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# Hells Canyon Complex Resident Fish Study

Tracy J. Richter  
HCC Fisheries Biologist

**Technical Report  
Appendix E.3.1-5**

Hells Canyon Complex  
FERC No. 1971

December 2001  
*Revised July 2003*

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# **A Literature Review and Discussion of the Trophic Structure in Reservoirs Similar to Hells Canyon Complex**

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**Technical Report  
Appendix E.3.1-5**  
Hells Canyon Complex  
Resident Fish Study

## **Chapter 5**

Hells Canyon Complex  
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## **ABSTRACT**

A literature search was conducted on food habits for species found in the Hells Canyon Complex reservoirs. This search was limited to studies conducted in the northwestern United States. Fish species were separated into basic trophic levels and trophic groups based on diet. Relative weights were used to determine whether a fish species might be limited by food availability.

## 1. INTRODUCTION

In 1991 Idaho Power Company (IPC) began a Hells Canyon Complex (HCC) resident fish study under its fall chinook interim recovery plan and study (1991). IPC wanted to implement an interim operational plan to protect fall chinook salmon spawning between Hells Canyon Dam and the mouth of the Salmon River. The existing operational plan would be modified to account for low- and high-water conditions. Under the interim recovery plan, Brownlee Reservoir would be drafted to improve water quality in the lower Snake River during critical life stages of the fall chinook. In addition, requirements of the resident fish in the reservoirs of the HCC would be studied.

In 1996, as part of the process for relicensing the HCC, IPC began conducting studies to support its license application. These studies have been developed in collaboration with the Aquatics Work Group (AWG) of the Collaborative Team (IPC 1999) and extend the resident fish studies begun in 1991. AWG identified seven issues of concern, which led to this current study: 1) reservoir level effects on resident fish; 2) effects on native fish of introducing nonnative resident fish (effects of exotic fish on native species); 3) evaluation of water fluctuations on warmwater fisheries within all reservoirs; 4) impacts of Hells Canyon Dam on resident game fish during high discharge (are game fish lost?); 5) effects of daily and seasonal reservoir fluctuations on recruitment (nonspawning success) of largemouth bass, smallmouth bass, and crappie (specific to the reservoirs); 6) evaluation of trophic structure in reservoirs and downstream, including predation by squawfish on resident and anadromous fish; and 7) impacts of high flow releases below Hells Canyon Dam on smallmouth bass spawning success and recruitment. From these issues, AWG set two goals: 1) evaluate impacts of reservoir water-level fluctuations on the aquatic community, and 2) evaluate entrainment of reservoir species from HCC.

Partially addressing the AWG's issues of concern, this study's objective was to evaluate the trophic structure in the HCC reservoirs. Because food habit studies have been done on most fish species found in the HCC reservoirs, this report will review literature about the trophic structure in reservoirs similar to HCC.

Trophic structure involves links between predator and prey. It considers feeding relationships (who eats whom) among organisms in an ecosystem. Simply stated, trophic structure refers to the distribution among trophic or feeding levels. Trophic structure should not be confused with trophic state, which is a relative description of nutrients and organic contents in a body of water. Myers et al. (2002) describe the HCC's trophic state. This chapter discusses the trophic structure of the HCC reservoirs.

## 2. METHODS

A literature search was conducted to determine food habits of the fish species sampled in the HCC reservoirs (Table 1). Fish were classified into trophic groups based on diet information described in Chipps et al. (1997) (Table 2). The search was restricted to studies conducted in the

northwestern United States in systems similar to the HCC. Summaries of these results (Table 3) were used to classify fish species into trophic levels.

### 3. RESULTS AND DISCUSSION

A limited amount of literature on food habits was available from the northwestern United States for the species present in the HCC. Smallmouth bass was the only species for which a food habit study had been done within the HCC (Rohrer 1984; Bennett and Dunsmoor 1986, 1990; Dunsmoor et al. 1991). Although Gibson (1974) examined the stomachs of 85 channel catfish from the Snake River (from Grand View, Idaho, to the C.J. Strike Dam), food habit studies for smallmouth bass, black crappie, white crappie, bridgelip sucker, largescale sucker, bluegill, northern pikeminnow, channel catfish, pumpkinseed, and yellow perch were from Lower Granite Reservoir (Bennett 1983, Bennett et al. 1999) (Table 3). Carlander's (1969, 1977) summaries on food habits supplement information that was lacking in other literature.

Fish species were separated into trophic groups based on diet (Table 4). Trophic groups closely follow basic trophic levels, which number four (Figure 1). Trophic level I consists of photosynthetic organisms (such as phytoplankton and aquatic vegetation). Phytoplankton species found in samples from HCC reservoirs are listed in Table 5. Trophic level II consists of herbivores (generally fish that feed on organisms in trophic level I). Also, most zooplankton sampled in the HCC reservoirs (Table 6) and some macroinvertebrates comprise this trophic level (Table 7). Trophic level III includes planktivores, benthivores, omnivores, and insectivores—species that prey on organisms from trophic level II. Piscivores (fish that feed on other fish) occupy trophic level IV. Differences between trophic levels III and IV can be indistinct.

A species can be included in several trophic levels depending on food availability and niche partitioning. Bond's (1979) simplified diagram of hypothetical trophic relations of fishes shows interactions between trophic levels (Figure 2).

Trophic level diagrams are limited in that they do not clearly indicate fish that feed directly on plants. Generally, these fish are placed in trophic level II. Figure 3 indicates the trophic levels of HCC species as adults. Some overlap occurs when fish are placed according to strict definitions of trophic levels. But this overlap is minor considering the fact that a single species can feed at more than one trophic level in its lifetime. If the larval stage of a swimming predator is also considered, the predator's life history could easily include three of the four trophic levels.

When working with trophic levels, trophic adaptability should also be taken into account. This concept portrays a species' flexibility to shift from one food source to another when the occasion arises (Gerking 1994). According to the optimal foraging theory, when a food item appears that is more beneficial than that eaten previously, many species take advantage of the opportunity. Using this theory, we might assume that if a prey item is limited or absent, a species would switch to an alternate food item. Dunsmoor et al. (1991) concluded that adult smallmouth bass in Brownlee Reservoir maintained high growth rates despite the low availability of fish prey because they were able to forage profitably on large zooplankton. Switching to an alternate food

source was not detrimental to smallmouth bass, but such a switch might have impacted growth, fecundity, or condition in other species. Therefore, when a species shows a negative change in growth or condition, it might be wise to investigate the quantity or quality of available food (Bowen 1996).

To measure fish condition, three basic condition indices are available; one of the more easily interpreted indices is relative weight ( $W_r$ ), which also allows comparisons among species. Richter and Chandler (2001) calculated  $W_r$  for selected species in the HCC (Table 8). Species whose mean  $W_r$  is above 105 are considered to have an overabundant food supply; species whose mean  $W_r$  is between 85 and 105 are considered to be in balance with their food supply; those below 85 are considered to have a limited food supply.

Examples of species in the HCC that have an overabundant food supply are black crappie, bluegill, largemouth bass, and pumpkinseed. Channel catfish have a mean  $W_r$  over 105 in Oxbow and Hells Canyon reservoirs, suggesting that food sources in these reservoirs may be different from those in Brownlee Reservoir, where mean  $W_r$  is 97. Species considered in balance with their food supply are smallmouth bass, northern pikeminnow, chiselmouth, and white crappie.

The data collected in the HCC indicates that several species have  $W_r$  below 85, but not for all HCC reservoirs. In Brownlee Reservoir, bridgelip sucker was the only sampled species having a  $W_r$  less than 85. In Hells Canyon Reservoir, common carp, largescale sucker, mountain whitefish, rainbow trout, and yellow perch had low  $W_r$ . Of species sampled in Oxbow Reservoir, only rainbow trout had a  $W_r$  less than 85. In the reach above Brownlee Reservoir, low  $W_r$  were calculated for largescale sucker and mountain whitefish.

When limited food supply is investigated, species in this study that had sufficient sample sizes and  $W_r$  below 85 should receive priority. Species that may have limiting food supplies in at least one of the HCC reservoirs are largescale sucker, bridgelip sucker, common carp, mountain whitefish, rainbow trout, and yellow perch.

## 4. LITERATURE CITED

- Becker, G. C. 1983. Fishes of Wisconsin. The University of Wisconsin Press, Madison, WI. 1052 p.
- Bennett, D. H. 1983. Status of the warmwater fishery and the potential of improving warmwater fish habitat in the lower Snake River reservoirs. U.S. Army Corps of Engineers.
- Bennett, D. H., and L. K. Dunsmoor. 1986. Brownlee Reservoir fish population dynamics, community structure and the fishery. Idaho Department of Fish and Game. Federal Aid in Fish Restoration, Job Performance Report F-73-R-8. 36 p.
- Bennett, D. H., M. A. Madsen, S. M. Anglea, T. Cichosz, T. J. Dresser, Jr., M. Davis, and S. R. Chipps. 1999. Fish interactions in lower Granite Reservoir, Idaho–Washington.

- Final completion report. U.S. Army Corp of Engineers, Walla Walla District. Project No.14-45-0009-1579 w/o 21 and No. 14-16-0009-1579 w/o 32. 279 p.
- Bond, C. E. 1979. Biology of fishes. W.B. Saunders, Philadelphia, PA. 514 p.
- Bowen, S. 1996. Quantitative description of the diet. In: B. R. Murphy and D. W. Willis, editors. Fisheries techniques. 2nd edition. American Fisheries Society, Bethesda, MD. p. 513-532.
- Carlander, K. D. 1969. Handbook of freshwater fishery biology. Volume I. Iowa State University Press, Ames.
- Carlander, K. D. 1977. Handbook of freshwater fishery biology. Volume II. Iowa State University Press, Ames.
- Chipps, S. R., D. H. Bennett, and T. J. Dresser, Jr. 1997. Patterns of fish abundance associated with a dredge disposal island: implications for fish habitat enhancement in a large reservoir. North American Journal of Fisheries Management 17:378-386.
- Cooper, E. L. 1987. Carp in North America. American Fisheries Society, Bethesda, MD.
- Dunsmoor, L. K. 1990. Relative prey importance and availability in relation to smallmouth bass growth in Brownlee Reservoir, Idaho, with notes on dietary indices. M. Sc. thesis. University of Idaho, Moscow. 150 p.
- Dunsmoor, L. K., D. H. Bennett, and J. A. Chandler. 1991. Prey selectivity and growth of a planktivorous population of smallmouth bass in an Idaho reservoir. First International Smallmouth Bass Symposium. p. 14-23.
- Eder, S., and C. A. Carlson. 1977. Food habits of carp and white suckers in the South Platte and St. Vrain rivers and Goosequill Pond, Weld County, Colorado. Transactions of the American Fisheries Society 106(4):339-346.
- Etnier, D. A. 1971. Food of three species of sunfishes (*Lepomis*, Centrarchidae) and their hybrids in three Minnesota lakes. Transactions of the American Fisheries Society. 100(1):124-128.
- Gerking, S. D. 1994. Feeding ecology of fish. Academic Press, San Diego, CA.
- Gibson, H. 1974. Survey of fish populations in the Snake River from (1) Brownlee flowline to proposed Guffey Dam site (near Murphy, Idaho); (2) Grandview, Idaho to C.J. Strike Dam. Job performance report. Idaho Department of Fish and Game, Boise, ID. Project No. F-63-R3.
- Heidinger, R. C. 1975. Chemical and physical effects on the centrarchid basses. In: H. Clepper, editor. Black bass biology and management. Sport Fishing Institute, Washington, D.C. p 11-20.

- Held, J. W., and J. J. Peterka. 1974. Age, growth, and food habits of the fathead minnow, *Pimephales promelas*, in North Dakota Saline Lakes. Transactions of the American Fisheries Society 103(4):743-756.
- IPC (Idaho Power Company). 1991. Idaho Power Fall chinook interim recovery plan and study. August. IPC, Boise, ID. 28 p. Presented to: Northwest Power Planning Council and National Marine Fisheries Service.
- IPC. 1999. Detailed aquatic study plans. Distributed with meeting notes from the June 22, 1999, Aquatic Resource Work Group. IPC, Boise, ID. 400 p.
- Lawler, R. E. 1960. Observation on life history of channel catfish, *Ictalurus punctatus* (rafinesque), in Utah Lake, Utah. Job performance report. Federal Aid in Fish Restoration Project F-4-R-5. 69 p.
- Litvak, M. K., and R. I. C. Hansell. 1990. Investigation of food habit and niche relationships in a cyprinid community. Canadian Journal of Zoology 68:1873-1879.
- Myers, R., J. Harrison, S. K. Parkinson, B. Hoelscher, J. Naymik, and S. E. Parkinson. 2002. Pollutant transport and processing in the Hells Canyon Complex. In: Technical appendices for Hells Canyon Complex Hydroelectric Project. Idaho Power, Boise, ID. Technical Report E.2.2-2.
- Northcote, T. G., and G. L. Ennis. 1994. Mountain whitefish biology and habitat use in relation to compensation and improvement possibilities. Reviews in Fisheries Science 2:347-371.
- Richter, T. J., and J. A. Chandler. 2001. Status of the fish community 1991–2000. In: T. J. Richter, editor. Chapter 3. Hells Canyon Complex resident fish study. Technical appendices for Hells Canyon Complex Hydroelectric Project. Idaho Power, Boise, ID. Technical Report E.3.1-5.
- Rohrer, R. L. 1984. Brownlee Reservoir fish population dynamics, community structure and the fishery. Idaho Department of Fish and Game. Federal Aid in Fish Restoration, Job Performance Report F-73-R-6.
- Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Reprinted 1990. Fisheries Research Board of Canada, Ottawa. Bulletin 184. 966 p.
- Shinn, D., A. Foster, and M. Stephenson. 2001. Benthic macroinvertebrates of Hells Canyon. In: Technical appendices for Hells Canyon Complex Hydroelectric Project. Idaho Power, Boise, ID. Technical Report E.3.1-8.
- Ward, D. L., C. J. Knutsen, and R. A. Farr. 1991. Status and biology of black crappie and white crappie in the lower Willamette River near Portland, Oregon. Technical Report 91-3. Oregon Department of Fish and Wildlife, Portland, OR.

Table 1. List of species collected by electrofishing in the Hells Canyon Complex reservoirs, 1991–2000.

Common Name	Scientific Name	Status in Snake River
Black crappie	<i>Pomoxis nigromaculatus</i>	Nonnative
Bluegill	<i>Lepomis macrochirus</i>	Nonnative
Bridgelip sucker	<i>Catostomus columbianus</i>	Native
Brown bullhead	<i>Ictalurus nebulosus</i>	Nonnative
Channel catfish	<i>Ictalurus punctatus</i>	Nonnative
Chiselmouth	<i>Acrocheilus alutaceus</i>	Native
Common carp	<i>Cyprinus carpio</i>	Nonnative
Fathead minnow	<i>Pimephales promelas</i>	Nonnative
Flathead catfish	<i>Pylodictis olivaris</i>	Nonnative
Largemouth bass	<i>Micropterus salmoides</i>	Nonnative
Largescale sucker	<i>Catostomus macrocheilus</i>	Native
Mottled sculpin	<i>Cottus bairdi</i>	Native
Mountain whitefish	<i>Prosopium williamsoni</i>	Native
Northern pikeminnow	<i>Ptychocheilus oregonensis</i>	Native
Peamouth	<i>Mylocheilus caurinus</i>	Native
Pumpkinseed	<i>Lepomis gibbosus</i>	Nonnative
Rainbow trout	<i>Oncorhynchus mykiss</i>	Native
Smallmouth bass	<i>Micropterus dolomieu</i>	Nonnative
Tadpole madtom	<i>Noturus gyrinus</i>	Native
Warmouth	<i>Lepomis gulosus</i>	Nonnative
White crappie	<i>Pomoxis annularis</i>	Nonnative
Yellow perch	<i>Perca flavescens</i>	Nonnative

Table 2. Trophic group classification (Chipps et al. 1997).

Trophic Group	Percentage Composition in Diet
Herbivore	> 90% plant detritus, < 10% invertebrates
Omnivore	25–90% plant detritus, 10–75% invertebrates
Insectivore	> 90% invertebrates
Insectivore-piscivore	> 25% fish, remainder invertebrates

Table 3. Food habits of fish species sampled in the Hells Canyon Complex reservoirs based on literature from the northwestern United States.

Species	Prey	Reference
Black crappie	Cladocerans, fish, and aquatic insects	Bennett 1983, Ward et al. 1991, Bennett et al. 1999
Bluegill	Diptera, insect parts, ephemeroptera, crustaceans, and mollusks	Etnier 1971, Bennett et al. 1999
Brown bullhead	Insects, fish, fish eggs, mollusks, and plants	Carlander 1969, Becker 1983
Channel catfish	Fish, aquatic and terrestrial insects, crayfish, wheat, and cladocerans	Lawler 1960, Bennett 1983, Gibson 1974
Chiselmouth	Benthic algae or weeds, diatoms, insects	Scott and Crossman 1973
Common carp	Organic debris, cladocerans, planktonic copepods, insects, benthic algae or weeds, benthic invertebrates, and worms	Scott and Crossman 1973, Elder and Carlson 1977, Cooper 1987
Flathead catfish	Insect larvae, fish, and crayfish	Carlander 1969, Becker 1983
Largemouth bass	Fish and crayfish	Heidinger 1975, Carlander 1977
Fathead minnow	Debris, benthic algae or weeds, insects, and zooplankton	Scott and Crossman 1973, Held and Peterka 1974, Litvak and Hansell 1990
Mottled sculpin	Fish, benthic algae or weeds, benthic crustaceans, insects, and polychaetes	Scott and Crossman 1973, Becker 1983
Tadpole madtom	Cladocera, ostracods, <i>Hyalella</i> , chironomids, and debris	Carlander 1969, Becker 1983
Peamouth	Snails, aquatic insects, and ants	Carlander 1969
Pumpkinseed	Crustaceans, mollusks, insect parts, and diptera	Etnier 1971, Bennett et al. 1999
Rainbow trout	Aquatic and terrestrial insects, small cyprinids, cladocera, amphipods, and algae	Carlander 1969
Northern pikeminnow	Fish, cladocerans, crayfish, aquatic insects, terrestrial insects, and wheat	Carlander 1969, Bennett 1983, Bennett et al. 1999
Bridgelip sucker	Plant material, diatoms, detritus, blue-green algae, and filamentous algae	Bennett 1983
Largescale sucker	Plant material, diatoms, detritus, blue-green algae, and filamentous algae	Bennett 1983
Smallmouth bass	Crayfish, fish, and terrestrial and aquatic insects	Bennett 1983, Rohrer 1984, Bennett and Dunsmoor 1986, Dunsmoor 1990, Dunsmoor et al. 1991
White crappie	Cladocerans, fish, and aquatic insects	Bennett 1983, Ward et al. 1991, Bennett et al. 1999
Mountain whitefish	Lake populations: zooplankton, benthic invertebrates (mollusks), surface insects, and fish	Carlander 1969, Northcote and Ennis 1994
Warmouth	Cladocerans, insects, crayfish, and fish	Carlander 1977, Becker 1983
Yellow perch	Fish, diptera, and terrestrial and aquatic insects	Bennett et al. 1999

Table 4. Fish species assigned to trophic group based on diet.

Herbivore	Omnivore	Insectivore	Insectivore–piscivore
Chiselmouth	Common carp	Bluegill	Black crappie
	Bridgelip sucker	Pumpkinseed	Channel catfish
	Largescale sucker	Peamouth	Largemouth bass
	Brown bullhead	Mottled sculpin	Northern pikeminnow
	Fathead minnow	Rainbow trout	Smallmouth bass
		Tadpole madtom	White crappie
			Warmouth
			Mountain whitefish
			Yellow perch
			Flathead catfish

Table 5. Common phytoplankton species found in the samples collected throughout the Hells Canyon Complex (Myers et al. 2001).

Chlorophyta	Chrysophyta	Cryptophyta	Cyanophyta	Pyrrhophyta
<i>Actinastrum hantzschii</i>	<i>Asterionella formosa</i>	<i>Cryptomonas ovata</i>	<i>Anabaena flos-aquae</i>	<i>Glenodinium sp.</i>
<i>Ankistrodesmus falcatus</i>	<i>Cyclotella sp.</i>	<i>Rhodomonas minuta</i>	<i>Anabaena spiroides</i>	<i>Peridinium sp.</i>
<i>Chlamydomonas sp.</i>	<i>Fragilaria construens</i>	<i>Rhodomonas minuta</i> var. <i>nannoplanktica</i>	<i>Aphanizomenon flos-aquae</i>	
<i>Cosmarium regnesi</i>	<i>Fragilaria crotonensis</i>		<i>Chroococcus dispersus</i> var. <i>minor</i>	
<i>Crucigenia tetrapedia</i>	<i>Melosira granulata</i>		<i>Merismopedia tenuissima</i>	
<i>Dictyosphaerium</i>	<i>Melosira granulata</i> var. <i>angustissima</i>		<i>Microcystis aeruginosa</i> cells	
<i>Pediastrum duplex</i>	<i>Navicula sp.</i>		<i>Oscillatoria limnetica</i>	
<i>Scenedesmus dimorphus</i>	<i>Nitzschia sp.</i>		<i>Oscillatoria geminata</i>	
<i>Scenedesmus quadricauda</i>	<i>Pennate diatom</i>		<i>Oscillatoria sp.</i>	
<i>Schroederia setigera</i>	<i>Stephanodiscus hantzschii</i>		<i>Phormidium mucicola</i>	
<i>Selenastrum sp.</i>	<i>Stephanodiscus niagarae</i>			
<i>Sphaerocystis schroeteri</i>				

Table 6. Common zooplankton species found in the samples collected throughout the Hells Canyon Complex (Myers et al. 2001).

<b>Cladocera</b>	<b>Copepoda</b>	<b>Rotifer</b>
<i>Daphnia galeata mendotae</i>	<i>Acanthocyclops vernalis</i>	<i>Asplanchna sp.</i>
<i>Daphnia pulicaria</i>	<i>Cyclops sp.</i>	<i>Keratella chochlearis</i>
	<i>Diacyclops bicuspidatus thomasi</i>	unknown rotifers
	<i>Diaptomus sp.</i>	
	<i>Leptodiaptomus novamexicanus</i>	
	<i>Nauplius (larvae)</i>	

Table 7. Common macroinvertebrate species found in the samples collected throughout the Hells Canyon Complex reservoirs (Shinn et al. 2001).

<b>Hells Canyon Complex Reservoirs</b>		
<i>Zaitzevia sp.</i>	<i>Stenonema terminatum</i>	<i>Drunella doddsi</i>
<i>Paratanytarsus sp.</i>	<i>Chironomus sp.</i>	<i>Harnischia sp.</i>
<i>Cricotopus sp.</i>	<i>Tanytarsus sp.</i>	<i>Dicrotendipes sp.</i>
<i>Polypedilum sp.</i>	<i>Rheotanytarsus sp.</i>	<i>Orthocladus sp.</i>
<i>Endochironomus sp.</i>	<i>Cladotanytarsus sp.</i>	<i>Procladius sp.</i>
<i>Simulium sp.</i>	<i>Cryptochironomus sp.</i>	<i>Glyptotendipes sp.</i>
<i>Hyalella azteca</i>	<i>Prosimulium sp.</i>	<i>Ostracoda</i>
<i>Copepoda</i>	<i>Gammarus sp.</i>	<i>Caecidotea sp.</i>
<i>Sphaeriidae</i>	<i>Acari</i>	<i>Bivalvia</i>
<i>Vorticifex effusa</i>	<i>Pisidium sp.</i>	<i>Corbicula fluminea</i>
<i>Physella sp.</i>	<i>Gyraulus sp.</i>	<i>Physidae</i>
<i>Turbellaria</i>	<i>Ferrissia sp.</i>	<i>Potamopyrgus antipodarum</i>
<i>Nematomorpha</i>	<i>Dugesia tigrina</i>	<i>Nematoda</i>
<i>Dero sp.</i>	<i>Nais sp.</i>	<i>Nais variabilis</i>
<i>Limnodrilus hoffmeisteri</i>	<i>Ophidonais serpentina</i>	<i>Ilyodrilus templetoni</i>
<i>Lumbricina sp.</i>	<i>Tubifex tubifex</i>	<i>Lumbriculidae</i>
<i>Helobdella stagnalis</i>	<i>Enchytraeidae</i>	<i>Hirudinea</i>
	<i>Hydra sp.</i>	

Table 8. Mean relative weights ( $W_r$ ) and number ( $N$ ) of species sampled in the Hells Canyon Complex reservoirs from 1991–2000 (from Chapter 3 in Richter and Chandler 2001).

Species	Minimum size	Brownlee		Above Brownlee		Hells Canyon		Oxbow	
		$N$	$W_r$	$N$	$W_r$	$N$	$W_r$	$N$	$W_r$
Black crappie	100	479	118	15	109	655	113	205	117
Bluegill	100	372	107	20	111	403	111	294	117
Brown bullhead								2	127
Channel catfish	100	125	97	101	91	15	106	66	108
Chiselmouth	100	225	98	88	96	47	101	47	111
Common Carp	100	100	99	186	91	410	81	25	95
Flathead catfish		2	93	2	76				
Largemouth	150	88	110	47	105				
Pumpkinseed	50	23	105	12	100	15	108	13	111
Northern pikeminnow	100	88	96	10	88	14	87	38	103
Bridgelip sucker	100	563	81	37	85	114	88	66	88
Largescale sucker	100	1,072	90	332	82	233	81	57	91
Smallmouth bass	150	4,883	94	651	92	1,194	91	1,029	92
Rainbow trout	100	11	88	2	90	22	77	21	83
White crappie	100	213	106	27	100	61	92	19	105
Mountain Whitefish	100			149	79	1	83	1	100
Yellow perch	100	180	93	15	90	33	83	16	99

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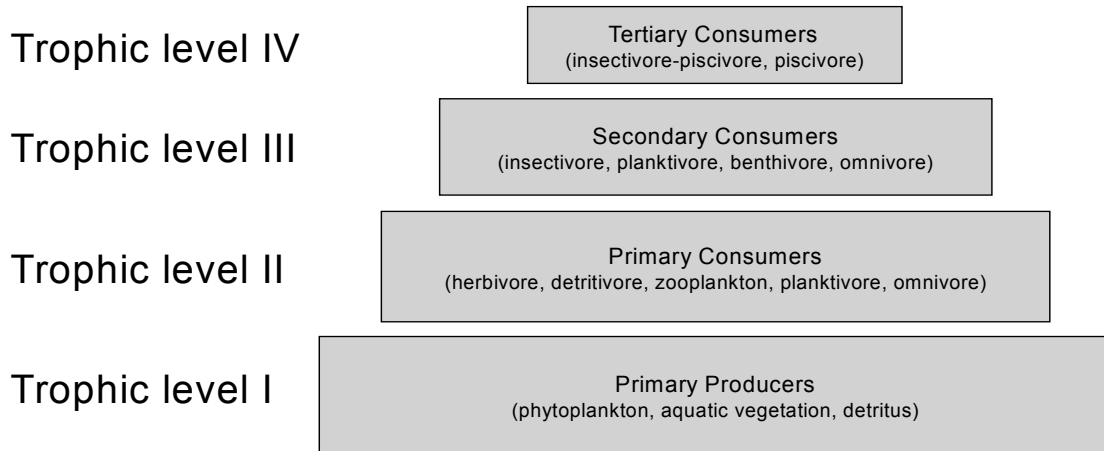


Figure 1. Simplistic trophic level structure.

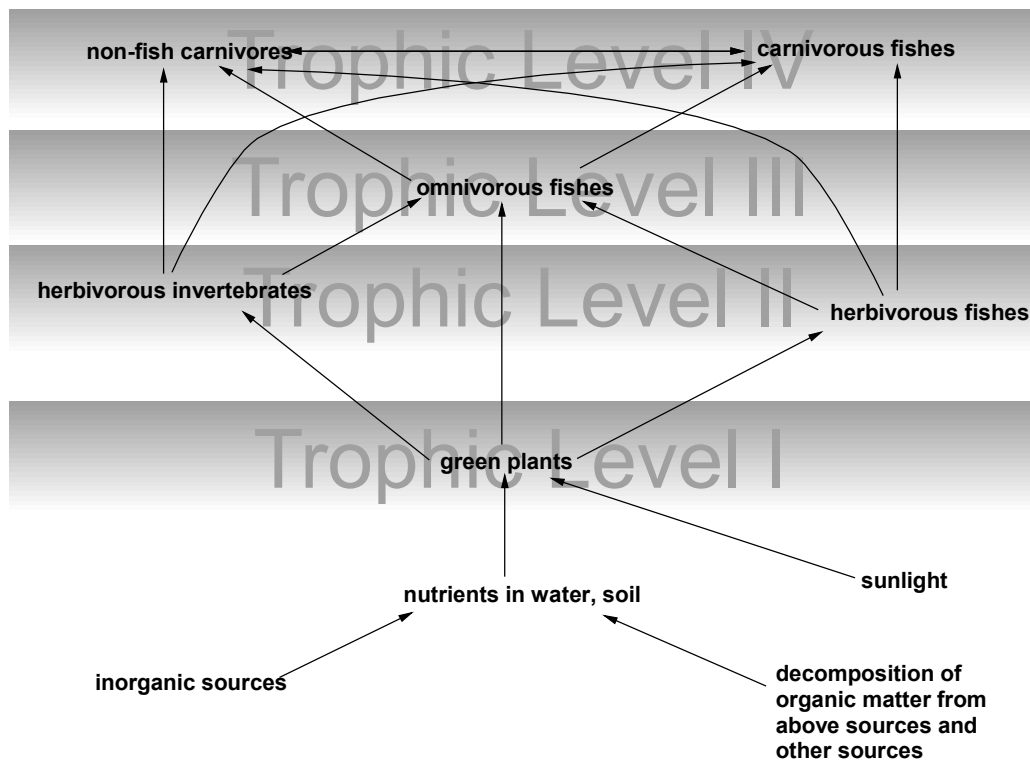


Figure 2. Simplified diagram of hypothetical trophic relationships of fishes superimposed over trophic level structure.

## Hells Canyon Complex Reservoirs

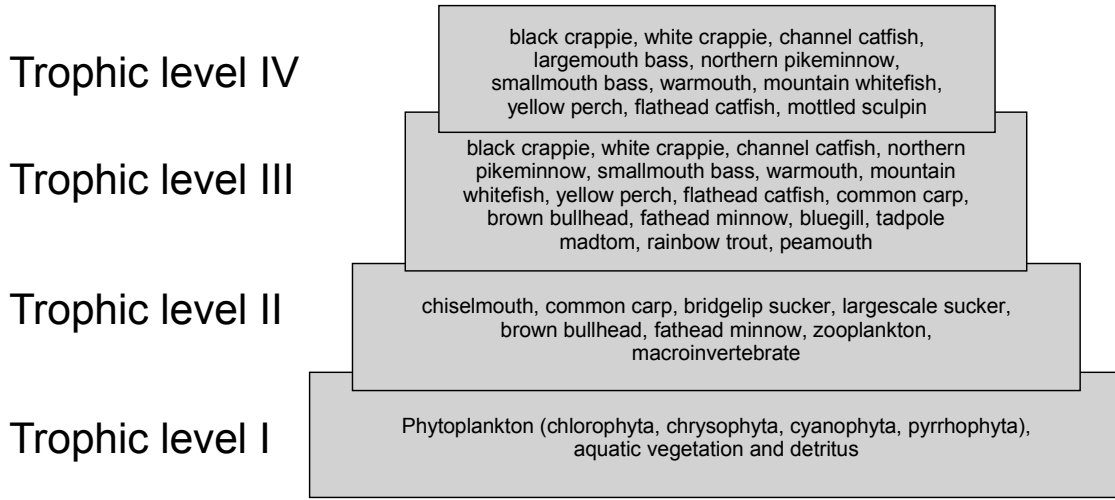


Figure 3. Hells Canyon Complex species classified into trophic levels. Notice that trophic levels overlap, even when based on adult food habits.