black Crappie						48.9991		
Smallmouth bass								
Daphnia	14.2857	20.7348	18.8220	3.7805		0.0042	90.7885	
Leptodora							0.1662	
Bosmina								
Copepoda	0.0296	0.1137						
Alona								
Unidentified zooplankton	0.3847							
Mixed zooplankton parts	0.3640							
Diptera	3.5692	0.2964	3.0148	1.5054		0.0125	0.1364	
Ephemeroptera	2.4061		0.6286	0.0060			0.0115	
Hemiptera								
Odonata				0.4039			0.1057	
Trichoptera	1.1098							
Neuroptera								
Plecoptera								
Coleoptera								
Dermaptera								
Hymenoptera								
Megaloptera	1.3140							
Unidentified insect	3.1164							
Insect parts			4.8190					
Mixed invertebrate parts	22.2528		29.6706	0.0095				
Gastropoda	38.9446	0.0034		0.0236				
Hydracarina (mites)	0.0059							
Annelida				0.0266				
Amphipoda	13.1522		5.5872				5.6049	
Nematoda				0.0054		0.2409	0.0019	
Coelenterata								
Acari (ticks)								
Isopoda								
Arachnida (spiders)								
Turbellaria								
Other								
Unknown	0.3788		37.4578	0.0015				
Vegetation/inorganic material		0.7134		0.3136		1.3581	2.1741	

[1]BG bluegill, YP yellow perch, BC black crappie, LMB largemouth bass, SMB smallmouth bass, WAL walleye, RBT rainbow trout, PS pumpkinseed

Table 1(b) Percent by weight of prey items consumed by fishes[1] collected during spring 2001.

Prey Item	BG	YP	BC	LMB	SMB	WAL	RBT	PS
Bluegill								
Unknown non-salmonid		0.1973		0.9732	7.6577			
Cottus spp.		0.0921		0.4669	0.0703			
Largemouth Bass								
Yellow Perch				97.0846	89.6927			
Ameiurus spp.								
Micropterus spp.								
Burbot								
Black Crappie								
Smallmouth bass								
Daphnia	66.2338	52.9550		0.0012	0.0003		24.0801	
Leptodora								
Bosmina		0.0026						
Copepoda		0.1684						
Alona								
Unidentified zooplankton								
Mixed zooplankton parts		0.4289						
Diptera	32.4675	41.7403		0.0761	1.8820		72.8066	
Ephemeroptera								
Hemiptera								
Odonata		0.1447						
Trichoptera								
Neuroptera								
Plecoptera								
Coleoptera								
Dermaptera								
Hymenoptera					0.0347			
Megaloptera		1.1683						
Unidentified insect							0.3757	
Insect parts		2.5497		0.0004	0.0039			
Mixed invertebrate parts							0.2192	
Gastropoda								
Hydracarina (mites)	1.2987	0.0026		0.0008			0.1895	
Annelida		0.0737			0.0255			
Amphipoda				0.0133				
Nematoda		0.0763			0.0003			
Coelenterata								
Acari (ticks)								
Isopoda								
Arachnida (spiders)								
Turbellaria								
Other					0.0039			
Unknown		0.0737						
Vegetation/inorganic material		1.4946		1.3836	0.3700		2.3289	

[1]BG bluegill, YP yellow perch, BC black crappie, LMB largemouth bass, SMB smallmouth bass, WAL walleye, RBT rainbow trout, PS pumpkinseed

Table 1(c) Percent by weight of prey items consumed by fishes[1] collected during summer 2001.

Prey Item	BG	YP	BC	LMB	SMB	WAL	RBT	PS
Bluegill			10.5834			0.4965		
Unknown non-salmonid	0.0053					0.6844	0.0409	
Cottus spp.	0.0515		3.5261			9.3016		
Largemouth Bass						4.0687		
Yellow Perch						74.7150	90.1127	
Ameiurus spp.						3.2691		
Micropterus spp.						0.2654		
Burbot						1.6348		
Black Crappie						3.5216		
Smallmouth bass								
Daphnia	16.6453		61.4197			0.1279	2.5420	
Leptodora	0.0463		0.3046			0.0560	0.0548	
Bosmina	0.0095		0.0207				0.0008	
Copepoda	0.0294		0.5008			0.0002	0.0016	
Alona	0.0599		0.2117					
Unidentified zooplankton			6.5565					
Mixed zooplankton parts	1.8622		4.2075			0.0067	0.0057	
Diptera	37.8015		9.6799			0.7707	1.3158	3.2726
Ephemeroptera	0.7024					0.0363		
Hemiptera	0.1041					0.0001		
Odonata	0.2776		0.2478					
Trichoptera	2.8306		0.0052					0.5278
Neuroptera	0.1893							
Plecoptera								
Coleoptera								
Dermaptera								
Hymenoptera								
Megaloptera						0.0238		
Unidentified insect	1.4500		0.4491					
Insect parts	20.3981		0.4698			0.0026	0.0008	
Mixed invertebrate parts	3.0725					0.0481		
Gastropoda	0.6141		0.1394			0.0002		95.5133
Hydracarina (mites)	2.2302		0.2891			0.0001	0.0041	
Annelida			0.0207			0.0003		
Amphipoda	0.7276		0.0723					0.3431
Nematoda	0.0011		0.0361					
Coelenterata								
Acari (ticks)	0.0011		0.0103					
Isopoda	0.2913							
Arachnida (spiders)								
Turbellaria							0.0004	
Other	2.0326							
Unknown	0.5131							
Vegetation/inorganic material	8.0724		1.2494			0.9938	6.3786	0.3431

[1]BG bluegill, YP yellow perch, BC black crappie, LMB largemouth bass, SMB smallmouth bass, WAL walleye, RBT rainbow trout, PS pumpkinseed

Table 1(d) Percent by weight of prey items consumed by fishes[1] collected during fall 2001.

Prey Item	BG	YP	BC	LMB	SMB	WAL	RBT	PS
Bluegill				27.3102	13.0072	44.6050	0.8134	
Unknown non-salmonid		0.0337	13.4974	17.7128	35.1833	8.7150		
Cottus spp.				18.5013	9.0625	7.8703		
Largemouth Bass						2.3233		
Yellow Perch				25.4401		11.2132		
Ameiurus spp.						13.4225		
Micropterus spp.						9.8595		
Burbot								
Black Crappie				4.6276				
Smallmouth bass								
Daphnia		24.1855	55.4764	0.3694	25.1770	0.0002	87.5475	80.4214
Leptodora		0.0316		0.0013		0.0001	1.6787	
Bosmina		0.0105	0.0247		0.0798			
Copepoda		0.7191	0.1851	0.0022	0.1097			
Alona				0.0009				
Unidentified zooplankton			27.3434				0.2674	5.1901
Mixed zooplankton parts								
Diptera		66.5296	0.7310	2.2210	8.3945	0.1648	3.2579	3.2374
Ephemeroptera		0.0443						
Hemiptera					0.1030		0.0093	
Odonata		0.0633		0.0142				
Trichoptera		0.4618	0.1881	0.0035				0.5653
Neuroptera								
Plecoptera							0.0137	
Coleoptera					2.3927		0.0741	
Dermaptera					1.5121			
Hymenoptera					0.1163			
Megaloptera								
Unidentified insect		3.8991	2.1560	0.0078	0.3057	0.0001		
Insect parts					1.7281			
Mixed invertebrate parts		1.0312						4.5735
Gastropoda		2.1573		0.0483				6.0123
Hydracarina (mites)								
Annelida		0.0485		0.2473				
Amphipoda		0.0675	0.3979	0.0082				
Nematoda				0.0013				
Coelenterata								
Acari (ticks)								
Isopoda								
Arachnida (spiders)				0.0060			0.0668	
Turbellaria								
Other						0.0025		
Unknown						0.0508	0.8275	
Vegetation/inorganic material		0.7170		3.4765	2.8281	1.7724	5.4439	

[1]BG bluegill, YP yellow perch, BC black crappie, LMB largemouth bass, SMB smallmouth bass, WAL walleye, RBT rainbow trout, PS pumpkinseed

Table 1(e) Percent by weight of prey items consumed by fishes[1] collected during winter 2002.

Prey Item	BG	YP	BC	LMB	SMB	WAL	RBT	PS
Bluegill				0.4219		8.9286		
Unknown non-salmonid		81.1789	0.1552	0.9316		3.2977		
Cottus spp.				0.1692		2.2611	6.6873	
Largemouth Bass								
Yellow Perch				95.2814		84.8228		
Ameiurus spp.								
Micropterus spp.								
Burbot								
Black Crappie								
Smallmouth bass								
Daphnia	73.7726	8.1740	97.1182	0.3015		0.0135	74.8525	100.0000
Leptodora						0.0002		
Bosmina		0.0052	0.0443			0.0003		
Copepoda	0.2261	0.0891	0.7537	0.0174		0.0008	0.0005	
Alona								
Unidentified zooplankton								
Mixed zooplankton parts		0.0996	1.3966					
Diptera	5.0711	8.6979	0.0665	0.0412		0.0040	9.4376	
Ephemeroptera			0.0222				0.0008	
Hemiptera								
Odonata								
Trichoptera								
Neuroptera								
Plecoptera								
Coleoptera								
Dermaptera								
Hymenoptera								
Megaloptera			9.8426	0.4815				
Unidentified insect								
Insect parts			0.0222					
Mixed invertebrate parts	5.7817							
Gastropoda							0.0205	
Hydracarina (mites)								
Annelida								
Amphipoda			0.2438	0.0304				
Nematoda		0.0052						
Coelenterata				0.0011				
Acari (ticks)								
Isopoda								
Arachnida (spiders)								
Turbellaria								
Other								
Unknown		0.1939						
Vegetation/inorganic material	15.1486	1.5562	0.1773	2.7958		0.6710	9.0007	

[1]BG bluegill, YP yellow perch, BC black crappie, LMB largemouth bass, SMB smallmouth bass, WAL walleye, RBT rainbow trout, PS pumpkinseed

Table 1(f) Percent by weight of prey items consumed by fishes[1] collected during summer 2003.

Prey Item	BG	YP	BC	LMB	SMB	WAL	RBT	PS
Bluegill					6.9625	2.0872		
Unknown non-salmonid			59.9808	0.5001	4.4625	1.6226		
Cottus spp.				3.0384	16.2064			
Largemouth Bass								
Yellow Perch				91.1358	51.9110	93.0350		
Ameiurus spp.				3.0384	1.9946			
Micropterus spp.								
Burbot								
Black Crappie								
Smallmouth bass								
Daphnia			0.0481	0.0011	0.4546	0.8874		
Leptodora					0.0005			
Bosmina								
Copepoda			1.6354	0.0011	0.0011	0.0005		
Alona					0.0011			
Unidentified zooplankton								
Mixed zooplankton parts								
Diptera			4.1847	0.0203	1.1562	1.4085	0.8363	
Ephemeroptera					0.0300	0.0073		
Hemiptera						0.0045		
Odonata								
Trichoptera					0.0038	0.0423		
Neuroptera								
Plecoptera								
Coleoptera								
Dermaptera								
Hymenoptera								
Megaloptera					0.2380			
Unidentified insect								
Insect parts					0.2921	0.0005		
Mixed invertebrate parts					0.1399	0.2160		
Gastropoda					0.0113			
Hydracarina (mites)			0.0481	0.0006	0.0038	0.0005		
Annelida					0.0150	0.6047		
Amphipoda					0.0306	0.0368		
Nematoda								
Coelenterata								
Acari (ticks)								
Isopoda								
Arachnida (spiders)					0.0005			
Turbellaria								
Other								
Unknown								
Vegetation/inorganic material			34.1029	2.2647	16.0847	0.0464	99.1637	

[1]BG bluegill, YP yellow perch, BC black crappie, LMB largemouth bass, SMB smallmouth bass, WAL walleye, RBT rainbow trout, PS pumpkinseed

Objective 3. To quantify mortality of selected fished in Moses Lake.

Task 3.1- To conduct spring and fall standardized shoreline sampling to quantify abundance of age 0 fishes.

Task 3.2- To monitor critical water quality parameters during the rearing season for fishes in Moses Lake.

Task 3.3- To compare spring and fall density estimates of shoreline inhabiting age 0 game fishes with those from other ecosystems.

Task 3.4- To conduct a creel survey to quantify angler exploitation.

Task 3.5- To quantify winter predation losses.

Task 3.6- To quantify entrainment losses from Moses Lake.

Task 3.1 included using both beach seining and popnetting sampling techniques during both fall 2002 and spring 2003. During the fall survey and spring survey we beach seined 122 and 134 sites, respectively. In addition, 13 and 15 popnet samples were collected during the fall and spring, respectively. The goal of this sampling was to quantify the abundance of age 0 fish and their over-winter survival. During our seining events we encountered some interesting results. Fall sampling was far more labor intensive due to the abundance of macrophyte growth which created some difficulties pulling each 100' beach seine through such material. However, areas of thick macrophytes were sampled by popnetting to assure representative sampling of all habitats. Quite often our seine hauls required sub-sampling. We calculated the species composition and age structure and ultimately the percentage of each species represented in the entire seine haul. Fish were collected at every site during the fall survey, whereas, during the spring survey we had 27 sites where no fish were captured. Despite the empty seine hauls 6961 g and 4898 g of fish per site were sampled during the spring and fall surveys, respectively. During both surveys yellow perch represented the largest percentage of biomass (Table 2).

Table 2 Species composition based on weight of fishes captured during fall 2002 and spring 2003 beach seining in Moses Lake.

	Fall 2002	Spring 2003
Black crappie	2.60 %	0.49 %
Bluegill	0.87 %	0.01 %
Bullhead (spp.)	4.16 %	0.04 %
Carp	35.55 %	16.21 %
Largemouth bass	5.7 %	0.23 %
Rainbow trout	0.47 %	0.16 %
Sculpin (spp.)	0.01 %	0.02 %
Smallmouth bass	1.93 %	0.33 %
Sucker (spp.)	0.47 %	0.03 %
Walleye	1.03 %	0.32 %
Yellow perch	47.21 %	82.16 %

Furthermore, using previously collected otoliths and scales, we were able to separate each sample into age categories and compare the change in the number of species per site from individual measurements (Table 3). Centrarchids (crappie, bluegill, and bass) had the lowest over-winter survival rates while the relative abundance of yellow perch increased. Using the entire weight of the seine haul (individual + batch) we were able to confirm the total weight of each age class per site during the fall and spring seine surveys (Table 4).

Table 3 Estimated number of age 0, 1, 2, and 3+ fish per site captured during the fall 2002 and spring 2003 beach seining surveys.

Fall 2002	**0**	**1**	**2**	**3+**
Black crappie	1.30	0.84	0.02	0.03
Bluegill	6.08	0.57	0.07	0.03
Largemouth bass	4.41	1.64	0.12	0.02
Smallmouth bass	2.10	0.33	0.02	0.06
Walleye	0.25	0.01	0.00	0.02
Yellow perch	15.20	2.51	0.03	0.02
Spring 2003				
Black crappie		0.49	0.00	0.01
Bluegill		0.08	0.01	0.00
Largemouth bass		0.04	0.00	0.01
Smallmouth bass		0.07	0.00	0.02
Walleye		0.16	0.00	0.00
Yellow perch		10.96	0.01	0.00

Table 4 Total biomass of each age class per beach seine site for fishes from Moses Lake.

Fall 2002	**Total weights (g)**	**Age 0 (g)**	**Age 1 (g)**	**Age 2 (g)**	**Age 3+ (g)**
Black crappie	15458.2	38.5	60.3	3.4	24.5
Bluegill	5193.3	26.9	4.9	5.3	5.5
Largemouth bass	34061.6	104.8	107.9	32.1	34.4
Smallmouth bass	11521.4	29.3	12.5	2.5	50.0
Walleye	6173.8	8.0	0.80	0.0	41.8
Yellow perch	282120.0	1619.4	605.9	24.5	62.6
Spring 2003					
Black crappie	4583.5		25.2	0.0	9.0
Bluegill	76.9		0.2	0.4	0.0
Largemouth bass	2168.1		1.1	0	15.1
Smallmouth bass	3102.9		2.0	0.0	21.1
Walleye	3005.5		22.4	0.0	0.0
Yellow perch	766376.9		5700.4	18.8	0.0

Although the overall biomass of fish captured was greater during the spring survey, this was attributed to the abundance of yellow perch that were captured in several seine hauls. For example, in one seine haul during the spring survey we captured ~144kg of yellow perch. These data suggest good over winter survival for yellow perch although poor survival for centrarchid fishes.

The purpose of task 3.2 was to monitor water quality parameters to detect any possible deleterious conditions that may negatively impact fishes within Moses Lake. During this contract period we monitored temperature, dissolved oxygen, pH, specific conductivity, and turbidity. Temperature and dissolved oxygen concentrations never attained levels considered lethal (Table 5). Mean water column temperature was highest in early august while mean DO levels were at or above 5 mg / L. Dissolved oxygen decreased through winter 2002 and increased in later February.

Table 5 Mean temperature (C) and dissolved oxygen (DO) concentrations (mg / L) from each of the four sections of Moses Lake.

		Section 1	Section 2	Section 3	Section 4
10/1/02	Mean temp.	16.5	15.3	16.6	15.8
	Mean DO	8.5	8.8	9.2	11.0
10/17/02	Mean temp.	13.7	12.9	13.4	12.9
	Mean DO	9.6	11.2	10.1	12.2
11/18/02	Mean temp.	na	6.9	6.6	6.4
	Mean DO	na	13.3	14.3	13.9
11/19/02	Mean temp.	6.8	8.5	na	na
	Mean DO	14.1	14.2	na	na
12/2/02	Mean temp.	4.6	5.9	4.6	3.9
	Mean DO	14.6	14.9	14.4	14.5
12/19/02	Mean temp.	4.0	4.0	4.1	na
	Mean DO	13.2	13.1	13.5	na
12/30/02	Mean temp.	3.3	3.5	3.3	3.3
	Mean DO	13.3	12.6	13.6	13.7
1/14/02	Mean temp.	2.7	2.8	2.7	3.0
	Mean DO	7.7	9.6	7.1	7.8
1/28/03	Mean temp.	2.8	4.7	2.7	3.4
	Mean DO	6.0	5.2	6.5	6.2
2/21/03	Mean temp.	5.0	6.1	4.9	5.3
	Mean DO	14.3	13.4	16.9	15.8
3/19/03	Mean temp.	7.8	9.7	7.5	8.6
	Mean DO	13.3	12.0	12.4	13.1
5/15/03	Mean temp.	15.2	14.5	15.3	17.0
	Mean DO	9.0	9.2	8.5	9.0
7/3/03	Mean temp.	21.8	22.9	22.4	23.2
	Mean DO	6.8	9.1	8.1	10.4
8/4/03	Mean temp.	23.7	22.8	24.8	25.0
	Mean DO	5.0	5.3	5.6	7.1
9/9/03	Mean temp.	21.3	19.6	21.4	21.0
	Mean DO	5.0	6.5	5.5	7.8

The purpose of task 3.3 was to compare spring and fall density estimates of shoreline inhabiting age 0 game fishes with those from other ecosystems. This task is ongoing. These comparative estimates will be found in the literature and graphically compared to estimates made in Moses Lake to assess year-class strength and quantify over-winter mortality.

A creel survey was conducted to quantify angler exploitation for task 3.4. The creel survey was complete at the end of October, and we are in the process of analyzing the data.

The purpose of task 3.5 was to quantify winter predation losses. The sample collection for this task is complete, and this task will commence once the time is available to begin bioenergetics modeling.

Task 3.6 was to quantify entrainment losses from Moses Lake. During the fall drawdown that occurred in November 2002 we operated two entrainment nets below the Moses Lake Irrigation District outlets (Figure 1). We had originally planned on sampling below the Bureau of Reclamation outlets with their assistance, but were forced to sample at the Moses Lake Irrigation District outlets. Sampling was conducted in a stratified random block design in 4 hour blocks. In the fall we sampled for 26.33 hours and 48.06 hours during the day and night, respectively. We also sampled one day during the winter for 6.83 daylight hours and 8.0 darkness hours to determine if fish were still susceptible to entrainment during low winter flows. We calculated species composition for fishes entrained in both fall and winter (Tables 6 and7).

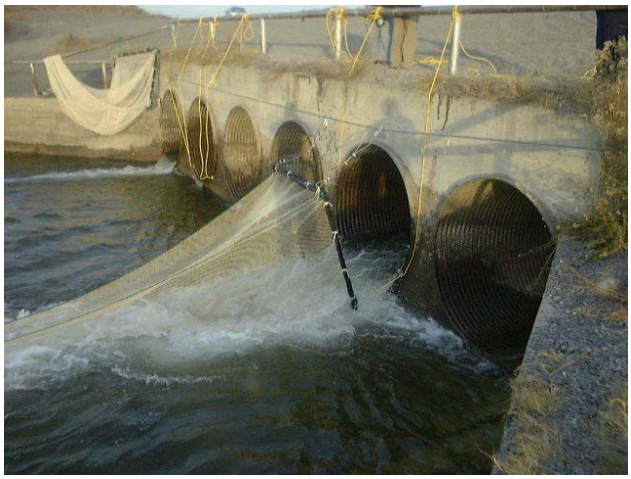

Figure 1 Moses Lake Irrigation District outlets and entrainment net sampling.

Table 6 Species composition based on the number of fishes[1] captured during the fall 2002 Moses Lake entrainment survey.

	Day		Night		Total	
	# of fish	%	# of fish	%	# of fish	%
BBH	0	0.0	3	0.77	3	0.76
BC	1	12.5	302	77.84	303	76.52
BG	1	12.5	14	3.61	15	3.79
BH	0	0.0	4	1.03	4	1.01
COT	0	0.0	5	1.29	5	1.26
LMB	3	37.5	42	10.82	45	11.36
PS	1	12.5	0	0.0	1	0.25
RBT	1	12.5	0	0.0	1	0.25
SMB	0	0.0	8	2.06	8	2.02
WAL	0	0.0	1	0.26	1	0.25
YP	1	12.5	8	2.06	9	2.27

[1]BBH brown bullhead, BC black crappie, BG bluegill, BH bullhead, COT sculpin spp., LMB largemouth bass, PS pumpkinseed, RBT rainbow trout, SMB smallmouth bass, WAL walleye, YP yellow perch

Table 7 Species composition based on the number of fishes[1] captured during the winter 2003 Moses Lake entrainment survey.

	Day		Night		Total	
	# of fish	%	# of fish	%	# of fish	%
BC	26	78.79	57	55.88	83	61.48
BG	4	12.12	5	4.90	9	6.67
BUR	0	0.0	1	0.98	1	0.74
COT	0	0.0	2	1.96	2	1.48
LMB	3	0.09	1	0.98	4	2.98
RBT	0	0.0	1	0.98	1	0.74
SMB	0	0.0	2	1.96	2	1.48
YP	0	0.0	33	32.35	33	24.44

[1]BC black crappie, BG bluegill, BUR burbot, COT sculpin spp., LMB largemouth bass, RBT rainbow trout, SMB smallmouth bass, YP yellow perch

During the entrainment survey black crappie represented 72.8 % of all fish collected. Furthermore, only 7.7 % of fish were captured during daylight hours, while 92.3 % were captured during darkness. We calculated the mean discharge in cubic feet / second (cfs) for the fall and winter entrainment surveys (Table 8).

Table 8 Mean discharge (cfs) for the fall 2002 and winter 2003 Moses Lake entrainment surveys.

Fall		Winter	
Day	Night	Day	Night
119.21	42.67	8.26	8.26

The fall day survey mean discharge is elevated due to the first day of surveying. We then decreased flow to maintain the integrity of our sampling gear. During the winter constant base flows were present; hence the identical discharge values. In addition to

calculating mean discharge, we calculated the number of fishes entrained per hour for both fall and winter sampling (Table 9).

Table 9 Number of fishes captured per hour during the fall 2002 and winter 2003 Moses Lake entrainment sampling.

	Fall		Winter	
	Day	Night	Day	Night
Brown bullhead	0	0.062	0	0
Black Crappie	0.038	6.283	3.804	7.125
Bluegill	0.038	0.291	0.585	0.625
Bullhead	0	0.083	0	0
Burbot	0	0	0	0.125
Sculpin spp.	0	0.104	0	0.25
Largemouth bass	0.114	0.874	0.439	0.125
Pumpkinseed	0.038	0	0	0
Rainbow trout	0.038	0	0	0.125
Smallmouth bass	0	0.166	0	0.25
Walleye	0	0.021	0	0
Yellow perch	0.038	0.166	0	4.125
Total	**0.304**	**8.051**	**4.829**	**12.75**

Though the winter discharge was much lower, more fish were entrained per hour during both daylight and darkness. The Moses Lake Irrigation District outlets discharge considerably less water than the Bureau of Reclamation outlets, and we are currently working with the Bureau of Reclamation to obtain the discharge data. We will use this data to expand the number of fish entrained per hour at the Moses Lake Irrigation District outlets to the greater discharge per hour present at the Bureau of Reclamation outlets.

Objective 4 To assess effects of habitat changes from shoreline development and carp on the fish community in Moses Lake.

Task 4.1- To sample turbidity.
Task 4.2- To identify the food web of Moses Lake.
Task 4.3- To quantify and assess quality of littoral habitat.
Task 4.4- To identify summer, fall, and winter concentrations of carp.

The purpose of task 4.1 was to determine if turbidity changed during times of heavy carp concentrations, generally in the late spring and early summer. As well as measuring turbidity, we also recorded secchi depth readings. We began collecting data later than anticipated due to equipment problems with our hydrolab. During June and July there appeared to be an increase in turbidity and a decrease in secchi depth compared to other times of the year.

We will use stable isotope analysis to identify the food web of Moses Lake as stated in task 4.2. All of the tissue samples have been collected and prepared, and now need to be processed in the mass spectrometer at the University of Idaho.

Task 4.3 was to quantify and assess the quality of littoral habitat in Moses Lake. We are currently waiting for the final product from Central Washington University. The overall product will include habitat loss during winter drawdowns as well as incorporating much of our biological data.

To identify summer, fall and winter concentrations of carp as stated in task 4.4 we surgically implanted radio transmitters into 20 carp, and tracked their movements for approximately 10 months. We will begin the data analysis shortly. We did not observe overlapping radio signals in any area of Moses Lake; however, we have recorded GPS coordinates of areas of carp concentration during the spring. These concentrations were observed during other surveys.