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QUANTIFICATION OF HUNGRY HORSE RESERVOIR WATER LEVELS NEEDED TO MAINTAIN OR ENHANCE RESERVOIR FISHERIES

Annual Report 1985

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QUANTIFICATION OF HUNGRY HORSE RESERVOIR WATER LEVELS NEEDED TO MAINTAIN OR ENHANCE RESERVOIR FISHERIES

Annual Report 1985

Prepared By:

Bruce May, Project Biologist
John Fraley, Project Coordinator
Montana Department of Fish, Wildlife and Parks
P.O. Box 67, Kalispell, Montana 59903

Prepared for:

Mr. John Ferguson, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
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June, 1986

EXECUTIVE SUMMARY

This study is part of the Northwest Power Planning Council's resident fish and wildlife plan, which is responsible for mitigating damages to fish and wildlife resources caused by hydroelectric development in the Columbia River Basin. The major goal of this study is to quantify seasonal water levels needed to maintain or enhance the reservoir fishery. This annual report summarizes data collected from 1983-85.

Operation of the reservoir has large impacts upon the habitat for fish food organisms and fish. The annual drawdown reduces reservoir volume, volume in euphotic zone, surface area, wetted bed, area of littoral zone and may weaken thermal structure.

Hungry Horse Reservoir in 1985 was isothermal from about late November to April, thermally stratified from June until about mid-October and ice-covered from mid-December to mid-April. Water temperature played an important role in determining fish distribution and activity by regulating metabolism, spawning periodicity and food availability. Dissolved oxygen and pH had little direct influence on fish distribution.

The zooplankton community was dominated by _Daphnia_, _Diaptomus_ and _Cyclops_. They comprised approximately 90 percent of the biomass in 1984-85. _Daphnia pulex_, the primary zooplankter consumed by game fish, accounted for 13 percent of the biomass in 1984 and 10 percent in 1985 from May through August. _Daphnia_ biomass peaked in August and November while _Diaptomus_ was high in May June and November. In general, differences in abundance were higher between seasons than areas. Length distributions of _Daphnia_ illustrated that length composition changed seasonally, with more large _Daphnia_ present in late fall and winter. Zooplankton was concentrated in the upper 15-20 m of the water column in the euphotic zone.

The biomass of Diptera larvae in the occasionallydewatered and permanently wetted zones was 6 to 13 times greater than in the zone annually dewatered. Diptera populations recolonized the dewatered zone in the summer and fall.

The distribution of surface insects in the reservoir was temporally patchy. Aquatic Diptera biomass was highest in May, declined during the summer, peaked again in September and October and decreased markedly in November. Terrestrial insect biomass was highest in the late summer and fall, but declined to negligible levels in November. Area differences were small, and there was no significant difference between nearshore and offshore samples.

Terrestrial insects were the most important food item consumed by westslope cutthroat trout, followed by aquatic insects and

zooplankton. Hymenoptera, aquatic Diptera and Daphnia pulex comprised the bulk of the food consumed. Cutthroat were selective for the larger Daphnia pulex, feeding on individuals over 1.5 mm in length. The diet varied seasonally with terrestrials and aquatic insects prevalent in the spring, terrestrials in the summer and fall, and Daphnia pulex in the late fall and winter.

Fish was the principal component of bull trout food habits, constituting over 99 percent of the biomass. Suckers, mountain whitefish and northern squawfish weretheprimary fish species consumed by bull trout. The IRI (Page 46) values overestimated the importance of other food items as compared to fish in the diet of bull trout.

Mountain whitefish ate primarily Daphnia pulex, followed by aquatic Diptera, Epishura and terrestrial insects. Their diet was remarkably uniform with little seasonal change in food consumption.

It was difficult to assess the food habits of northern squawfish because of the high rate of regurgitation. Approximately 55 percent of the stomachs collected were empty. Fish accounted for 90 and 98 percent of the biomass consumed by juvenile and adult trout, respectively. Suckers, mountain whitefish, northern squawfish and bull trout were the primary fish species eaten. Initial analysis of stomachs collected in May, 1985 indicated that squawfish were utilizing cutthroat during this period.

Sampling with horizontal gill nets, purse seines and electrofishing gear indicated that fish distribution was controlled primarily by water temperature and food availability. Substrate composition and shoreline habit didn't appear to influence fish distribution. Cutthroat trout were concentrated in nearshore areas in surface waters when water temperatures were below about 17° C. Cutthroat moved into deeper offshore waters when surface temperature were above 18°C. Bull trout and mountain whitefish had temperature preferences similar to cutthroat, but they were more benthic-oriented species. Northern squawfish preferred warmer temperatures than salmonids. They moved into offshore waters in October when water temperatures declined to below 10-12°C. A movement into nearshore areas occurred in the spring when water temperatures increased to above 10°C. The difference in temperature preferences between salmonids and squawfish resulted in temporal and spatial separation during much of the year, except in the spring and fall.

The spawning run of westslope cutthroat trout into Hungry Horse Creek has declined markedly from a high of 1,160 spawners in 1968 to 370 in 1985. Recruitment of juvenile cutthroat has dropped approximately 50 percent during the same period. Reservoir operation, habitat degradation and angler mortalities appear to be factors which may have influenced these declines.

The catch rate of cutthroat by anglers in the fall also indicated cutthroat populations may have declined in the reservoir during this period,

A total of 794 anglers were contacted during the reservoir creel survey. Westslope cutthroat trout comprised 76 percent of the catch followed by bull trout (15.2 percent) and Mountain whitefish (8.9 percent). The mean catch rate of 0.17 cutthroat per hour of effort was higher than recorded in Libby Reservoir or Flathead Lake. The fall catch rate in HHR, however, was approximately 50 percent of that recorded from 1961-69.

A quantitative model is being developed to predict the impact of reservoir operation upon habitat, primary production, secondary production and gamefish populations. Particulate carbon will be used to track energy flow through trophic levels. The model will consist of a physical framework component within which will run the primary production, secondary production and fish submodels. A growth-driven population dynamics simulation model will be used to estimate impacts of reservoir operation upon population dynamics of cutthroat and rainbow trout. A long term monitoring study (approximately 10 years) is needed to provide data for validation of the models.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of numerous persons associated with the study. Steve Glutting, Gary Michael and Beth Morgan spent many long hours in the field collecting data under adverse conditions and many tedious hours in the laboratory. Beth had overall responsibility for processing collections of fish food organisms, stomach samples, and mounting scales. Steve was responsible for analyzing stream habitat and electrofishing data and wrote the preliminary draft of stream habitat section, of the report. Gary aged fish scales, summarized growth, fish trapping and movement data. He also prepared graphics and wrote the initial draft of the movement section of report. Joe Stewart, Paul Suek and John Wachsmuth were able field hands. They helped collect field data and maintain equipment, boats and vehicles. Chuck Weichler assisted with the processing of zooplankton samples, data entry and data summaries for the food habits and fish food parts of the report. He also wrote several data summary programs. Joann Jones assisted Beth in the lab processing benthos and surface insect samples and mounting scales.

Delano Hanzel assisted in computer work and he and Scott Rumsey aided in the preparation of the boat and barge for purse seining. Joe Huston provided background information on reservoir fish populations and tributary habitat. Dennice Grigg and Jean Blair typed this and other manuscripts. Rich Clark provided data on reservation operation and water levels in Hungry Horse Reservoir. Lloyd Reesman and Bob Anderson (Hungry Horse Ranger District) provided a storage area and allowed us to use the cabins at Anna and Betty Creek.

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INTRODUCTION

The Pacific Northwest Electric Power Planning and Conservation Act, passed in 1980 by Congress, has provided a mechanism which integrates and provides for stable energy planning in the Pacific Northwest. The Act created the Northwest Power Planning Council and charged the Council with developing a comprehensive fish and wildlife program to protect and enhance fish and wildlife impacted by hydroelectric development in the Columbia River Basin. Bonneville Power Administration (BPA) is one of the many agencies implementing the Council's program. The Hungry Horse Reservoir (HHR) study is part of the Council's program.

A maximum drawdown of 85 feet was recommended by Graham et al. (1982) for HHR. This recommendation was subsequently adopted by the Council as part of its fish and wildlife program. The maximum drawdown proposal and timing of drawdown will be reviewed in light of the data generated by this study, proposed changes in operation anticipated due to "water budget" flows and changing power demands in the northwest.

Reservoir operation affects gamefish production by altering the physical environment through changes in reservoir morphometrics such as surface area, water volume, mean depth and shoreline length. Annualdrawdown for flood controlandpower production adversely affects primary productivity (Woods 1982), benthos production (Benson and Hudson 1975), and fish production in reservoirs (Jenkins 1970). Graham et al. (1982) indicated that increased levels of drawdown in HHR from 1965to 1975 adversely affected the growth and survival of westslope cutthroat trout (*Salmo clarki lewisi*).

We hypothesize that reservoir operation may affect the production of gamefish by:

1) Controlling the amount of reservoir area which collects incoming solar energy and terrestrial insects;

2) Controlling the quantity and quality of habitats available to phytoplankton and zooplankton (volume of water) and benthic invertebrates (wetted reservoir bed);

3) Weakening the thermal structure of the reservoir bypassing large inflow and outflow volumes which subsequently reduces zooplankton production;

4) Reducing the availability of food organisms and littoral zone habitat for gamefish species.

OBJECTIVES

This study proposes to quantify seasonal water levels needed to maintain or enhance principal gamefish species in Hungry Horse Reservoir. The specific study objectives are:

1) Quantify the amount of reservoir habitat available at different water level elevations.

2) Estimate recruitment of westslope cutthroat trout juveniles from important spawning and nursery areas.

3) Determine the abundance, growth, distribution and use of available habitat by major game species in the reservoir.

4) Determine the abundance and availability of fish food organisms in the reservoir.

5) Quantify the seasonal use of available food items by major fish species.

6) Develop relationships between reservoir drawdown and reservoir habitat use by fish and fish food organisms,

7) Estimate the impact of reservoir operation on major gamefishspecies.

DESCRIPTION OF THE STUDY AREA

Hungry Horse Dam was completed in 1952 and the reservoir reached full pool elevation of 3,560 feet msl in July 1953. The dam impounded the South Fork of the Flathead River eight km upstream from its confluence with the Flathead River (Figure 1). Hungry Horse is a large storage reservoir, operated by the Bureau of Reclamation, whose primary benefits are flood control and power production. The principal power benefit comes from generation at downstream projects. Water passes through 19 downstream projects, generating approximately 4.6 billion kilowatt hours of energy annually as compared to 1.0 billion at the Hungry Horse project.

The South Fork drains an area of approximately 4,403 km2 on the west side of the Continental Divide in northwestern Montana. The basin is underlain principally by sedimentary rocks. The drainage is almost entirely within lands administered by the U.S. Forest Service with the upper part in the Bob Marshall Wilderness Area.

WATER QUALITY

Water quality data collected during 1978 indicated that Hungry Horse Reservoir was oligotrophic with low nutrient input and primary productivity. Low nutrient concentrations, transparent water and low algal standing crops are related to the basin's geology, comparatively pristine nature of the South Fork watershed and reservoir morphology. Most of the drainage area is underlain by nutrient-poor Precambrian sedimentary rock which is frequently deficient in carbonates and phosphorous (Simons and Rorabaugh 1971).

MORPHOMETRICS

At full pool the reservoir is 56 km in length with an area of 23,800 acres and a volume of 3,468,000 acre-feet. Usable storage for power production starts at elevation 3,336 msland includes 2,982,000 acre-feet which is 86.0 percent of total full pool volume. Maximum drawdown of 224 feet would leave only 14.0 percent of full pool capacity (Table 1). The maximum drawdown on record of 128 ft. in 1972 reduced the volume to 37 percent of full pool. The recommended drawdown of 85 ft. reduces reservoir volume to 53 percent of full pool capacity.

RESERVOIR OPERATION

Reservoir operation has varied considerably since HHR was first filled. Historic operation can be classified into three periods based on average annual maximum drawdown: 1) 1955-64 when drawdown averaged 64 ft., 2) 1965-75 when drawdown averaged 92 ft. and when drawdown for advance power began: and 3) 1976-1984 when drawdown averaged 66 ft. Maximum drawdown has ranged from 31 ft.

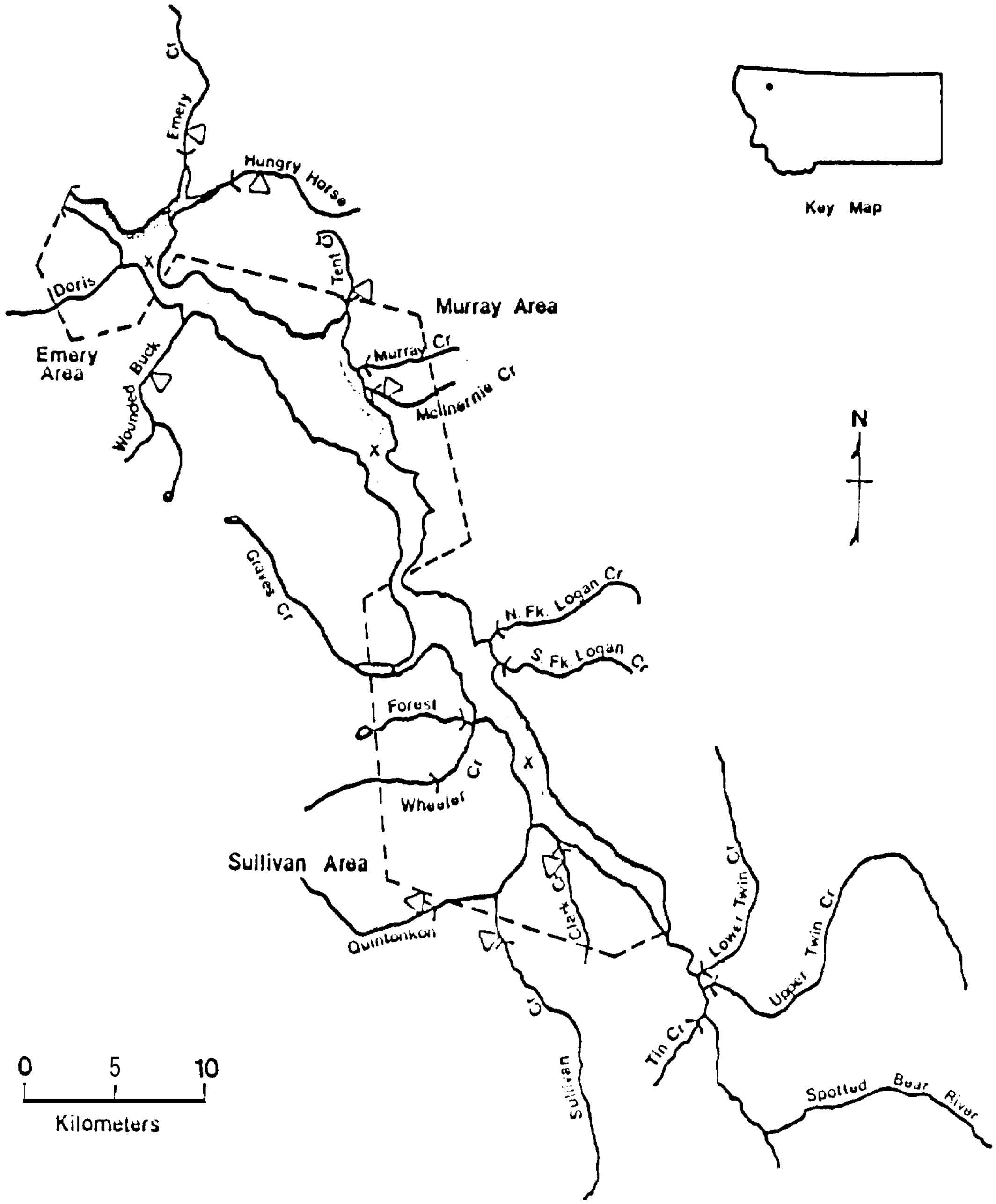


Figure 1. Map of Hungry Horse Reservoir showing study areas, netting areas ( ), water quality, vertical net and zooplankton stations (X), fish trap location (>), and electrofishing sections (A).

Table 1. Morphometric data for Hungry Horse Reservoir.

Drainage area (sq. miles)	1,700 (4,403 sq. km)
Average annual discharge (acre-ft)	2,386,918 (2.95 cubic km)[a]
Surface area (acres)	23,800 (9,632 ha)
Pool length (miles)	35 (56 km)
Shoreline length (miles)	133 (213 km)
Shoreline development	5.95
Mean depth (ft.)	146 (44.5 m)
Storage capacity (acre-f t)	3,468,000 (4.24 cubic km)
Useable storage (acre-ft)	2,982,000 (3.68 cubic km)
Storage ratio	1.45
Elevation at full pool (ft)	3,560 msl (1085.8 m)
Elevation at minimum pool (ft)	3,316 msl (1011.4 m)

[a] Based on unregulated flow from 1929-51.

in 1963 to 128 ft. in 1972, with a mean of 76 ft. (Figure 2). Maximum drawdown has been below the proposed 85-foot level in eight of 30 years of record. Water requirements for fish mitigation efforts and changing power loads may modify reservoir operation in the future.

The operation of HHR is controlled by a combination of interacting factors including: flood control, generation of hydroelectric power, recreational use of the reservoir, resident fish flows for the Flathead River and water budget flows. The reservoir is drafted in the fall to provide advance power for direct service industries. The major evacuation of water, however, occurs from December through March for flood control and power production. The reservoir is usually filled by the end of July and remains at full pool until after Labor Day to provide summer recreation opportunities. Operation is also regulated to provide flows for kokanee spawning and incubation of eggs in the Flathead River downstream from the mouth of the South Fork. From October 15 to December 15, flows in the Flathead River near Columbia Falls are maintained between 3,500-4,500 cfs. A minimum flow of 3,500 cfs is maintained the remainder of the year for incubation of kokanee eggs and for spawning and rearing of other fish species, and aquatic invertebrate production.

FISH SPECIES

Historic Status

Prior to construction of Hungry Horse Dam in 1952, the South Fork Flathead River drainage was considered the major spawning area for adfluvial fish stocks from Flathead Lake. Substantial numbers of bull trout and westslope cutthroat trout spawned in the South Fork drainage along with smaller numbers of mountain whitefish and kokanee salmon (Oncorhynchus Nerka Native fish species in the South Fork drainage prior to dam construction included westslope cutthroat, bull trout (Salvelinus confluentus), mountain whitefish (Prosopium williamsoni), northern squawfish (Ptychocheilus oregonensis), largescale sucker (Catostomus macrocheilus), longnose sucker (Catostomus catostomus), pygmy whitefish (Prosopium coulteri) and sculpins (Cottus sp.).

The native species comprise almost the entire fish population in the reservoir. They are considered abundant except for pygmy whitefish which is rated as rare. (Table 2). Pygmy whitefish may be more abundant than net data indicates, because they are not vulnerable to being caught in shoreline net sets.

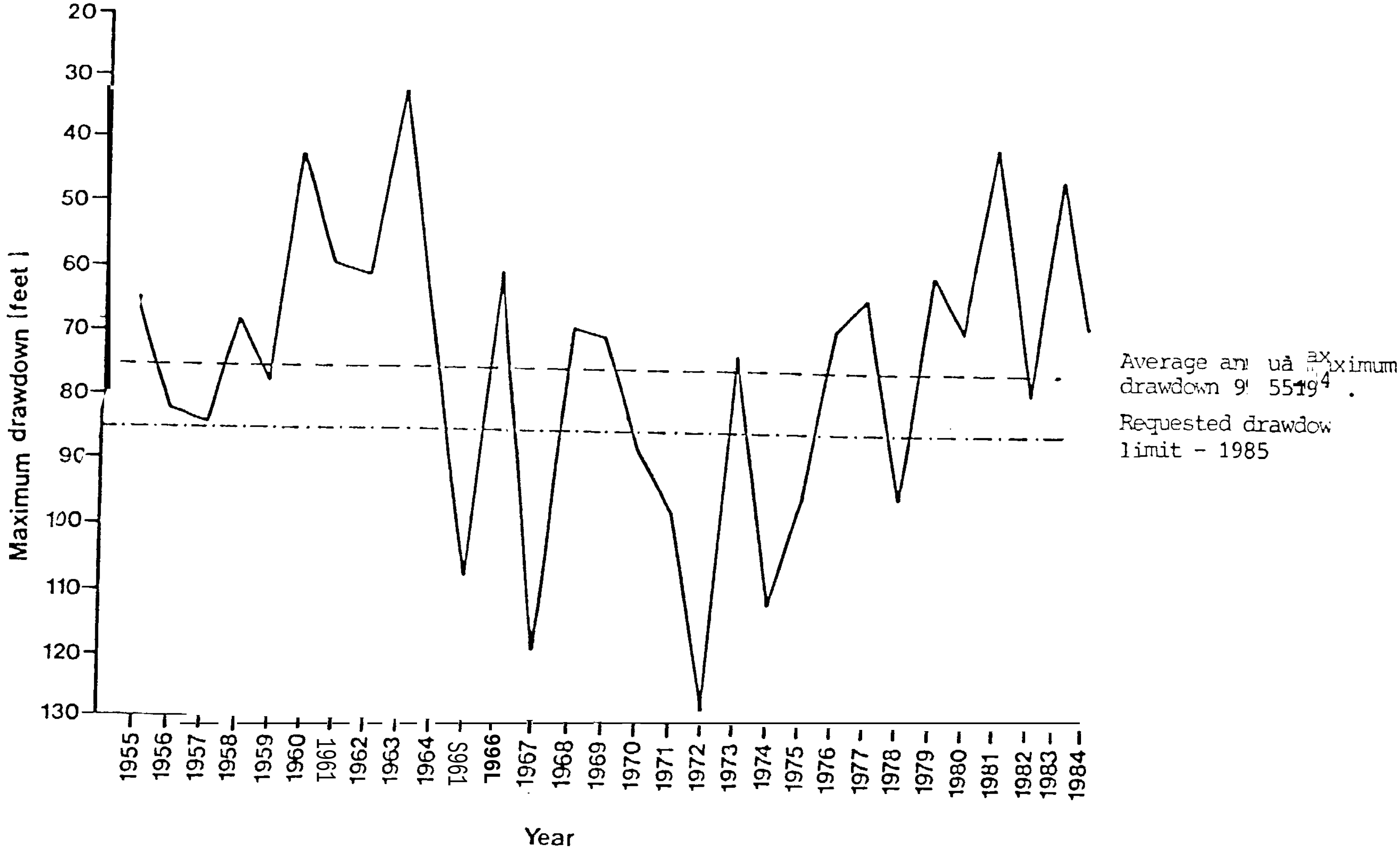


Figure 2. Annual maximum drawdown of Hungry Horse Reservoir for the years 1955-1984 Includes drafting for flood control as well as power production. Reservoir did not fill during 1973 and 1977.

Table 2. The relative abundance of fish species in Hungry Horse Reservoir as determined by gill net catches and creel surveys from 1958 to 1983. Abbreviations are given in parentheses.

Species	Scientific name	Relative abundance[a]
	Native Species	
Westslope cutthroat trout (WCT)	Salmo clarki lewisi	A
Bull trout (DV)	Salvelinus confluentus	A
Mountain whitefish (MWF)	Prosopium williamsoni	A
Pygmy whitefish (PWF)	Prosopium coulteri	R[b]
Northern squawfish (NSQ)	Ptychocheilus oregonensis	A
Largescale sucker (CSU)	Catostomus macrocheilus	A
Long-nose sucker (LnSU)	Catostomus catostomus	A
Sculpin species	Cottus sp.	R
	Exotic Species	
Rainbow trout (RB)	Salmo gairdneri	R
Yellowstone cutthroat trout (YCT)	Salmo lewisi bouvieri	R
Arctic grayling (GR)	Thymallus arcticus	R

[a] Relative abundance: A = abundant, C = common, R = rare.

[b] Pygmy whitefish may be more abundant than net catches indicated because they inhabit deep Offshore waters and are not vulnerable to shoreline net sets.

METHODS

General descriptions of methods used to collect and analyze data are presented in this report. Detailed methods for the Hungry Horse study were given in the 1985 annual report (May and Zubik 1985).

SEASONS

The year was stratified into four seasons based on reservoir operation and surface water temperatures.

1) Winter (mid-November trout April) - when the reservoir is **evacuated** for flood control and power production, surface water temperatures are below 8.0°C and the reservoir is isothermal ;

2) Spring (May and June) - when the reservoir is refilled and surface water temperatures are between 8-15°C and increasing.

3) Summer (July through mid-September) - when the reservoir is near full pool, surface water temperatures are between 16-22°C and the reservoir is thermally stratified.

4) Fall (mid-September through mid-November) - when drafting of the reservoir begins for power production and surface water temperatures are between 8-15gC and declining.

RESERVOIR HABITAT

HHR was segregated into the Emery, Murray and **Sullivan** areas based on reservoir morphometry and the effects of drawdown (Figure 1). Within each of these **study** areas a permanent station was selected for water quality and zooplankton data collection. Vertical fish distribution and benthic macroinvertebrate samples were collected near these permanent sites. In addition to permanent sampling sites, transects were established across the reservoir at visual landmarks where randomly selected zooplankton, surface insect and purse seine samples were collected,

The reservoir habitat was divided into nearshore (littoral) and offshore (limnetic) zones. The littoral zone included the are less than the depth of the euphotic zone (approximately 20 meters) and less than 100 meters from the shoreline.

Contour maps of the reservoir were digitized **by** lo-foot contour intervals for each geographic area.

Monthly lake-fill and hydraulic-residence times were calculated using the formulas adapted from Woods (1982). Lake-filling time represents the time required to replace the volume of a reservoir at a given inflow, whereas hydraulic-residence time represents the time required to replace the volume of a reservoir at a given outflow.

PHYSICAL LIMNOLOGY

Water temperature (°C), dissolved oxygen ($mg \cdot l^{-1}$), pH and specific conductivity (umhos.cm) were measured at the permanent sites. Measurements were taken biweekly from May through October with a Martek Mark V digital water quality analyzer, and monthly from November through march when access to the reservoir was available. The vertical profile data were collected immediately below the water surface, 1, 2, 3, 5, 7, 9, 11, 13, 15, 18, 21 m and every three meters down to 60 m, then every five meters from 60 m to 100 m or the bottom. Calibration of the meter was done in the field from May through October and in the laboratory immediately prior to field measurements from November through March when ambient air temperatures were below freezing.

Light transmittance was measured in foot candles suing a Protomatic photometer. Incident light was measured immediately above the water's surface. Light penetration was measured at depths of 90, 60, 30, 15, 5, 1 and 0.1 percent of the incident light. Greeson et al. (1977) defined the lower boundary of the euphotic zone as the 1.0 percent of incident light depth.

Water temperature, dissolved oxygen, pH, conductivity and light transmittance profile data were entered into computer data files and transferred to the U.S. Geological Survey WATSTORE system and the Environmental Protection Agency STORET system. Isopleth diagrams were generated using a computer program titled STAMPEDE (Woods and Falter 1982). This database will be used in correlation analyses of vertical zooplankton and fish distribution.

FISH FOOD AVAILABILITY

Zooplankton

Zooplankton densities were determined using Wisconsin plankton nets. Three 30-m vertical tows were made biweeklyinthe Emery and **Sullivan** areas and weekly tows were taken in the Murray area from May through November to reduce sampling variability. The Emery area was sampled through the ice in February. In each area samples were collected at the permanent limnological buoy and two randomly selected transects.

Vertical distribution of zooplankton was assessed using a 30-liter plexiglass Schindler plankton trap (Schindler 1969). A plankton trap sample series consisted of duplicate samples collected from the surface and every three meters down to 15 m, then every five meters down to 30 m. Plankton trap sample series were collected monthly in the three areas at the permanent limnological buoys.

Standard laboratory procedures were used to process the zooplankton samples. Five l.O-ml subsamples of each zooplankton sample were counted and the plankters identified to genus (Daphnia, Leptodora, Bosmina, diaptomus, Epischura and Cyclops) except for Daphnia pulex. The l.O-ml random subsamples were used to measure a representative sample of carpace lengths from each taxon. Biomass of zooplankton was calculated using length-weight regressions in Bottrell et al. (1976).

Surface Insects

Surface insects were collected with a net attached to a one-meter wide frame with a removable plexiglass bucket. Three randomly selected sites were sampled in each area biweekly from May through November. One tow was made within 100 m of the shore and one further than 100 m from shore. Each collection sampled approximately 600 m^2 of water surface. All insects were identified to order and weighed in the laboratory.

Benthos

Benthos collections were made monthly from May through November using a Peterson dredge which sampled 0.092 sq. meters of reservoir bottom. Three replicate samples were taken from each of the following depth intervals for a total of nine samples: 1) full pool elevation (3,560 ft.) to recommended drawdown elevation of 3,475 feet; 2) recommended drawdown to maximum drawdown on record at elevation 3,432 feet; and 3) below elevation 3,432 feet.

All macroinvertebrates were sorted from the samples, identified to order or class and weighed.

FOOD HABITS

Fish for food habits analysis were collected with gill nets from each area of the reservoir during the seasonal gill net series. Approximately twenty each of westslope cutthroat, bull trout, and northern squawfish and six mountain whitefish were collected from each area seasonally. The annual total for the entire reservoir was approximately 240 each for cutthroat, bull trout, and northern squawfish; and 72 mountain whitefish.

Zooplankton were identified to genus, insects to order and fish to species. The number, frequency of occurrence, and weight of each food item was calculated and combined into an index for relative importance (IRI). The IRI values range from 0 to 100, with a value of 100 indicating exclusive use of the food item.

FISH ABUNDANCE AND DISTRIBUTION

Horizontal Gill Nets

Standard experimental floating and sinking gill nets were used to sample fish in near-shore areas seasonally in each area. A floating net set consisted of two floating nets tied end to end (double floater) and fished perpendicular from shore. A sinking net consisted of a single net fished perpendicular from shore. In each area, seven double floaters and five sinkers were set in the evening and retrieved the next morning (Figure 1).

All fish were removed from the nets, identified to species, and length (mm) and weight (g) was recorded for each fish. Sex and state of sexual maturity (ripe, spent, mature, immature) were recorded for gamefish. Scale samples were taken from all gamefish and representative numbers from nongame fish. Otoliths were collected from westslope cutthroat trout beginning in December, 1984.

Purse seining

A 183 m long by 9.1 m deep purse seine was used to collect fish in the spring of 1985 in the Sullivan area. A total of 50 randomly selected purse seine hauls were conducted from May 6 - May 17. All fish caught were anesthesized, measured, weighed, tagged or marked and released.

Electrofishing

Near-shore zones, in the Sullivan area, were sampled in the spring to determine the utilization of this habitat by westslope cutthroat trout juveniles and capture adults for the tagging effort. Sampling was done at night using an electrofishing boat with boom mounted electrodes. Pulsed direct-current of approximately three amps and 200 volts was used to collect fish from shoreline areas less than 2 meters in depth.

Fish Trapping

A downstream fishtrapand leads covered with 6.4 mm square mesh hardware cloth was fished in Emery Creek (Figure 1). An upstream and downstream trap was operated in Hungry Horse Creek. Traps were checked twice daily and all fish were removed, anesthesized, measured and weighed. Species, length, weight, tag number and tag type were recorded for each fish. All fish longer than 250 mm were tagged with numbered anchor tags and fish 100 to 250 mm in length were tagged with numbered dangler tags. Scales were taken for age determination from representative samples of fish from each stream.

FISH MOVEMENT PATTERNS

Westslope cutthroat trout adults were tagged with Floy anchor tags and the juveniles were tagged with Floy dangler tags. Fish were captured with electrofishing gear, purse seine and gill nets in the reservoir, whereas fish traps and angling were used to collect cutthroat in reservoir tributaries and the South Fork of the Flathead River. Tag returns were provided by voluntary angler returns, creel census interviews and fish sampling activities in the reservoir and tributary streams.

GAMEFISH GROWTH

Total body length of cutthroat, bull trout and mountain whitefish collected during the study was measured to the nearest milimeter. Body weight was determined to the nearest gram for fish weighing less than 500 grams. Scales were taken from an area just above the lateral line along an imaginary line drawn between the posterior insertion of the dorsal fin and the anterior insertion of the anal fin. Otolith bones were removed from cutthroat trout and stored in envelopes in a dry state. Otoliths were aged by Dr. Ed Brothers to determine growth during the first year that the fish resided in the reservoir.

Cellulose acetate impressions of scales were examined using microfiche readers. Distances from the focus to annuli were measured to the nearest millimeter using transparent plastic rules and recorded directly onto computer coding sheets.

Age and growth information was analyzed using the FIRE 1 computer program described by Hesse (1977) and the AGEMAT program devised by MDFWP personnel. Body length-scale radius relationships are most accurately described using log-log plots constructed from pooled samples of tributary and lake fish. Condition factors were calculated as $(W \times 10^5)/L^3$, where "W" equaled weight in grams and "L" equaled total fish length in millimeters.

CREEL CENSUS

A partial creel census was conducted on Hungry Horse Reservoir from May through October. Anglers were interviewed at checking stations established at the west abutment of the dam and at the junction of the east side road (FS38) and Desert Mountain road (FS590). The east side station was used exclusively in May and June because the only low-water boat ramp was located on the eastside at Abbot Bay. From July through October each checking station was used on alternate census days.

All weekend and holiday days were sampled, plus one weekday per week. A census day began at 10:00 am and continued until sunset .

Creel clerks interviewed fishermen on a party basis with emphasis on the collection of complete trip interviews. Creel data collected included: 1) area of reservoir fished, 2) number of anglers in party, 3) total hours fished, 4) type of lure or bait used, 5) angler origin, 6) whether fishing was from shore or boat, 7) was fishing trip, incomplete or complete, and 8) species of fish sought, and 9) number of each species caught. In addition, total lengths in mm and weight in grams were taken on all gamefish, scales collected from westslope cutthroat trout and tag returns recorded.

Data obtained from interviews were recorded directly on coding forms and entered into the computer. Monthly, seasonal and overall catch rates were calculated by dividing the number of fish caught by the total hours fished.

TRIBUTARY HABITAT

Habitat Surveys

Habitat surveys were conducted on tributaries of HHR to evaluate spawning and rearing habitat available to adfluvial cutthroat and bull trout.

Streams were divided into reaches according to valley characteristics, stream gradient and stream order. Exact lengths and gradients were calculated for each reach using a Numonic 2400 Digittablet provided by the Flathead National Forest Service.

For each reach surveyed, a two-member survey crew walked the entire reach and recorded the following: 1) square meters of spawning gravel, 2) locations of bank instability, 3) location of barriers, 4) stream pattern, 5) flow character, 6) width of valley flat, 7) turbidity, 8) stage and 9) number of class I, II, and III pools according to the classification system used by Graham et al. (1980).

In addition, a more intensive habitat survey was conducted in a representative section within each reach which consisted of 30 random transects, one-meter wide across the stream. The information collected at each transect was recorded on stream survey data sheets.

Stream reaches that were considered too steep or too small to support an adfluvial fish population were not surveyed. Furthermore, when obvious natural barriers to fish migration were encountered, stream surveys were discontinued.

Culvert Evaluations

Fish passage was evaluated at culverts installed in streams crossing the main road around the reservoir. Flow and velocity measurements were taken weekly during the spawning run of westslope cutthroat trout. Length and diameter of culvert, depth of jump pool and height of jump into culvert from the pool was also recorded. Visual observations of fish passage attempts were noted.

TRIBUTARY FISH POPULATIONS

Population Estimates

Population estimates were obtained on seven streams in 1983 and three in 1985 (Figure 1) to determine fish abundance. The two-pass procedure (Zippin 1956) was used to make estimates in streams with flowslessthatabout 10-15 cfs. For streams with higher flows the mark-and-recapture method was utilized (Vincent 1971). The section length for the mark-recapture estimate was 300 m as compared to 150 m for the two-pass method. In general, methods outlined by Shepard and Graham (1983a) were used.

RESULTS AND DISCUSSION

RESERVOIR HABITAT

Operation of the reservoir has large impacts upon the habitat of fish food organisms and fish (Figures 3 and 4). The annual drawdown and refill cycle causes large changes in surface area, water volume and shoreline development. The amount of littoral area varies with the reservoir elevation along with volume in the euphotic zone, volume in preferred temperature ranges for zooplankton and fish growth, and area of reservoir bottom dewatered. The reservoir basin has been digitized by ten Foot contour intervals. These data have been plotted and are in the process of being verified. It will be incorporated in the physical framework fishery model being developed by Dr. Goodman (See Modeling Section). The physical framework model will predict the value of the parameters discussed above at various reservoir elevations.

The thermal structure of Libby Reservoir is also influenced by the large seasonal inflow and outlfow volumes (Woods 1982). Mayhew (1977) found that hydraulic residence times appear to influence zooplankton production by reducing thermal stability. Hydraulic-residence times of below one year were associated with reduced zooplankton populations. Increased flushing rates resulted in cooler water temperatures and a corresponding linear decrease in zooplankton populations.

Annual hydraulic-residence times in HHR vary considerably from year to year (Table 3) but are generally above one. The monthly, residence times, however, were below one during 16 months from 1983-85. The variance in retention times is influenced largely by reservoir operation (Figure 5). Maximum drawdown during this study has ranged from 45 feet in 1983 to 85 feet in 1985. The reservoir was held at full pool for almost eight weeks in 1983 as compared to about one week in 1985. The stream flows were below average in the summer throughout the Columbia Basin in 1985 which resulted in the storage reservoirs being drafted to meet firm power loads.

Physical shoreline habitat and reservoir substrate appear to have little direct influence on the distribution of westslope cutthroat trout. Trout in lentic environments are forced to actively seek food concentrations. Consequently there are no positive energy benefits accrued from occupying a feeding station as there is in lotic habits (Bachman 1984). Cutthroat in HHR appear to partition their time between an environment with preferred temperatures and an environment with abundant food. The fish make forays for food into water with higher than perferred temperature, but feeding behavior doesn't override thermal preferences.

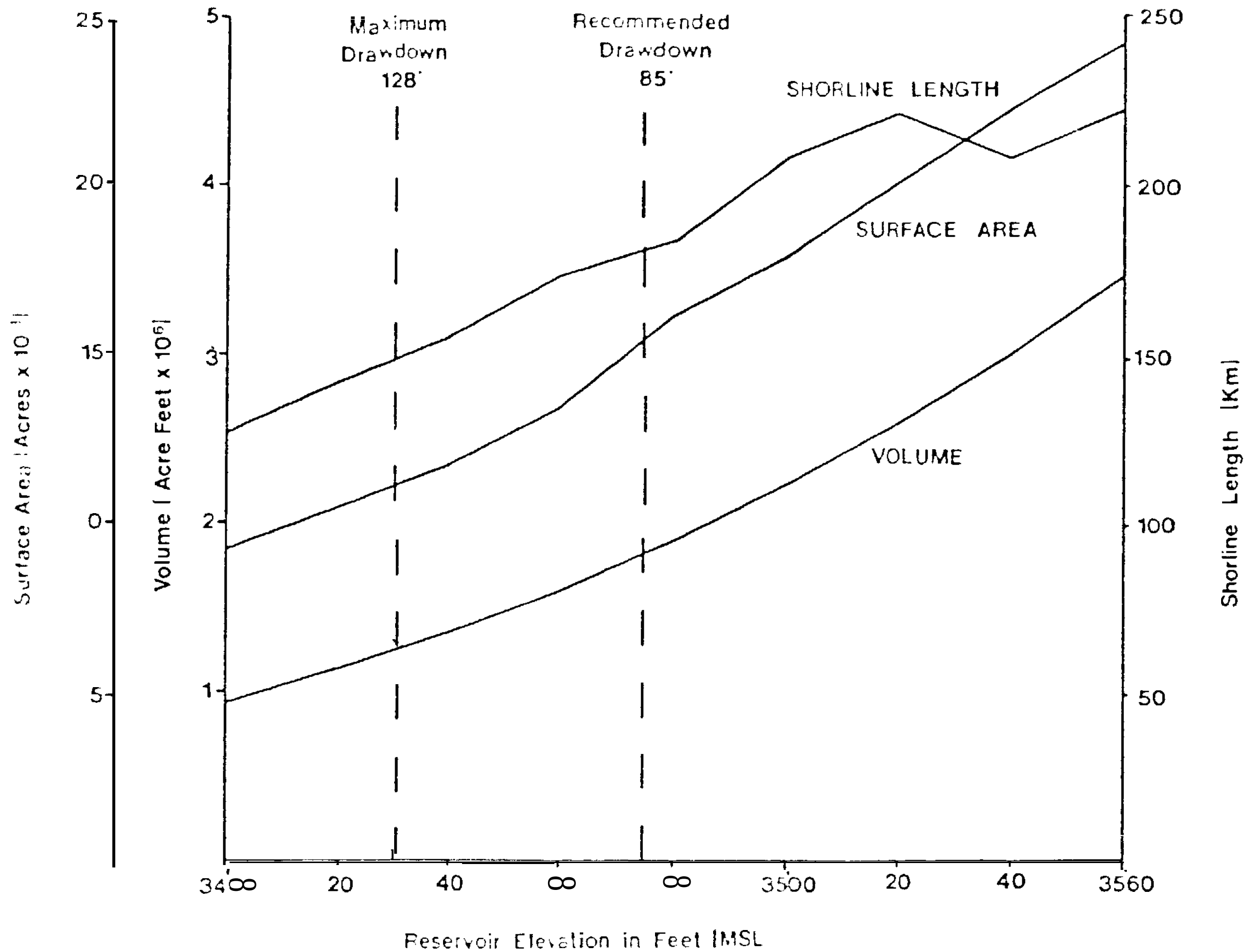


Figure 3 The relationship of reservoir elevation to surface area, volume and shoreline length of Hungry Horse Reservoir

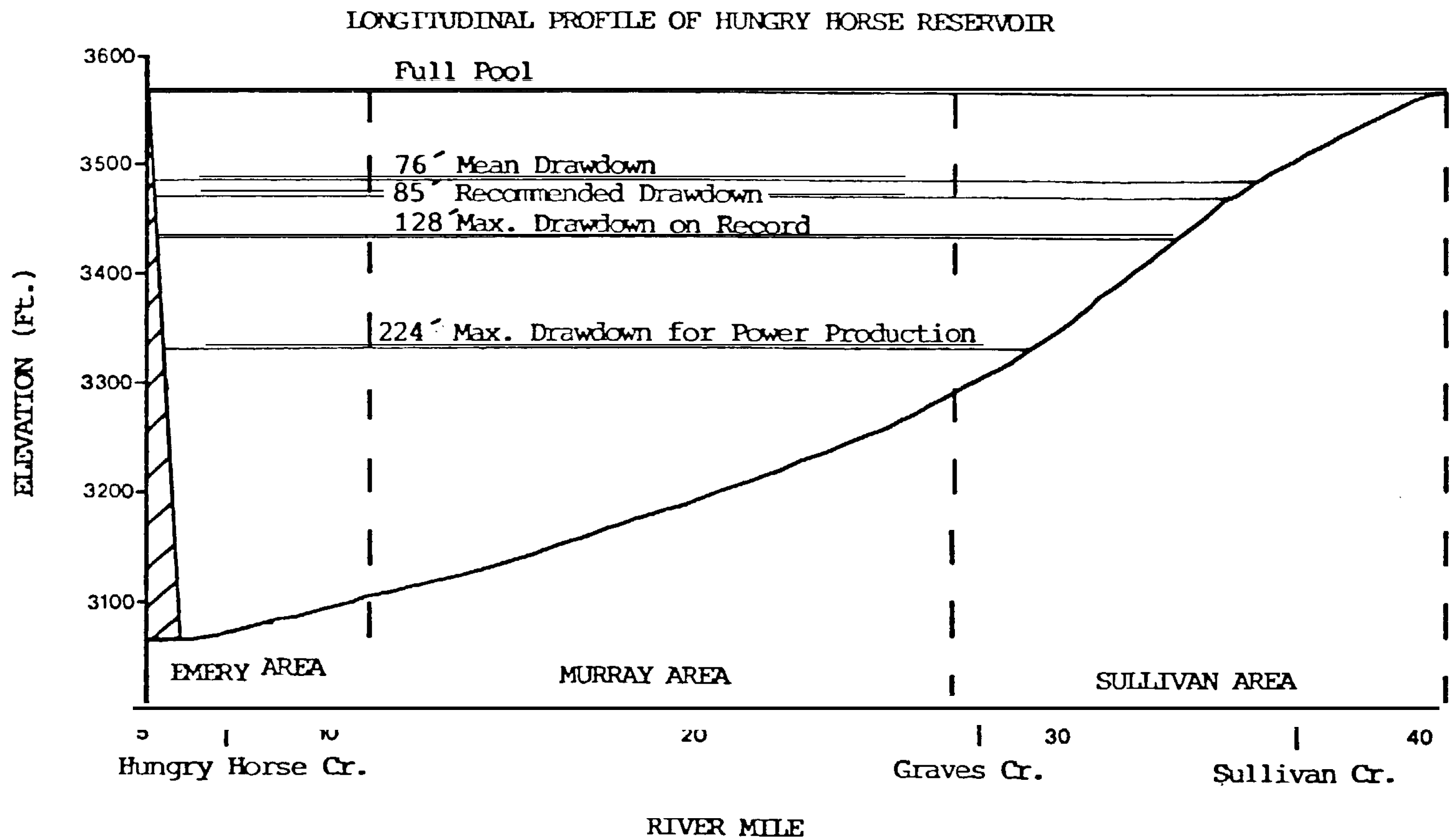


Figure 4. Longitudinal cross-sectional profile of Hungry Horse Reservoir at water surface elevations of 3,560 (full pool), 3,484; 3,475; 3,432 and 3,336.

Table 3. Monthly lake-filling and hydraulic residence times Eor low (1973) median (1980) and high (1974) water years in Hungry Horse Reservoir and for 1983-85.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual mean	Maximum drawdown (ft)	Cumulative discharge (AF)
							Lake-Filling Time (years)								
1973	3.02	5.75	2.97	1.26	0.33	0.47	2.05	5.29	7.28	5.24	1.65	2.13	3.12	63	1,871,000
1974	1.12	2.37	1.62	0.38	0.22	0.16	0.64	3.03	5.31	6.59	4.20	4.53	2.51	111	3,574,000
1980	5.54	5.47	3.99	0.50	0.30	0.59	1.86	4.47	3.79	5.43	3.08	1.40	3.04	69	2,351,000
1983	3.87	4.88	2.41	1.05	0.35	0.47	0.97	3.67	5.40	4.27	2.57	4.55	2.07	45	2,872,300
1904	1.98	3.50	2.31	0.73	0.37	0.34	1.34	4.60	4.61	3.89	3.58	4.38	2.64	68	2,202,900
1985	5.35	4.67	3.51	0.51	0.22	0.48	2.62	3.86	1.19	1.13	1.11	3.23	2.32	85	2,928,110
							Hydraulic Residence-Time (years)								
1973	0.62	0.57	1.94	1.53	4.14	26.21	1.14	0.87	7.23	0.89	1.54	4.18	4.24		
1974	0.74	0.54	0.36	0.21	0.82	1.47	0.87	2.15	1.15	0.70	0.47	0.57	0.84		
1980	3.92	6.31	11.99	16.81	14.37	1.03	2.11	2.19	1.18	1.89	1.25	0.72	5.31		
1983	1.15	0.88	1.03	0.54	0.87	4.92	1.08	2.58	0.80	0.79	3.73	0.71	1.59		
1384	1.02	0.59	0.77	1.92	1.24	3.50	8.39	1.38	1.03	1.27	2.22	0.80	2.06		
1985	0.54	0.53	0.62	3.66	13.00	1.88	0.96	0.58	0.62	0.97	6.41	0.66	2.54		

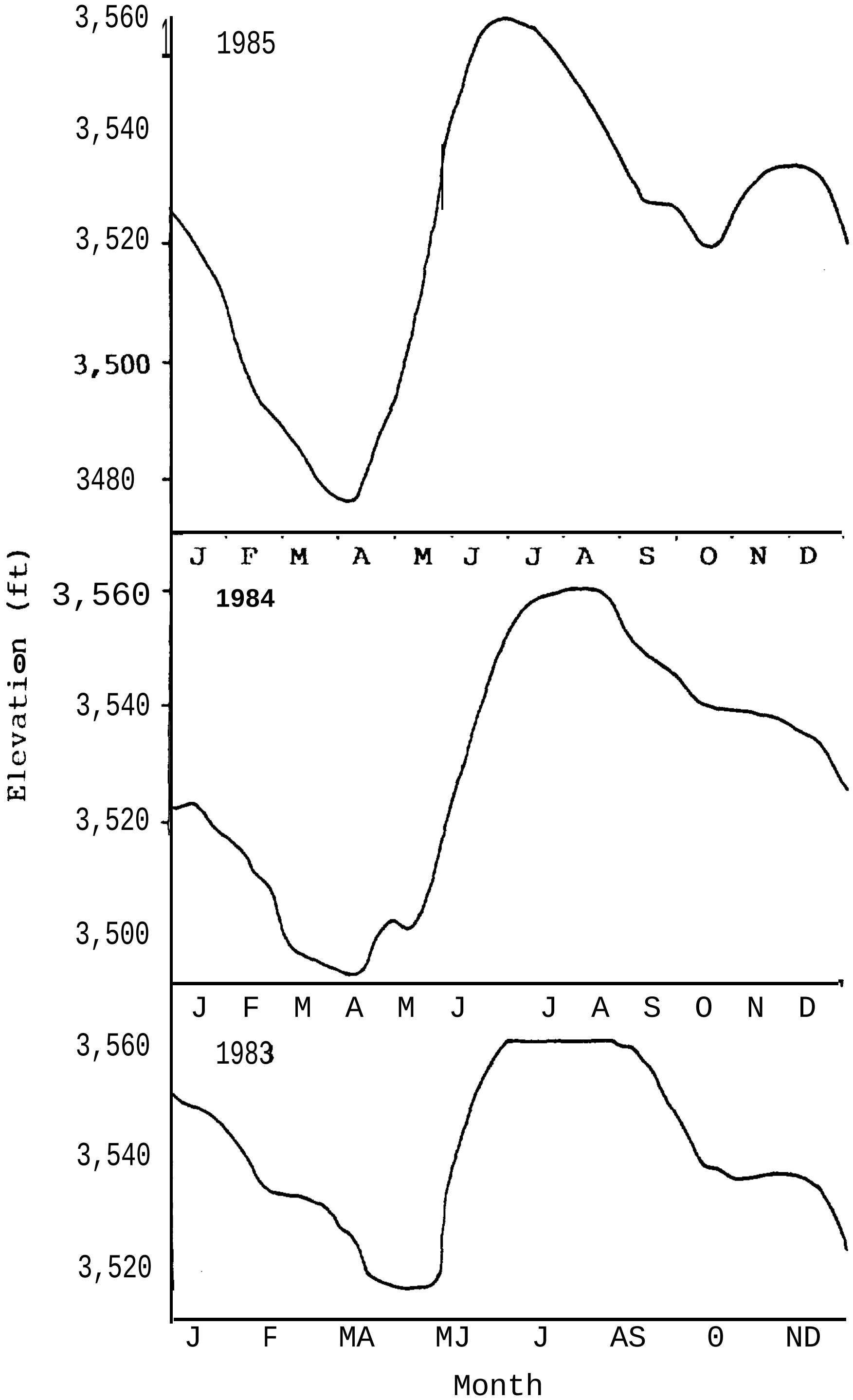


Figure 5. Reservoir elevations in Hungry Horse Reservoir from 1983-85.

PHYSICAL LIMNOLOGY

Temperature

Surface water temperatures ranged from 0.0° to 23.0° during 1985 (Figures 6, 7, and 8). Ice formation generally began in the upper part of the reservoir in late December and the entire reservoir was usually ice covered by mid-January. Ice-out in 1985 occurred sometime during the last week of April. Thermal stratification in 1985 occurred about the first week of June and continued through September. The reservoir is generally isothermal during the winter and spring. The preferred temperature range of 10-16°C for cutthroat trout (Hickman and Raleigh 1982) is depicted in Figure 6, 7 and 8. The water volume encompassingthesetemperatures was greatest in the spring and fall.

Dissolved Oxygen

The dissolved oxygen levels in HHR have been above the optimal levels of 7 mg/liter (Hickman and Raleigh 1982) required by cutthroat and shouldhavelittle impact on fish distribution. The levels which have been in the 8-10 mg/liter (Appendix A) range are adequate to sustain healthy aquatic life (Davis 1975).

pH and Specific Conductance

The pH values in HHR ranged from 7.4 to 8.9 with values in the 7.8 - 8.5 range most common (Appendix A). These values are within the range recommended for the protection of aquatic life (Thurston et al. 1972) and for cutthroat trout (Hickman and Raleigh 1982, and Sekulich 1974). Specific conductance measurements in HHR ranged between 110-150 umhos/om (Appendix A). These values were on the lower end of a productivity scale described in McKee and Wolf (1963).

Euphotic Zone

The depth of the euphotic zone varied seasonally and among the geographic areas in 1984 and 1985 (Figure 9). The seasonal variation was largely due to changes in the amount of incident light reflected at the water surface as the angle of the sun changes from perpendicular (Wetzel 1975). Wave action also reflects incident light at the water surface, and sediment input during run-off was responsible for rapid attenuation of light transmission. The euphotic zone of 2.5 to 22.0 mm tended to be deeper than recorded in Libby Reservoir (Shepard 1985). Runoff from the South Fork of the Flathead River, carrying large quantities of sediment, was responsible for shallow euphotic zone depths in the Sullivan area from April through June.

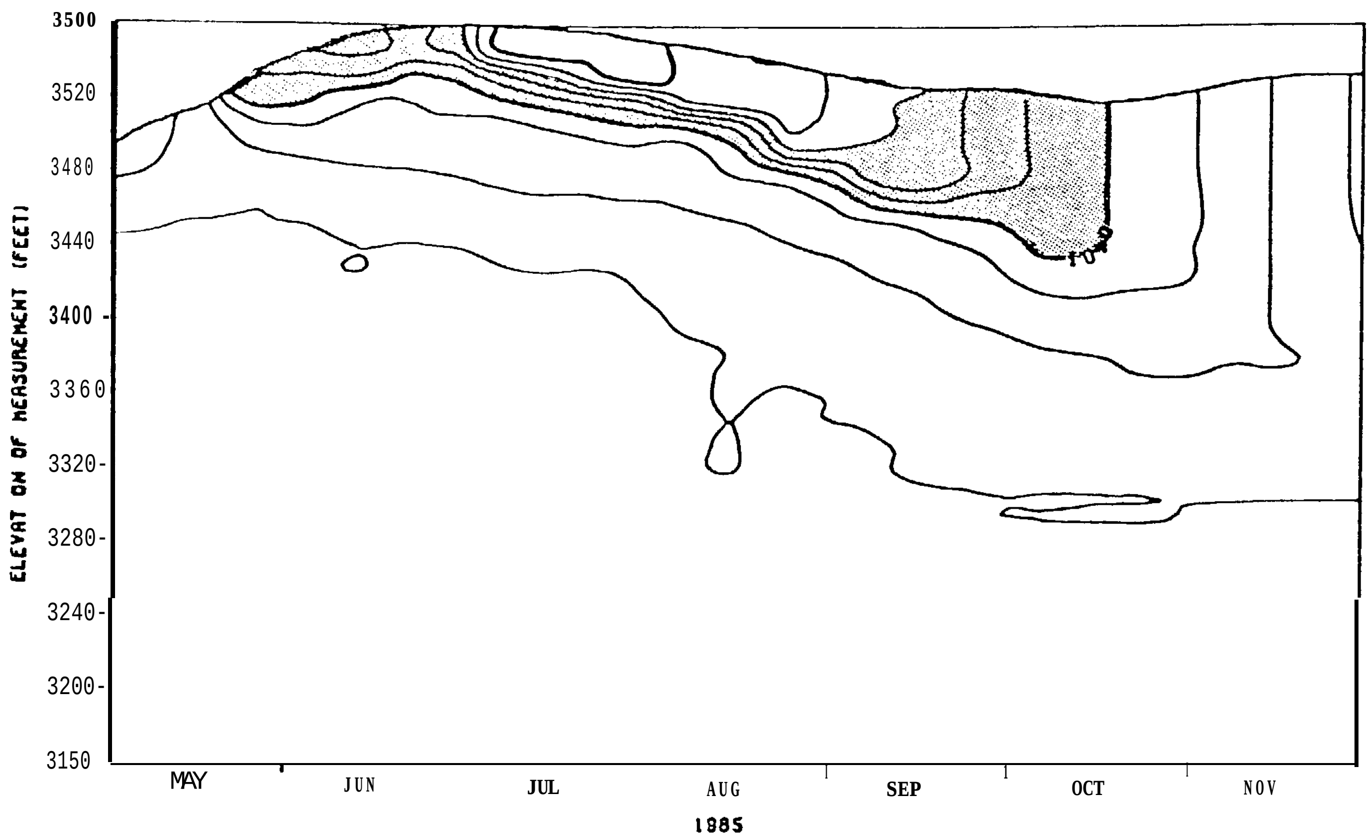


Figure 6. Isopleths of water temperature (2°C) from the Emery Station, Hungry Horse Reservoir, 1985. Shaded areas are the preferred temperature strata for cutthroat trout (10°-16°C).

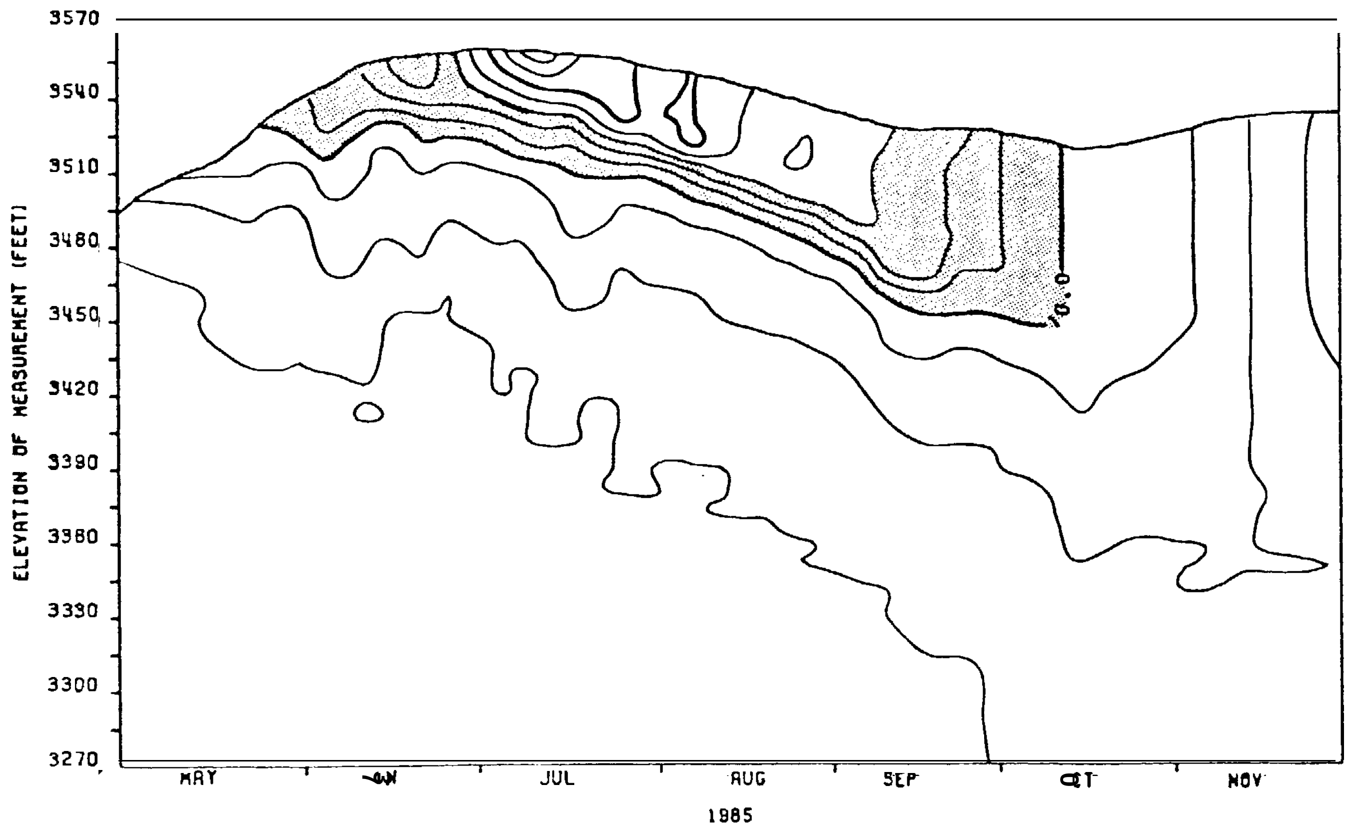


Figure 7. Isopleths of water temperature (2°c) from the Murray Station, Hungry Horse Reservoir, 1985. Shaded areas are preferred temperature strata for cutthroat trout (10°-16°c).

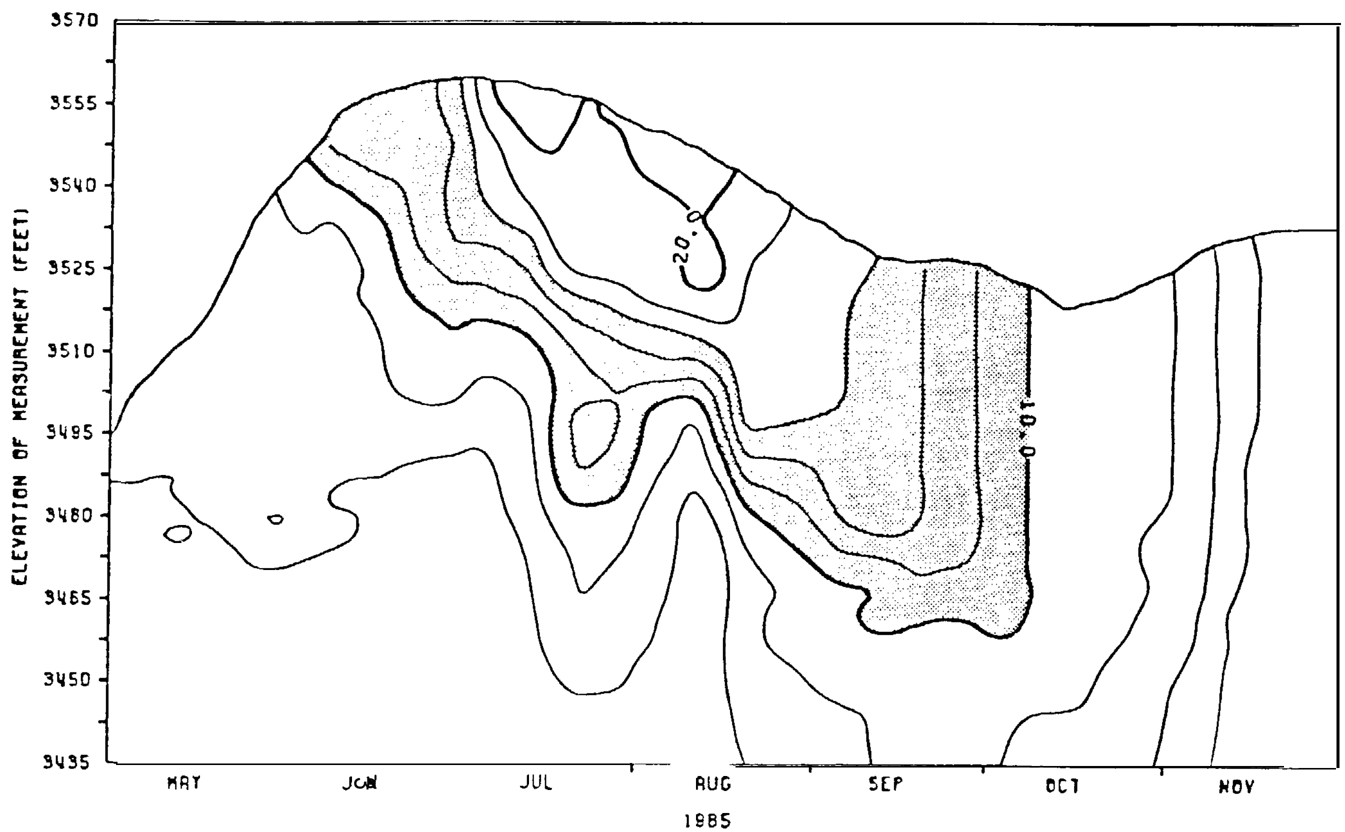
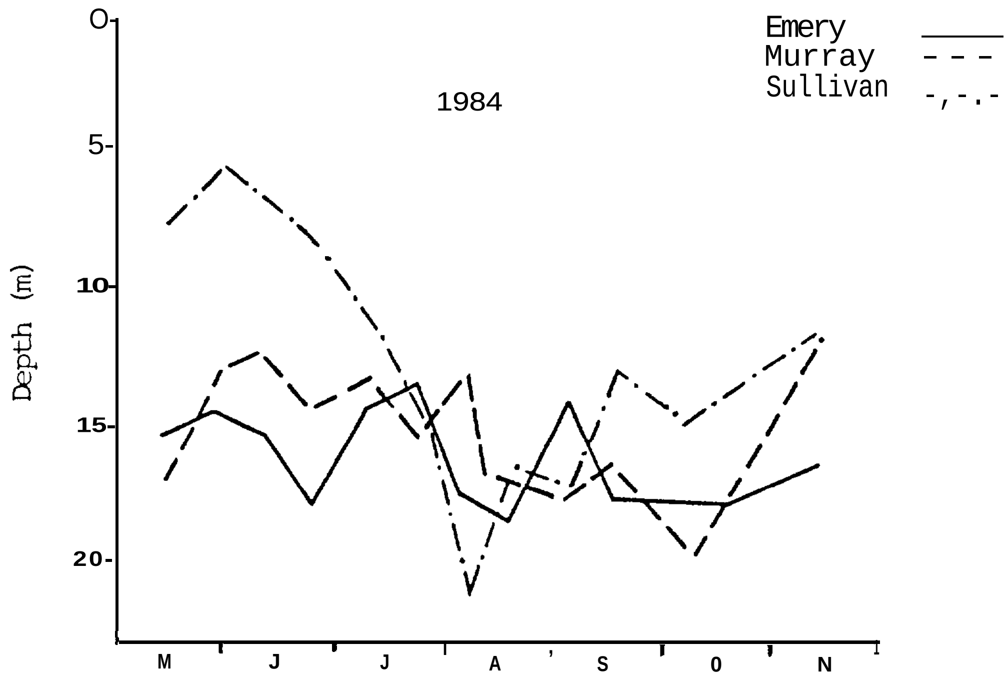


Figure 8. Isopleths of water temperature (2°c) from the Sullivan station, Hungry Horse Reservoir 1985. Shaded areas are preferred temperature strata for cutthroat trout (10°-16°c).



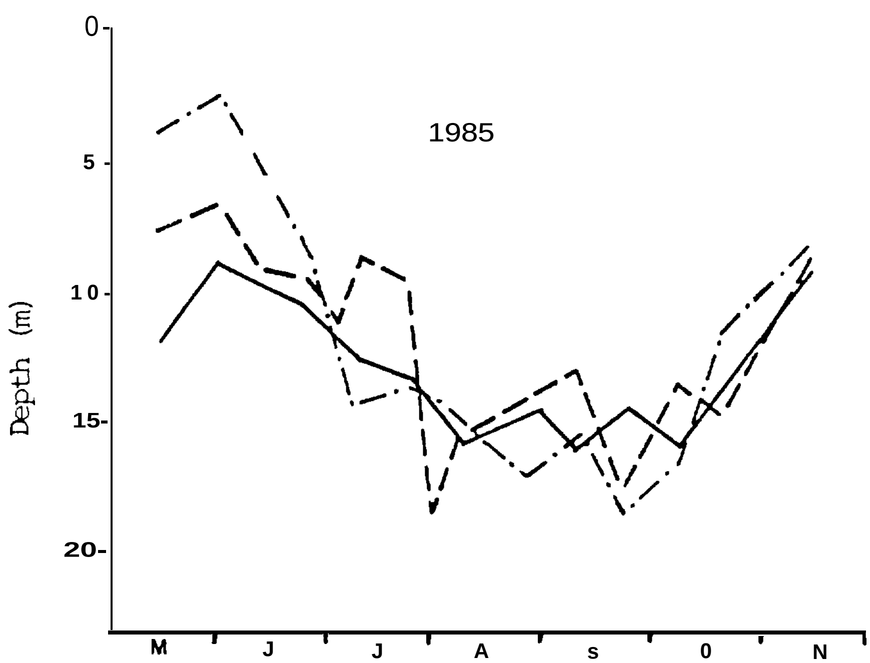


Figure 9. Euphotic zone depth in Hungry Horse Reservoir, 1984 and 1985.

FISH FOOD AVAILABILITY

Zooplankton

Standing Crop

The zooplankton community was dominated by Daohnia, Diaptomus and Cyclops (Figure 10). They comprised 93 and 90 percent of the biomass in 1984 and 1985, respectively (Appendix Bl-B8). Bosmina, Epischura and Leptodora contributed the remainder of the biomass to the annual total. Daphnia pulex, the primary zooplankter consumed by game fish, accounted for 13 percent of the biomass in 1984 and 10 percent in 1985 from May through August.

The seasonal progression in zooplankton abundance changes from year to year depending primarily upon water temperatures and food availability (Martin et al. 1981). Daphnia biomass in 1984 was low in the spring, increased to a peak of 220 $mg.m^{-3}$ in August, declined to 51 $mg.m^{-3}$ in September and increased in November, before declining again in December (Figure 10). Daphnia pulex abundance followed closely that recorded by Daphnia. Daphnia populations in 1985 were low in the spring and increased throughout the summer to 321 $mg.m^{-3}$ in August. During 1984, Diaptomus biomass was high in the spring, declined in the summer, increased in the fall to a high of 96 $mg.m^{-3}$, then declined in December. Cyclops abundance was highest from September through November and declined markedly in December. A similar pattern of abundance occurred in the spring and summer of 1985.

In general, differences in abundance were less between the areas than the differences between the seasons (Figures 11, 12, 13). Seasonal progression of zooplankton populations in the Sullivan area tended to lag behind the other two areas due to low water temperatures and high sediment input from the South Fork of the Flathead River during spring run-off. Leathe and Graham (1982) found no significant interstation differences in zooplankters in Flathead Lake.

Lengths

Length distributions of Daohnia pulex, the primary zooplankter eaten by gamefish, exhibited considerable seasonal variation (Figure 14 and 15). Larger Daphnia pulex (>l.5 mm) were most abundant in April, May and December. During December, 93 percent of the Daphnia pulex were larger than 1.5 mm in length and 58 percent were greater than 2.0 mm (Appendix B9). Even though Daphnia pulex populations declined in December, almost the entire population was in the larger size groups which are utilized by cutthroat and mountain whitefish. Little difference occurred in length frequency distributions between the Emery and Murray area. The Sullivan area population in April, May and November had more individuals larger than 1.5 mm in length than the other two areas.

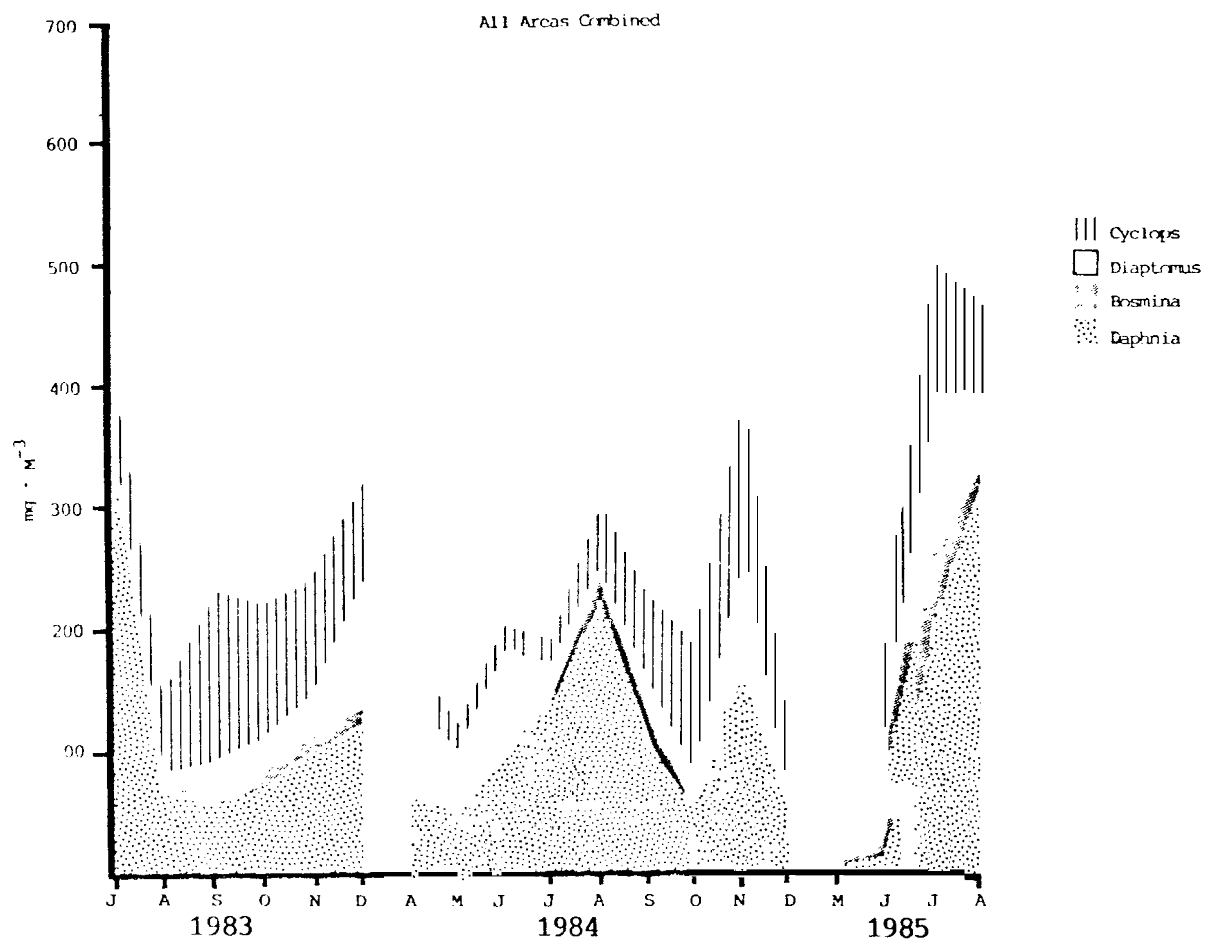


Figure 10. Seasonal biomass (mg · M^{-3}) of the four most abundant genera of zooplankton averaged for all three areas from July, 1983 through August, 1985. Based on 30m vertical tow samples from Hungry Horse Reservoir.

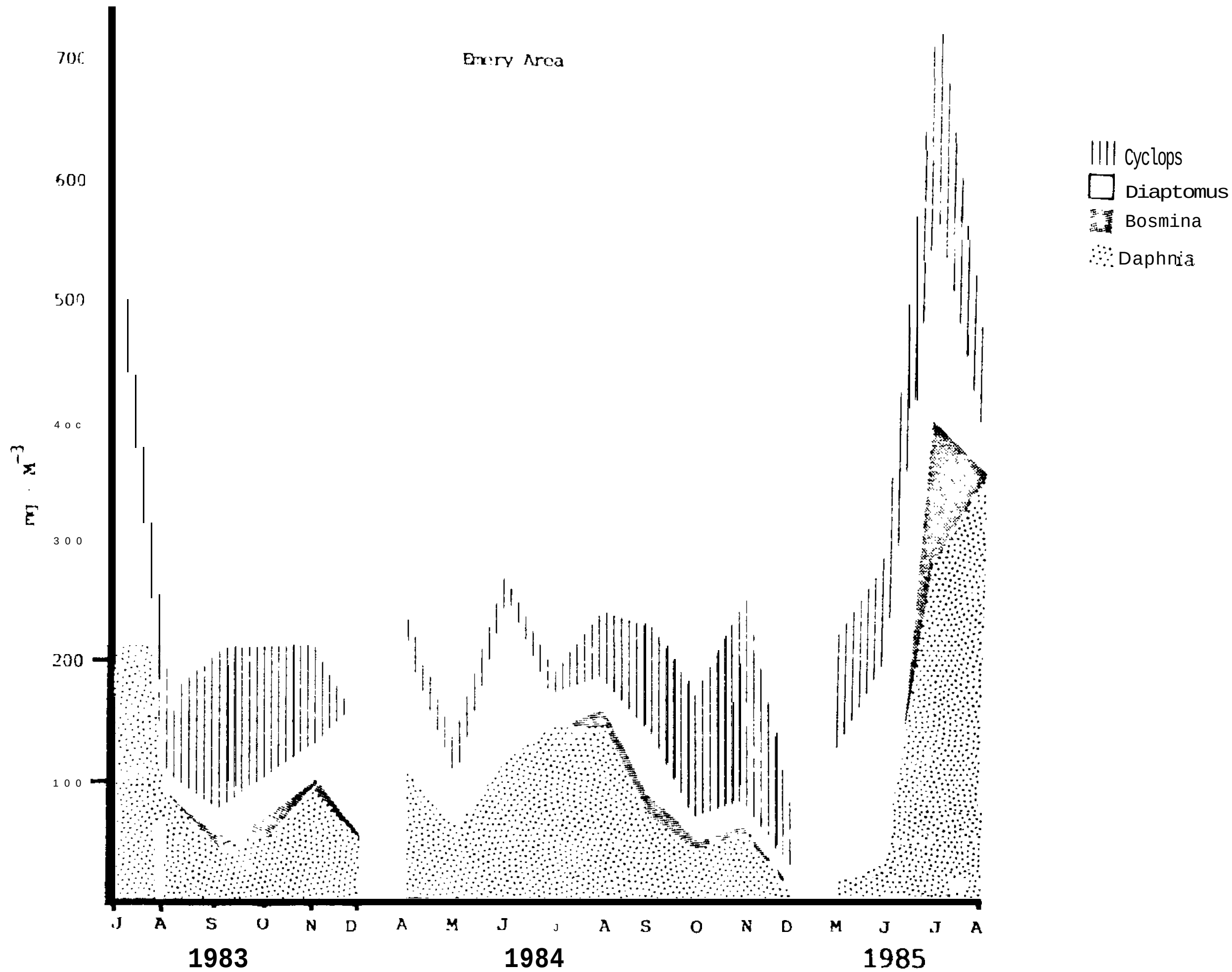


Figure 11. Seasonal biomass (mg · M^{-3}) of the four most abundant genera of zooplankton in the Emery area from July, 1983 through August, 1985. Based on 30m vertical tow samples from Hungry Horse Reservoir.

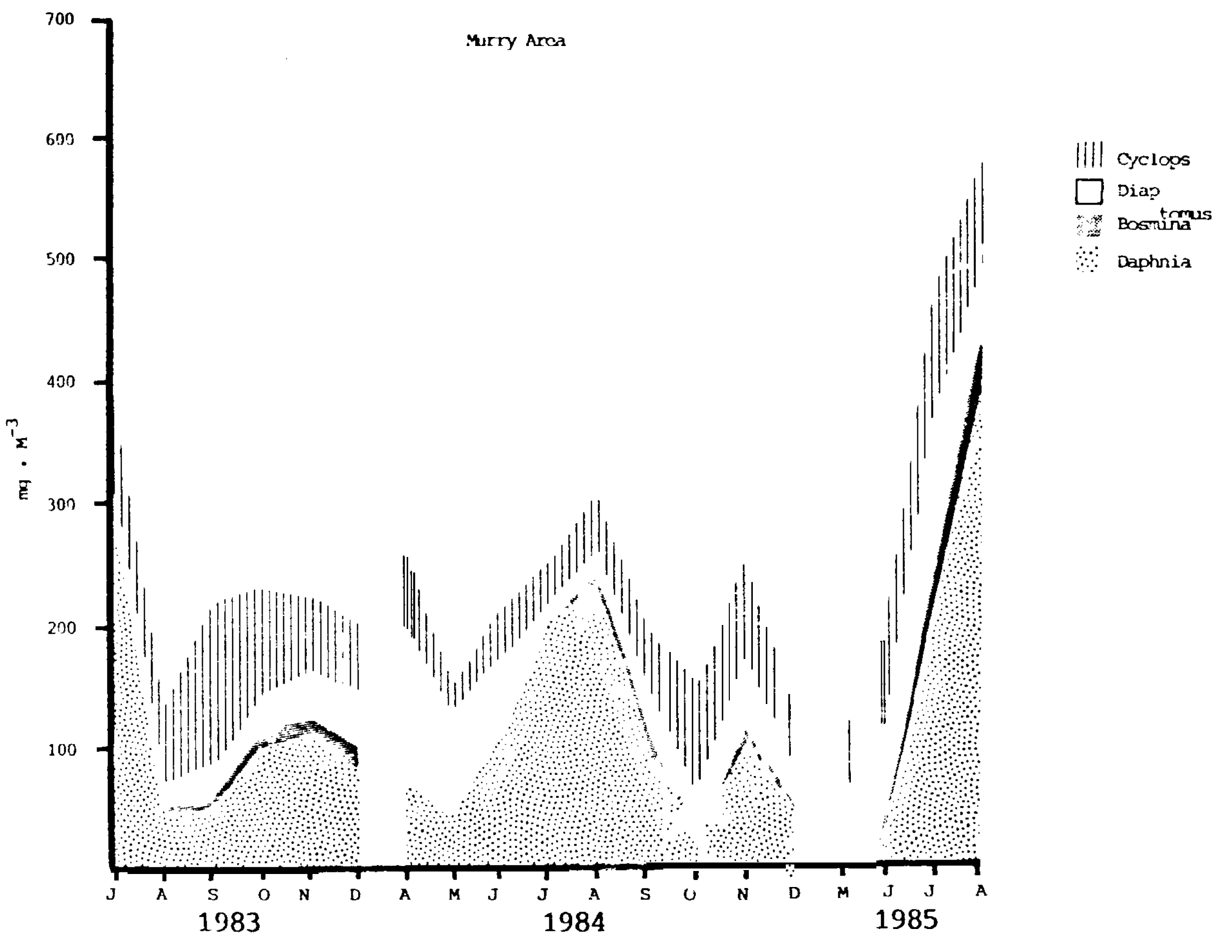


Figure 12. Seasonal biomass (mg · M^{-3}) of the four most abundant genera of zooplankton in the Murry area from July, 1983 through August, 1985. Based on 30m vertical tow samples from Hungry Horse Reservoir.

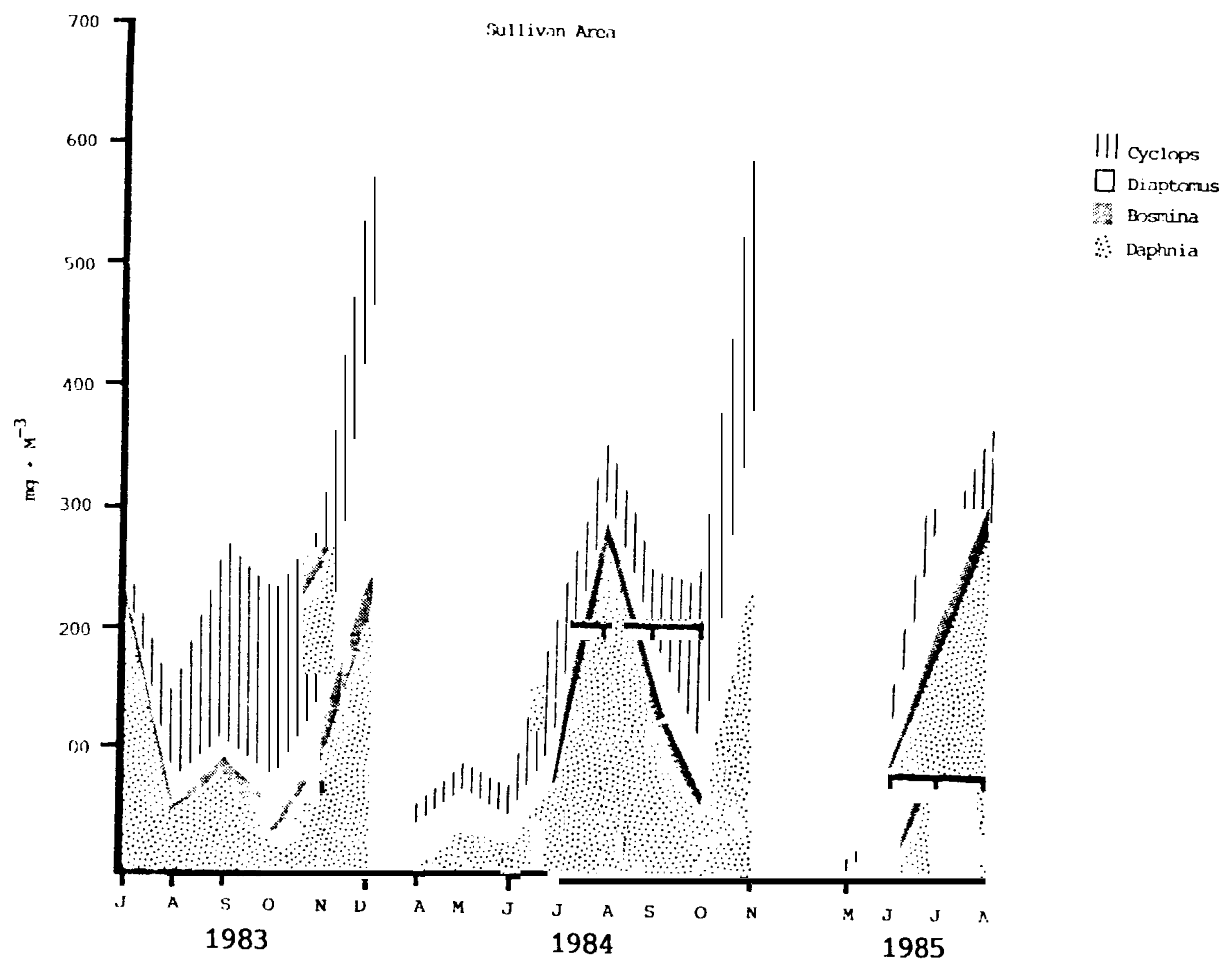


Figure 13. Seasonal biomass (mg · M^{-3}) of the four most abundant genera of zooplankton in the Sullivan area from July, 1983 through August, 1985. Based on 30m vertical tow samples from Hungry Horse Reservoir.

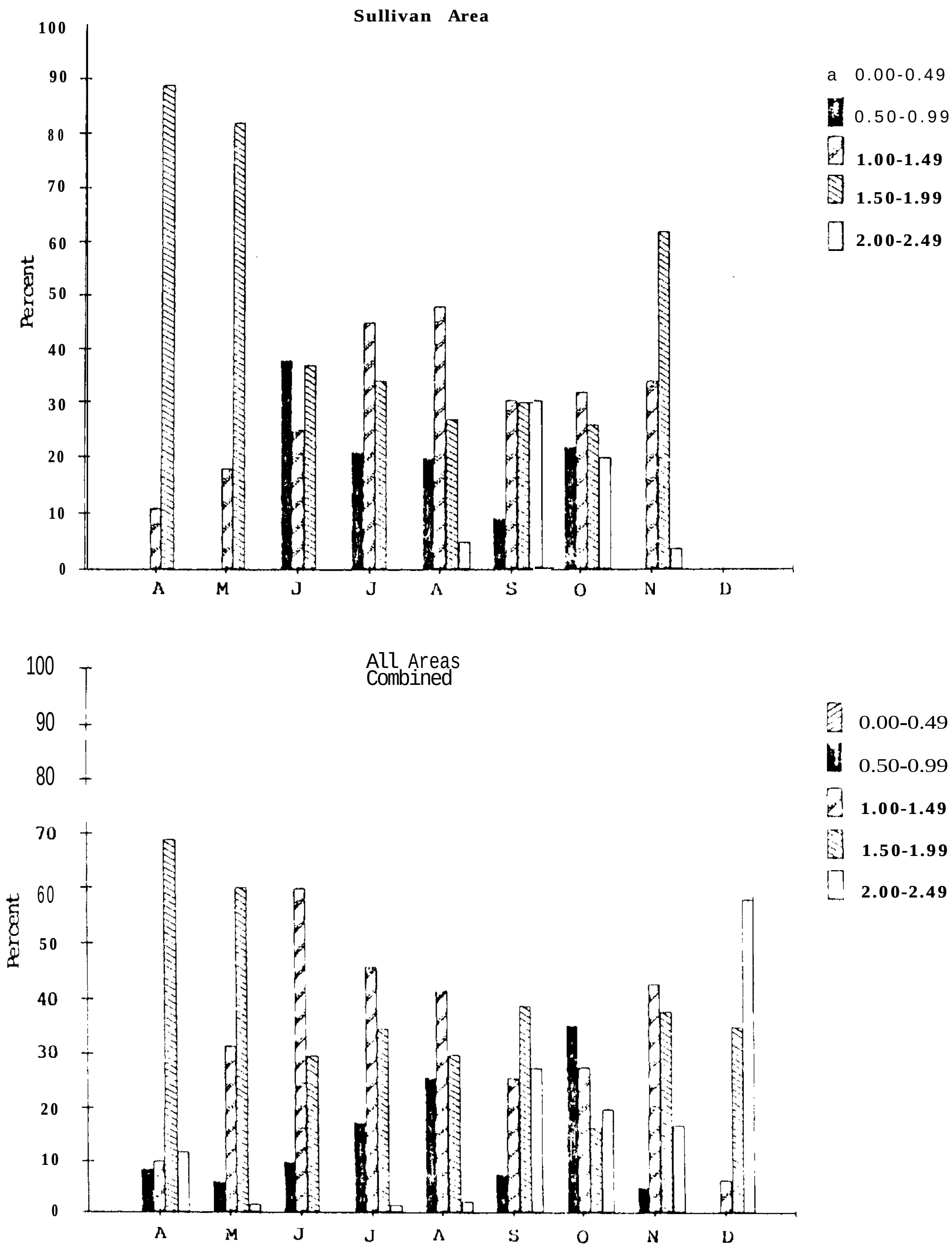


Figure 14. Length treguency distributions (by 0.5mm length classes) of Daphnia pulex captured in 30m vertical tows in the Sullivan area and areas combined in Hungry Horse Reservoir, 1984.

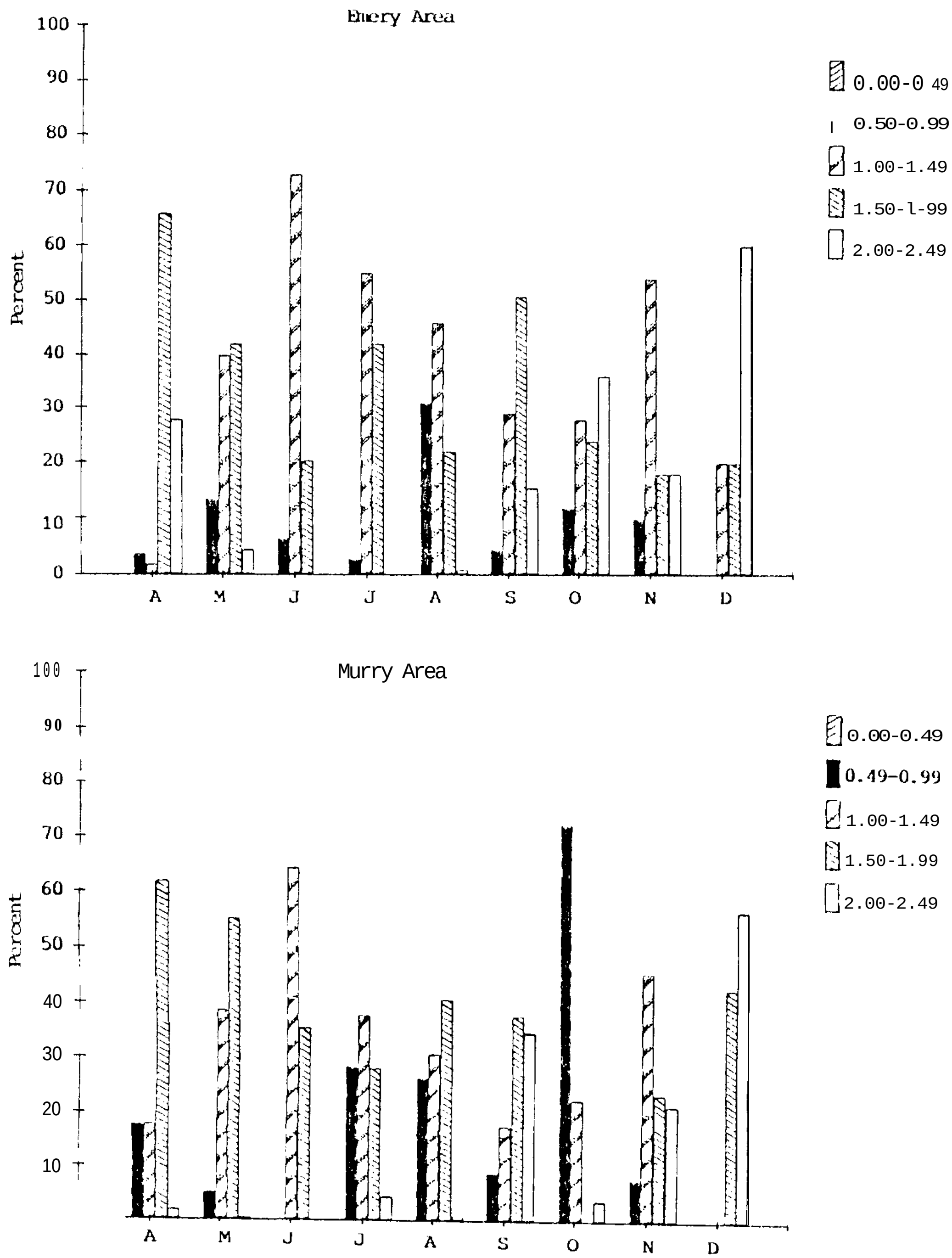


Figure 15. **Length frequency distributions (by 0.5mm length classes) of Daphnia pulex captured in 30m vertical tows in the Emery and Murry areas in Hungry Horse Reservoir, 1984.**

Vertical Distribution

The Schindler trap was used to assess the seasonal depth distribution of zooplankton in HHR (Appendix Bll, B12 and B13). Zooplanktondensities were higher during the day above the 15-m depth than below (Figure 16, 17 and 18). Generally, the major concentrations of all zooplankters were above the euphotic zone which makes them available as food to most fish species.

Efficiency

The Schindler trap is considered to be a very efficient zooplankton sampler (Schindler 1969, Prepas and Rigler 1978) and it was used to determine the sampling efficiency of the Wisconsin tow net. There was tremendous variation in sampling efficiency among areas, months and zooplankton taxon (Table 4). The efficiency for Daphnia ranged from 31 to 286 percent and averaged 100%. Bosmina, Diaptomus and Cyclops efficiencies also varied widely with their mean efficiencies greater than 100 percent. Thus, it appears that the Wisconsin plankton net was at least as efficient as the plankton trap. Shepard (1985) also found the Wisconsin net more efficient than the Schindler trap in Libby Reservoir. Leathe and Graham (1982) found no differences in zooplankton numbers between the two sampling techniques in Flathead Lake, except the Schindler trap was more efficient in collecting Daphnia thorata.

Benthos

Dipteran larvae and oligochaetes comprised over 99 percent of the benthic community biomass(Appendix Bl4, Bl5 and B16). In 1984 and 1985, Diptera made up 83.6 and 54.6 percent of the benthos samples, respectively. They were the only benthic taxon which were an important food item of reservoir fish. Diptera biomass was generally low during the spring (in May and June), increased during the summer and declined in the fall (Figures 19 and 20). The biomass was influenced by the emergence patterns of Diptera which had peaks in the spring and fall. The standing crop in the dewatered Sullivan area was a noticeable exception. Diptera recolonized the dewatered zones in the summer and fall which resulted in an increase in biomass in the fall.

The biomass of Diptera in the occassionally dewatered and permanently wetted areas was 6 to 13 times greater than in the areas which were annually dewatered. These differences were compared using a paired t-test, and were found to be highly significant, (Table 5). The adverse effects of reservoir drawdown upon benthic macroinvertebrates has been well documented in the literature (Benson and Hudson 1975, Baxter 1977, Fillian 1965, and Paterson and Fernando 1969).

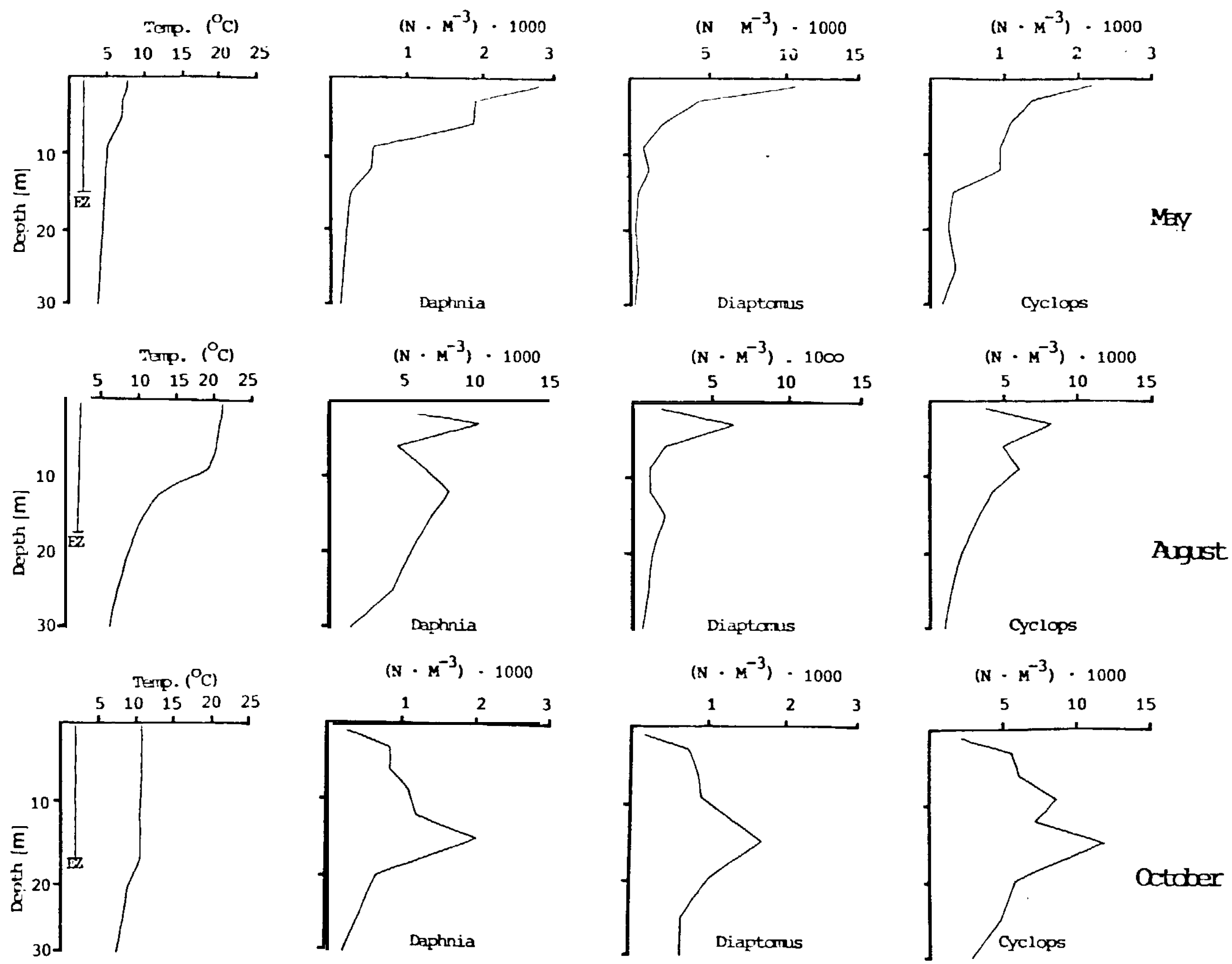


Figure 16. Temperature profile and euphotic zone (EZ) and depth distribution of the principal zooplankton at the permanent Emery station for May, August, and October, 1984.

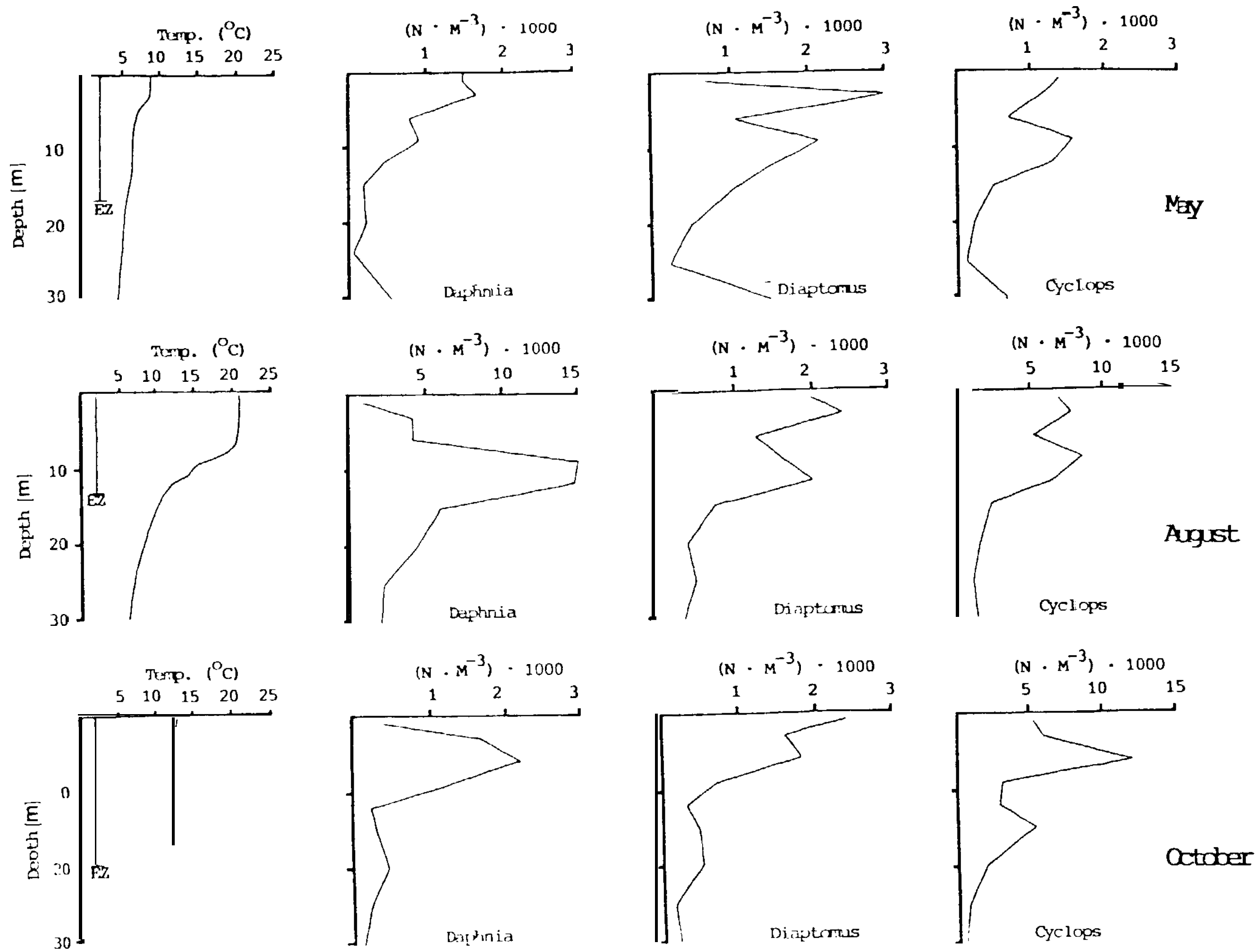


Figure 17. Temperature profile and euphotic zone (EZ) and depth distribution of the principal zooplankton at the permanent Murry station of May, August, and October, 1984.

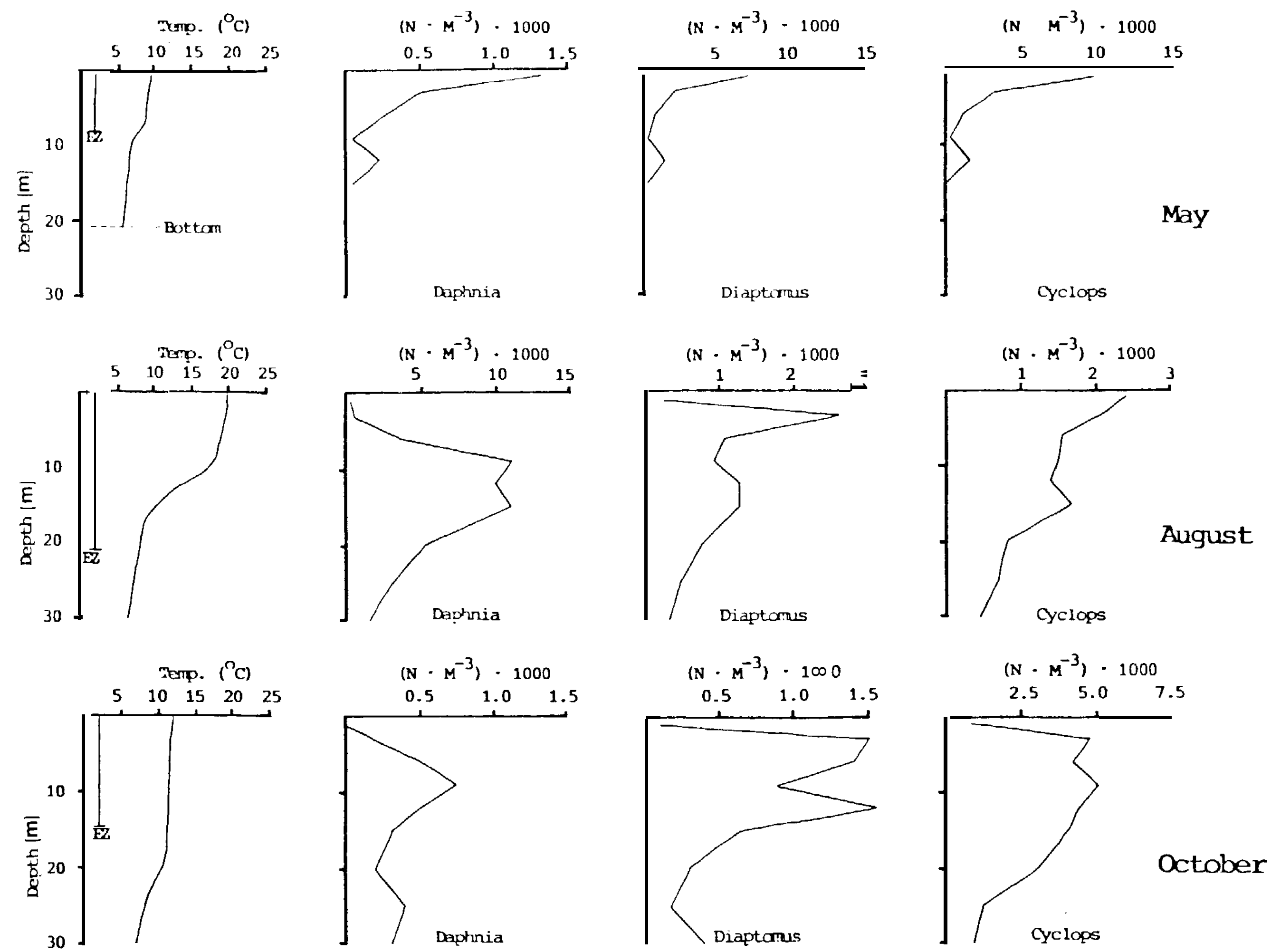


Figure 18. Temperature profile and euphotic zone (EZ) and depth distribution of the principal zooplankton at the permanent Sullivan station for May, August, and October, 1984.

Table 4. Sampling efficiency (percent) of Wisconsin net compared with a Schindler plankton trap for 30 m vertical tows in three areas of Hungry Horse Reservoir during 1983-1985. The schindler plankton trap was assumed to be 100 percent efficient. (E: Emery, M: Murray, S: Sullivan, Corn: Combined).

		Daphnia				Bosmina				Diaptomus				Cyclops			
Month	Year	E	M	S	Com	E	M	S	Com	E	M	S	Com	E	M	S	Com
September	83	143	102	158	130	125	163	395	195	43	199	150	152	20	134	221	119
August	83	158	147	286	197	88	175	260	182	125	239	207	180	15	225	197	140
October	83	127	132	--	129	85	127	--	100	143	228	--	189	178	167	--	173
November	83	94	225	--	137	77	132	--	103	172	452	--	253	126	410	--	1%
December	83	254	193	--	206	140	369	--	355	293	129	--	163	317	189	--	236
May	84	58	91	150	84	89	176	278	220	96	173	106	121	88	202	87	113
June	94	49	35	--	46		170	--	170	128	40	--	85	72	97	--	82
July	84	34	41	62	39	65	319	246	189	37	78	94	50	46	79	95	66
August	84	53	46	57	52	60	60	58	59	91	77	63	80	82	64	66	71
September	84	88	82	56	71	100	123	89	103	123	218	75	120	139	206	87	138
October	84	31	60	86	51	30	41	101	42	104	97	89	98	43	72	136	70
November	84	81	108	221	164	73	104	203	138	91	123	223	172	116	123	125	122
December	84	--	58	--	58	--	103	--	103	--	164	--	164	--	151	--	151
June	85	104	76	45	85	396	115	150	203	164	40	26	64	48	33	20	39
July	85	63	36	32	48	63	43	48	57	57	52	24	50	57	61	32	57
Mean		96	95	115	100	107	148	183	148	119	154	106	129	96	148	107	118

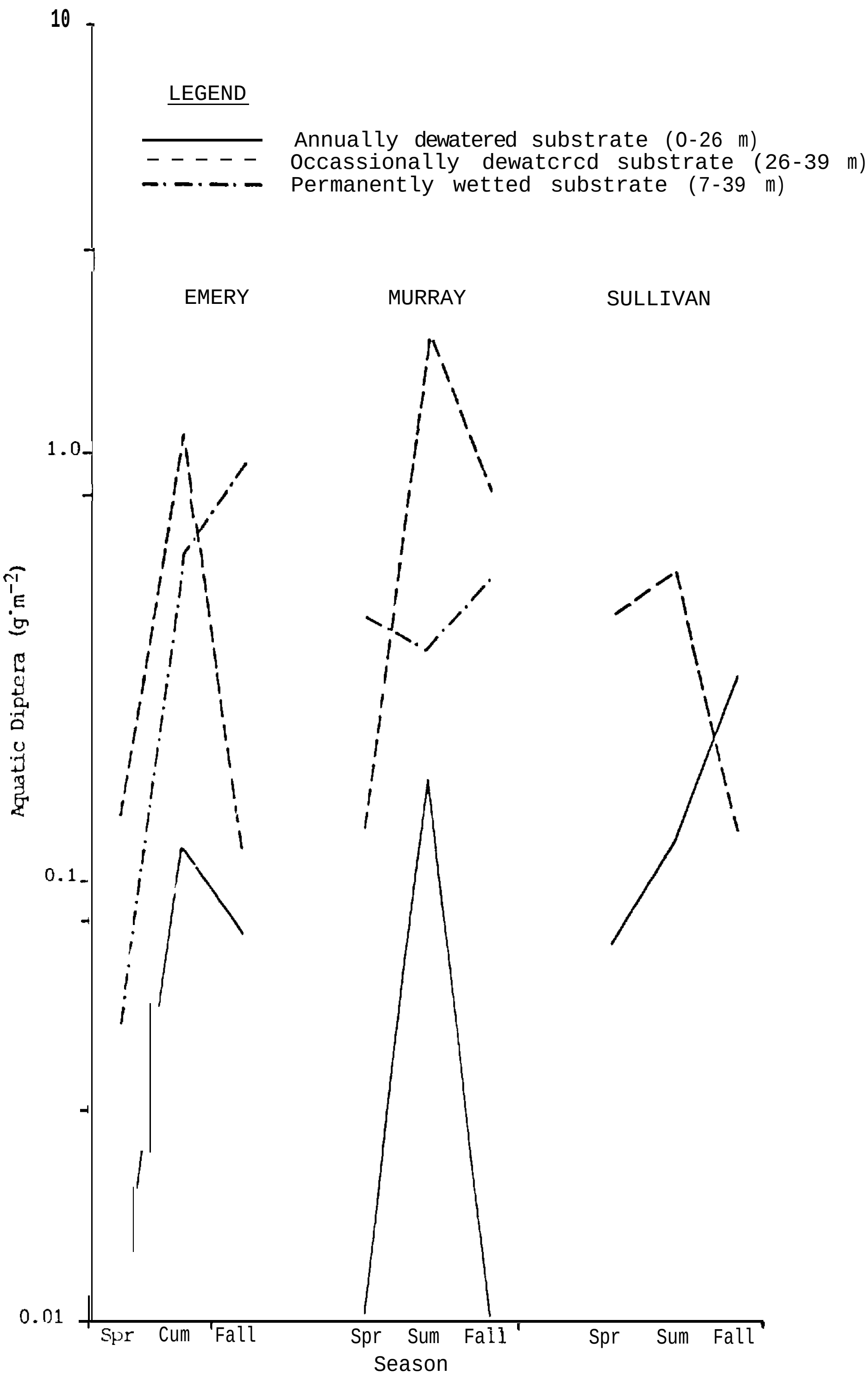


figure **19. Estimated biomass ($g \cdot m^{-2}$) of aquatic diptera in benthos samples from the Emery, Murray and Sullivan areas of Hungry Horse Reservoir, 1984.**

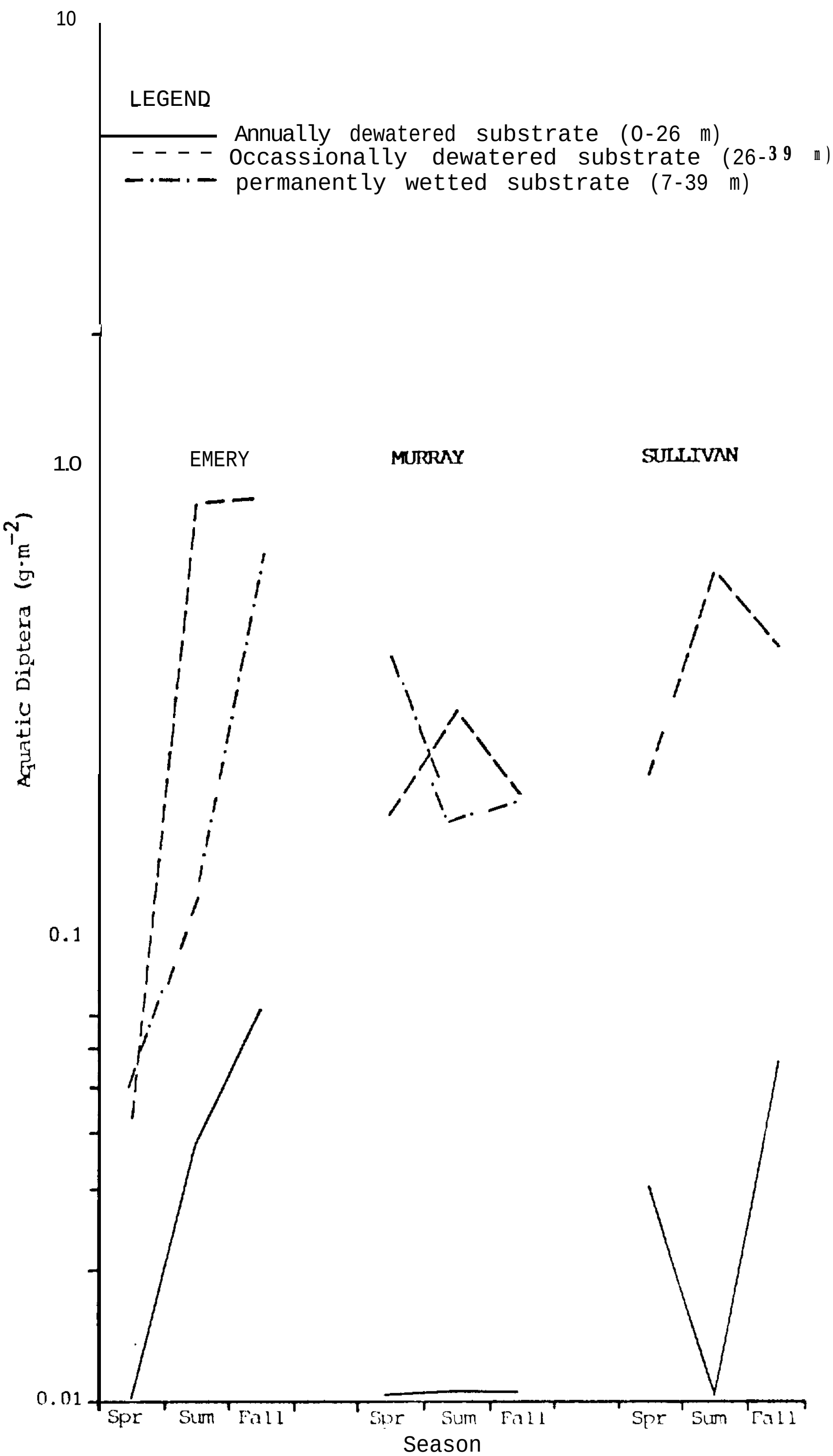


Figure 20, Estimated biomass ($g \cdot m^{-2}$) of aquatic diptera in benthos samples from the Emery, Murray and Sullivan areas of Hunqry Horse Reservoir, 1385.

Table 5. Comparison of mean biomass ($g \cdot m^{-2}$) of aquatic dipterans from benthos samples collected in Hungry Horse Reservoir, 1984 and 1985.

Paired t-test (p=.95)	Frequently dewatered		Occassionaly dewatered	Frequently dewatered		Permanently dewatered
1984						
Number of samples	81		81	81		81
Mean biomass	0.093		0.583	0.093		0.510
S.D.	0.134		0.779	0.134		0.459
Mean difference		0.490			0.417	
Paired t-test		7.06			7.84	
Test statistic (P=.99)		2.58			2.58	
1985						
Number of samples	180		180	180		180
Mean biomass	0.029		0.385	0.029		0.268
S.D.	0.050		0.431	0.050		0.386
Mean difference		0.356			0.239	
Paired t-test (p=.95)		11.02			8.23	
Test statistic (p=.95)		2.58			2.58	

Surface Insects

The distribution of surface insects in the reservoir was temporally patchy. Aquatic insects were represented almost entirely by Diptera, whereas the majority of the terrestrials consisted of, in decreasing order, Hymenoptera, Coleoptera, Homoptera and Hemiptera (Appendix B17 and B18). The seasonal progression of terrestrial biomass was similar in 1984 and 1985 (Figure 21). The standing crop was high in May and June ranging from 0.73 to 2.98 $g \cdot ha^{-1}$, low during July, increased in August and September to peaks of between 2.43 to 19.00 $g \cdot ha^{-1}$, then declined rapidly in November. The biomass of aquatic Diptera was highest in May ranging from 0.63-0.81 $g \cdot ha^{-1}$, declined in June, July and August, increased in September to about 0.20 $g \cdot ha^{-1}$ and decreased markedly in November (Figure 22). These food resources were most abundant in the spring and from August to about mid-October.

Terrestrial insects appeared to be more abundant in the Emery area in 1984 than in the Murray and Sullivan areas. However, this trend did not continue into 1985 and was probably due to the large sampling variation associated with the patchy distribution of the surface insects.

Paired t-tests indicated that there was no significant differences between nearshore and offshore standing crops of insects (Table 6). This is at least partly due to the large sampling variances of the insect tows. The Murray area was sampled weekly in 1985 to reduce the sampling variance, but the standard deviation remained high (4.394 for inshore samples and 3.770 for offshore samples). These values were higher than recorded in the Emery area and the offshore zone in the Sullivan area where the sample frequency was only biweekly.

FOOD HABITS

Westslope Cuthroat Trout

Food analysis was conducted on stomachs from 282 westslope cutthroat trout collected from **HHR** during 1983-84 (Appendix Cl). Stomachs from the three reservoir areas were analyzed together since little variation in feeding preferences could be attributed to geographic area. Food habits information will be utilized to allocate food resourcs in the growth submodel.

Terrestrial insects were the most important food item consumed by westslope cutthroat on an annual basis, followed by aquatic insects and zooplankton (Figure 23). Hymenoptera, aquatic Diptera and *Daphnia pulex* comprised the bulk of the individuals eaten from the respective major groups. Cutthroat selected for the larger *Daphnia pulex*, feeding primarily on individuals over 1.5 mm in length (May and Zubik 1985).

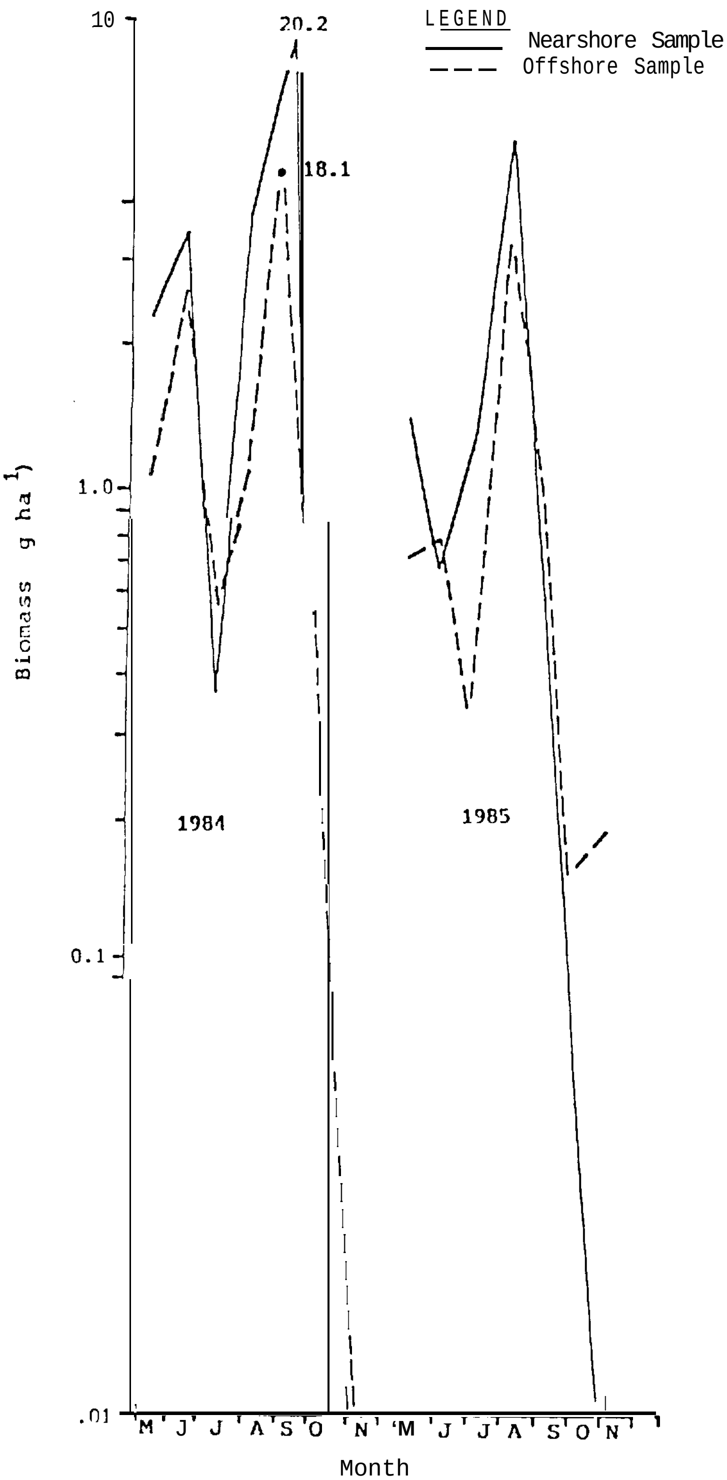


Figure 21. **The mean monthly biomass of terrestrial insects (g·ha) collected in nearshore (<100m) and offshore (>100m) samples from Hungry Horse Reservoir, 1984-85.**

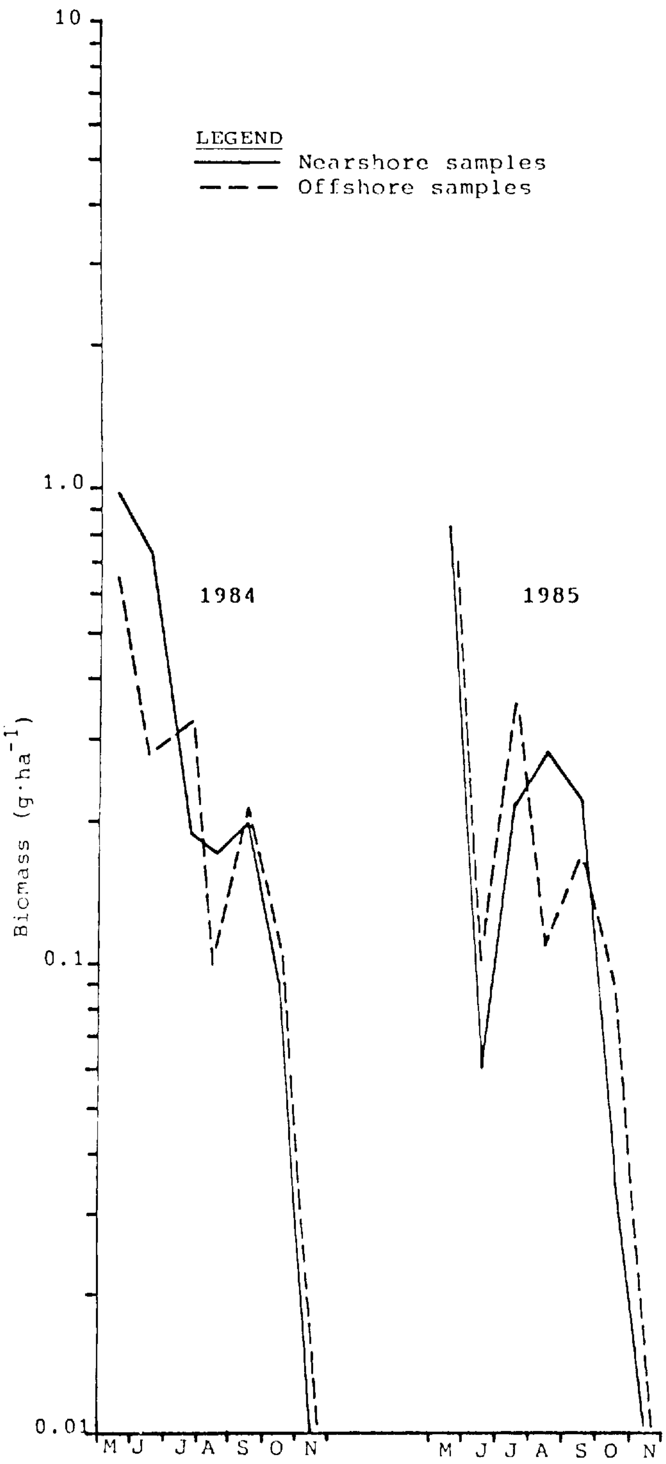


Figure 22. The mean monthly biomass of aquatic insects ($g \cdot ha^{-1}$) collected in nearshore (<100 m) and offshore (>100 m) samples from Hungry Horse Reservoir, 1984-85.

Table 6. Comparison of mean biomass ($g \cdot ha^{-1}$) of surface insects collected from near (<100 m) and offshore (>100 m) samples from Hungry Horse Reservoir, 1984-85.

	Aquatic Insects Nearshore	Aquatic Insects Offshore	Terrestrial Insects Nearshore	Terrestrial Insects Offshore
1984				
Number samples	99	99	99	99
Mean biomass	0.30	0.23	5.01	4.05
S.D.	0.65	0.50	21.31	19.60
Mean difference	0.07		0.96	
Paired t-test	0.85		.033	
Test statistic (P=.95)	1.96		1.96	
1985				
Number samples	160	161	160	161
Mean biomass	0.25	0.19	1.50	0.97
S.D.	1.00	0.46	4.02	3.26
Mean difference	0.06		0.53	
Paired t-test	0.69		1.29	
Test statistic (p=.95)	1.96		1.96	

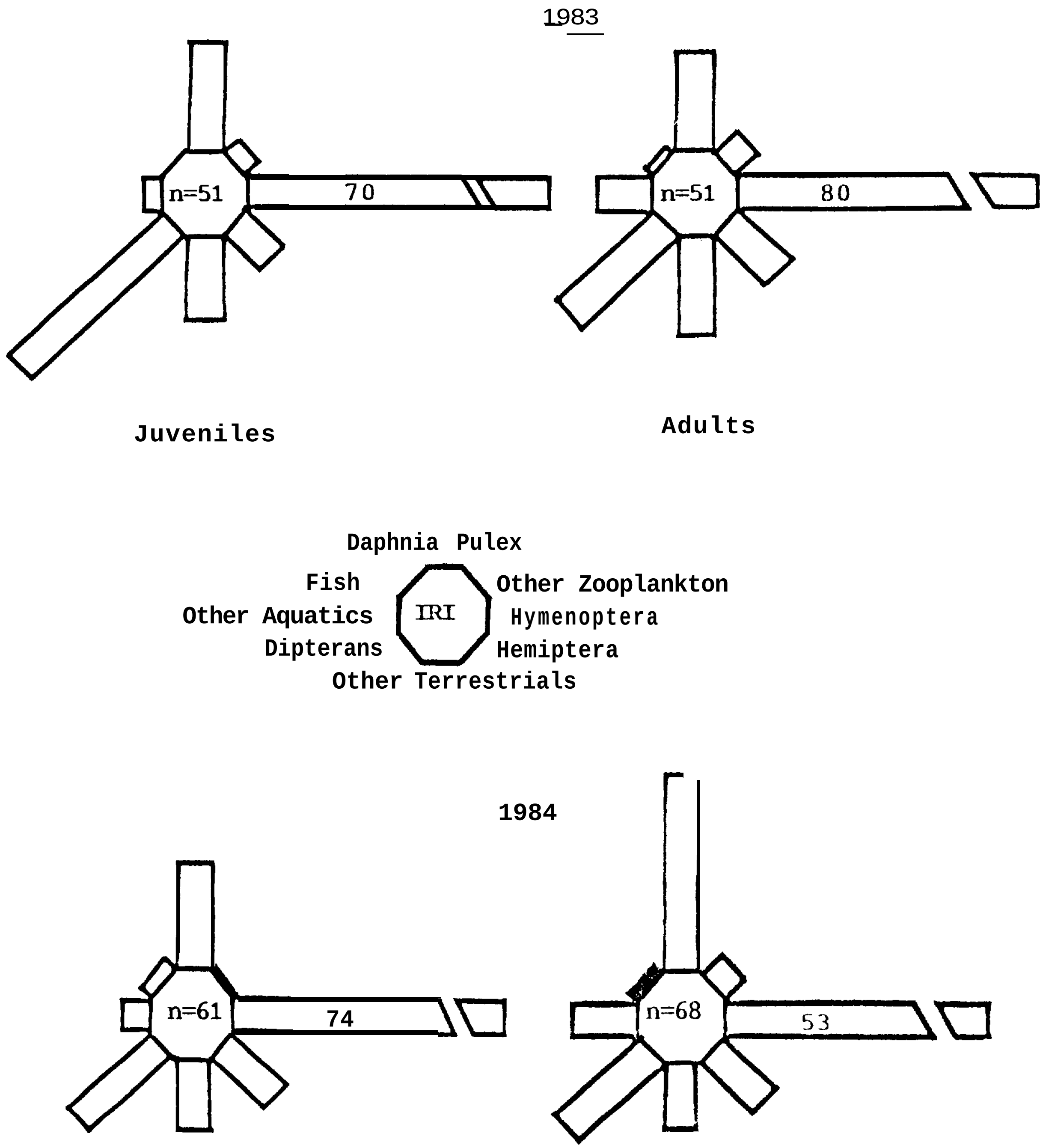


Figure 23- Indices of relative importance (IRI) for westslope cutthroat trout juveniles and adults collected in Hungry Horse Reservoir (areas combined) during 1983-84.

The diet of westslope cutthroat varied seasonally in response to food availability (Appendix C2-C19). Both juveniles and adults ate primarily terrestrial insects (IRI=82) in June with aquatic Dipteran (IRI=25) and Daphniapulex (IRI=9) second and third in importance, respectively. Terrestrial insects were the most important food item eaten during the summer and fall with the IRI usually above 90, while the IRI of aquatic Diptera was between 4 to 27. The exception to this general pattern occurred in August, 1983, when aquatic Diptera were the chief food ingested by juvenile cutthroat. When terrestrial insects were no longer available in the late fall and winter the cutthroat switched to a diet comprised primarily of Daphnia pulex followed by aquatic Diptera.

The food habits of cutthroat trout in lakes are highly variable and are influenced by the availability of food items, subspecies of cutthroat trout and species composition of the fish community. Westslope cutthroat trout food habits in HHR were similar to those found in Flathead Lake (Leathe and Graham 1982), Libby Reservoir (McMullin 1979) and some northern Idaho lakes (Bjornn 1957, Jeppson and Platts 1959). Cutthroat from Libby Reservoir fed more intensively on Daphnia than those from HHR.

Bull Trout

The stomachs of 193 bull trout collected from HHR in 1983-84 were examined for food items. Approximately 30 percent of the stomachs were empty. Fish was the principal component of the bull trout diet comprising over 99% of the biomass eaten (Appendix C20-C36). Northern squawfish and mountain whitefish were the dominant species consumed by juvenile bull trout. Adult bull trout ate in order of importance, suckers, mountain whitefish and northern squawfish. There was little evidence of cannibalism, and westslope cutthroat were only occassionally ingested

The IRI values overestimated the importance of other items as compared to fish in the bull trout food habits (Figure 24). According to IRI values, zooplankton, terrestrial insects and aquatic insects formed an important part of both juvenile and adult bull trout diets. The IRI formula overestimated the importance of these food items because of their comparatively high numbers and low biomass in comparison to the low number of fish eaten with high biomass values.

The food habits of bull trout were remarkably uniform throughout the year, consisting primarily of fish. Bull trout fed on mountain whitefish in the spring and fall, northern squawfish in the summer and suckers in the fall and early winter. Bull trout in Flathead Lake also consumed primarily fish (Leathe and Graham 1982).

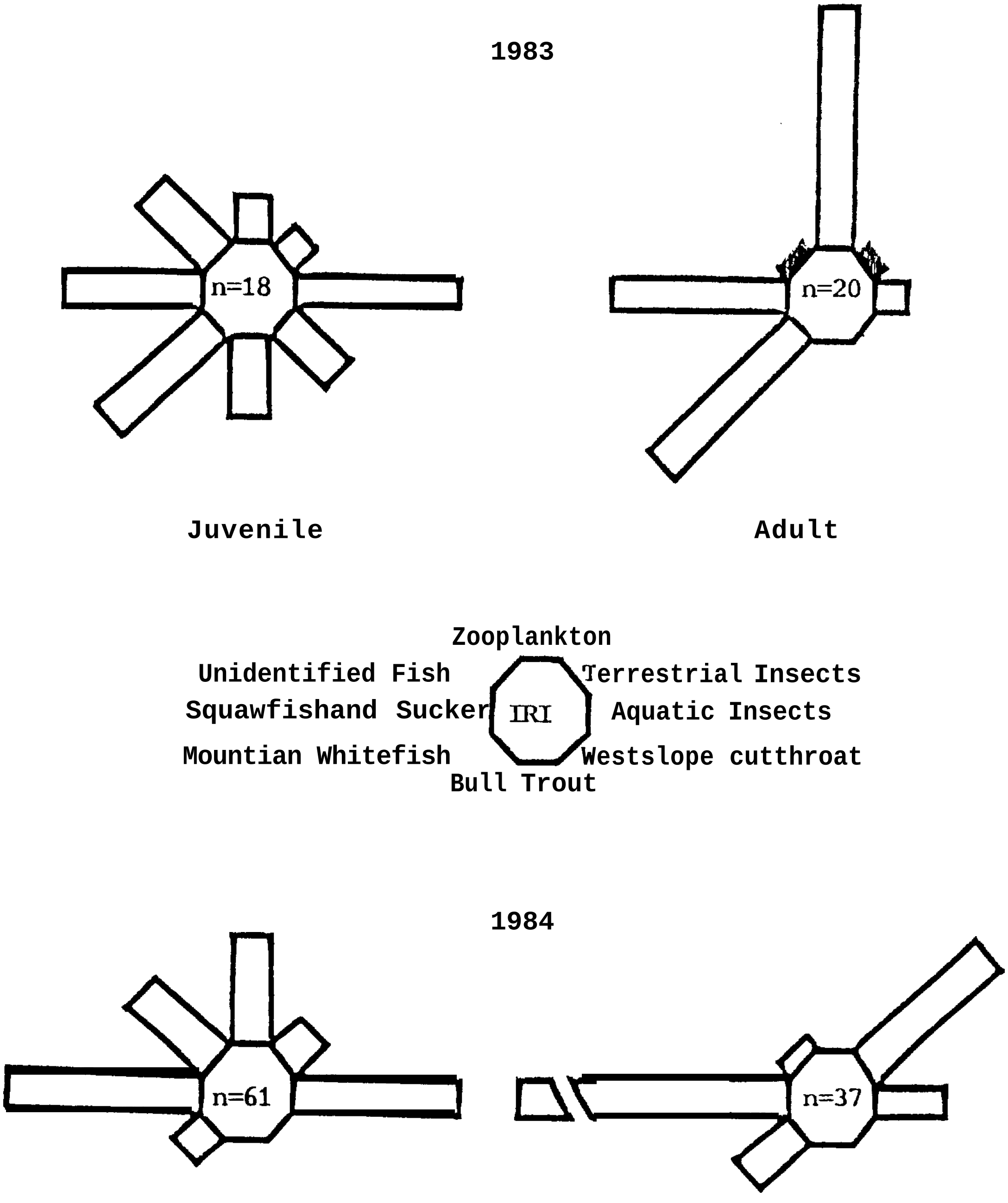


Figure24. Indices of relative importance (IRI) for bull trout juveniles and adults collected in Hungry Horse Reservoir (areas combined) during 1983-84.

MountianWhitefish

The food habits of mountain whitefish were determined by examining 128 stomachs collected from HHR in 1983-84 (Appendix Cl). Mountain whitefish ate primarily Daphniapulex in 1983-84 followed by aquatic insects, Epischura and terrestrial insects (Figure 25). The diet was uniform with little seasonal changes in food consumption (Appendix C37-C44). Daphnia had an IRI value of between 84 to 99 for all time periods sampled The IRI values for aquatic Diptera ranged from 3 to 30. Leathe and Graham (1982) found that mountain whitefish in Flathead Lake fed primarily on Daphnia thorata and exhibited little seasonal variation in food habits.

Northern Squawfish

Accessing the food habits of northern squawfish was difficult because of the high rate of regurgitation of the stomach contents. Approximately 55 percent of the 175 squawfish stomachs collected were empty. In addition, the biomass found in stomachs with food was low (Appendix C45-C59).

There were minor differences between the food habits of juvenile and adult northern squawfish (Figure 26). The juveniles consumed, in order of importance according to IRI values, Daphnia, fish, terrestrial insects, and aquatic Diptera. Over 90 percent of the biomass was fish, which indicates that IRI values underestimated the importance of fish in the diet of juvenile squawfish. Adult squawfish feed primarily upon fish, which constituted over 98 percent of the diet. Suckers, mountain whitefish, northern squawfish and bull trout were the primary fish species eaten. Initial analysis of stomachs collected in mid-May 1985 indicated squawfish utilized some cutthroat trout juveniles during this period

Only minor seasonal variations occurred in the food ingested by northern squawfish. Juvenile fed primarily on insects and fish during most of the year except in the late fall when they ate zooplankton and fish. Adults utilized fish in the spring, summer, and fall along with minor amounts of insects. Squawfish were not collected in the December gillnet samples, indicating they had moved offshore and become inactive with the cooler water temperatures.

FISH ABUNDANCE AND DISTRIBUTION

Horizontal Gill Nets

Factors Influencing Gill Net Catches

Estimation of fish abundance by the relative index method requires that gill net sampling be done at similar locations and times each year. It is especially critical that water

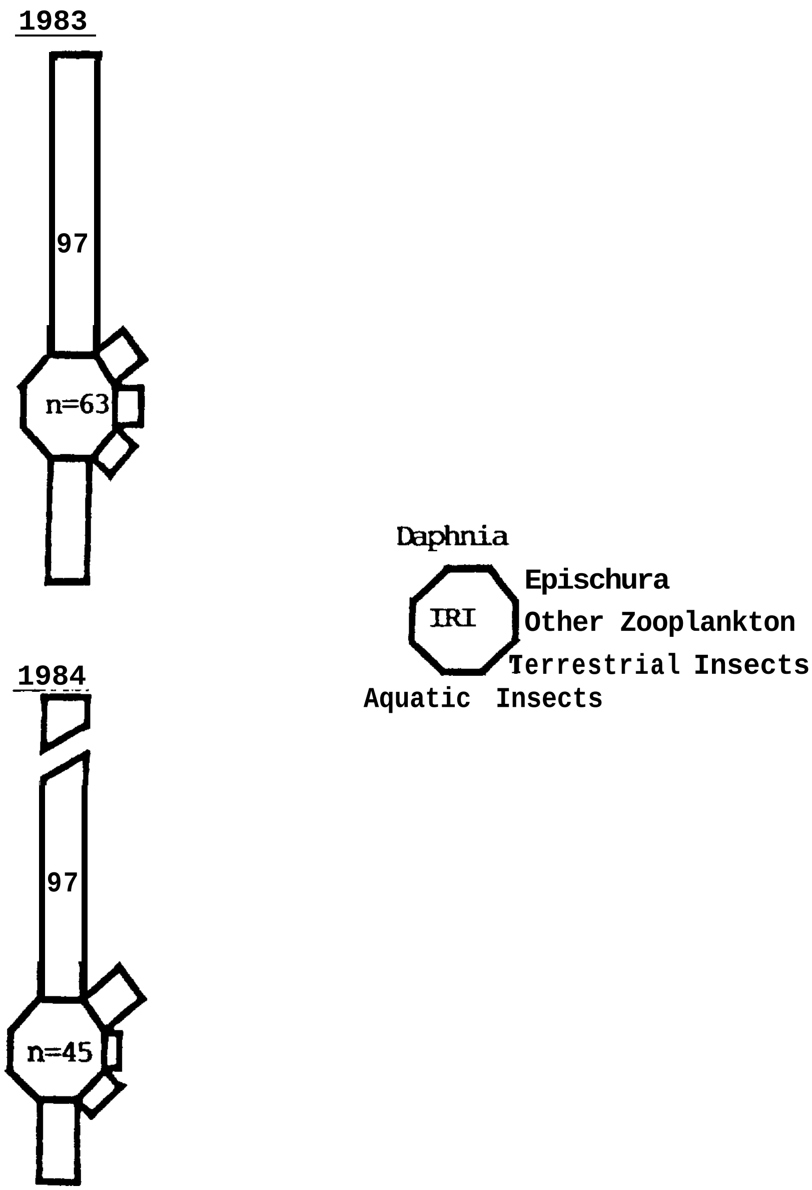


Figure Indices of relative importance (IRI) for mountain whitefish collected in Hungry Horse Reservoir (areas combined) during 1983-84.

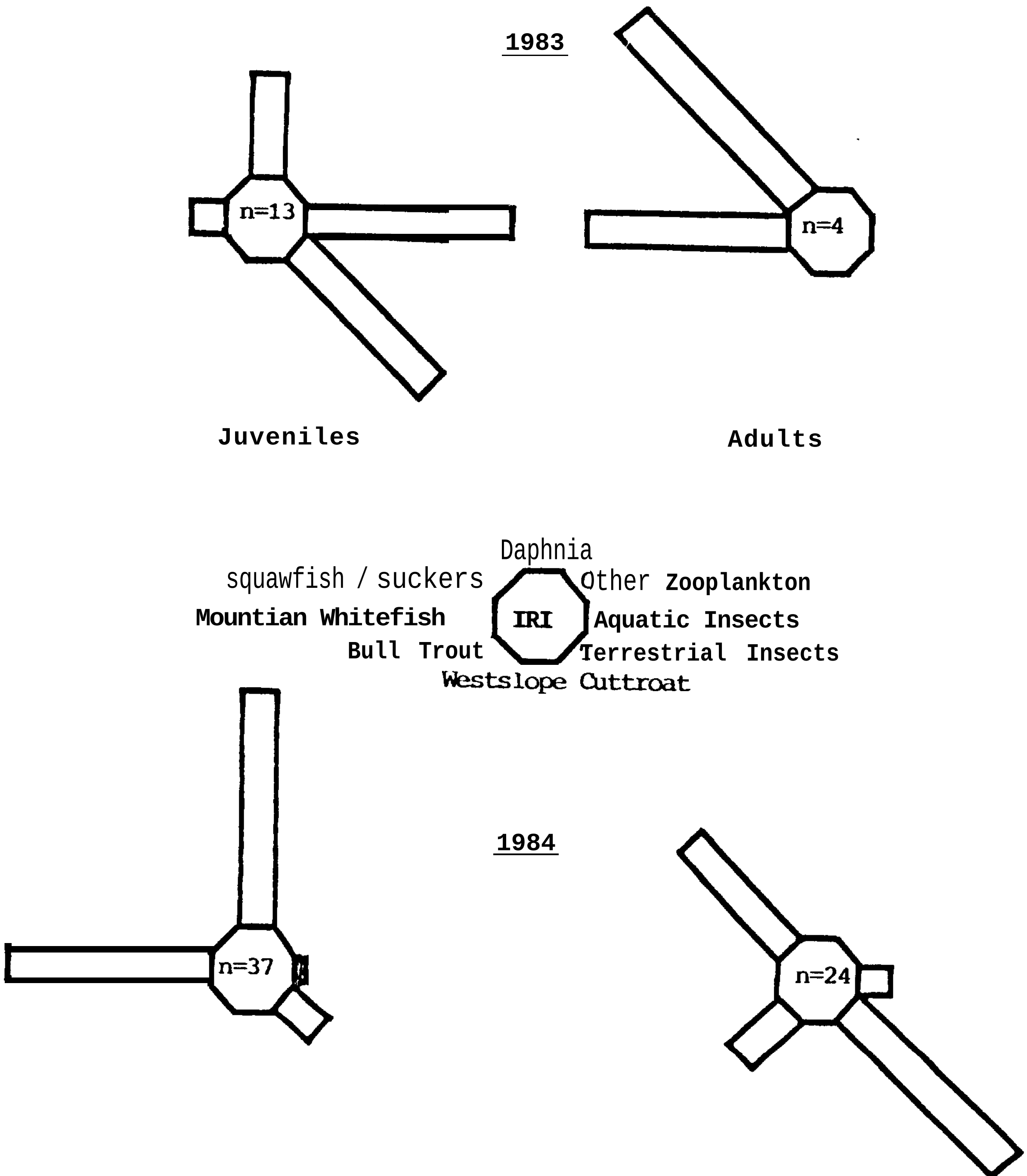


Figure 26. Indices of relative importance (IRI) for northern squawfish collected in Hungry Horse Reservoir (areas combined) during 1983-84.

temperatures and reservoir elevation be standardized. With this sampling design, the complex interrelation of factors influencing catch are minimized and catch-per-unit of effort is proportional to relative species abundance. Indexes derived from catch-effort data can be used to determine year to year changes in population size, species composition and other vital statistics. (Walburg 1969).

Catch Composition.

A total of 7,415 fish were caught from 1983-85 in shoreline sets of 696 floating and 205 sinking gill nets. Westslope cutthroat trout dominated the catch of floating nets comprising 41.8 to 54.1 percent of the catch (Table 7). Northern squawfish were also an important constituent of the floating net catch making up 26.6-45.7 percent of the sample. The most abundant species in the sinking net catches was mountain whitefish (36.7-40.4 percent of the catch) followed by northern squawfish, suckers, and bull trout. The catch composition of fish in floating and sinking nets has varied little among the years, except in 1985 when northern squawfish catches in floating nets were less than in previous years.

The variance in catch of species by net type indicated that cutthroat trout inhabit the upper part of the water column when they are distributed in the littoral zone. In contrast, mountain whitefish, suckers and bull trout were more closely associated with the reservoir bottom. Northern squawfish appeared to be dispersed throughout the water column in the nearshore habitat.

Westslope Cutthroat Trout

The catch of westslope cutthroat trout in floating gill nets varied considerably with the month and season of the year (Figure 27). Reservoir elevation, surface water temperature and euphotic zone depth-are given for the sampling dates in Table 8. Cutthroat were concentrated in surface waters in nearshore zones, except in the summer when water temperatures were above 17-18°C. Mean net catches in 1985 ranged from a low of 0.6 fish per net in August to 3.5 fish per net in May with an intermediate catch of 1.3 in the fall. Overall the 1985 catch of 1.8 cutthroat per net was higher than the 1.2 fish per net recorded in 1984. This difference in catch was probably due to sampling variance rather than actual population changes between the two years.

Sinking gill nets have been used to monitor fish populations in HHR from 1958 to 1981 (Graham et al. 1982). Mean catches during the period in the spring and fall have ranged from 0.8 cutthroat per net in the 1955-64 period to 1.2 fish per net in 1978 and 1980, indicating a comparatively stable population. Cutthroat trout mean catches in 1984 and 1985 were 0.2 fish per sinking net (Appendix Dl). This decline in catch may be the result of a reduction in the cutthroat trout population or sampling error,

Table 7. Percent composition by species and net type for gill net catches from Hungry Horse Reservoir in 1983, 1984 and 1985.

Species	Percent of Catch					
	Floating Nets			Sinking Nets		
	1983	1984	1985	1983	1984	1985
Westslope cutthroat trout (WCT)	43.9	41.8	54.1	2.3	1.4	0.8
Bull trout (DV)	3.4	5.8	8.4	9.4	14.0	16.5
Mountain whitefish (MWF)	11.5	4.2	8.4	40.4	36.7	38.3
Northern squawfish (NSQ)	39.6	45.7	26.6	22.8	22.8	23.1
Largescale suckers (CSU)	1.4	2.2	2.4	10.1	9.1	8.7
Longnose sucker (LNSU)	0.2	0.3	0.1	15.0	15.9	12.5
Total fish caught	712	1147	711	963	2110	1772

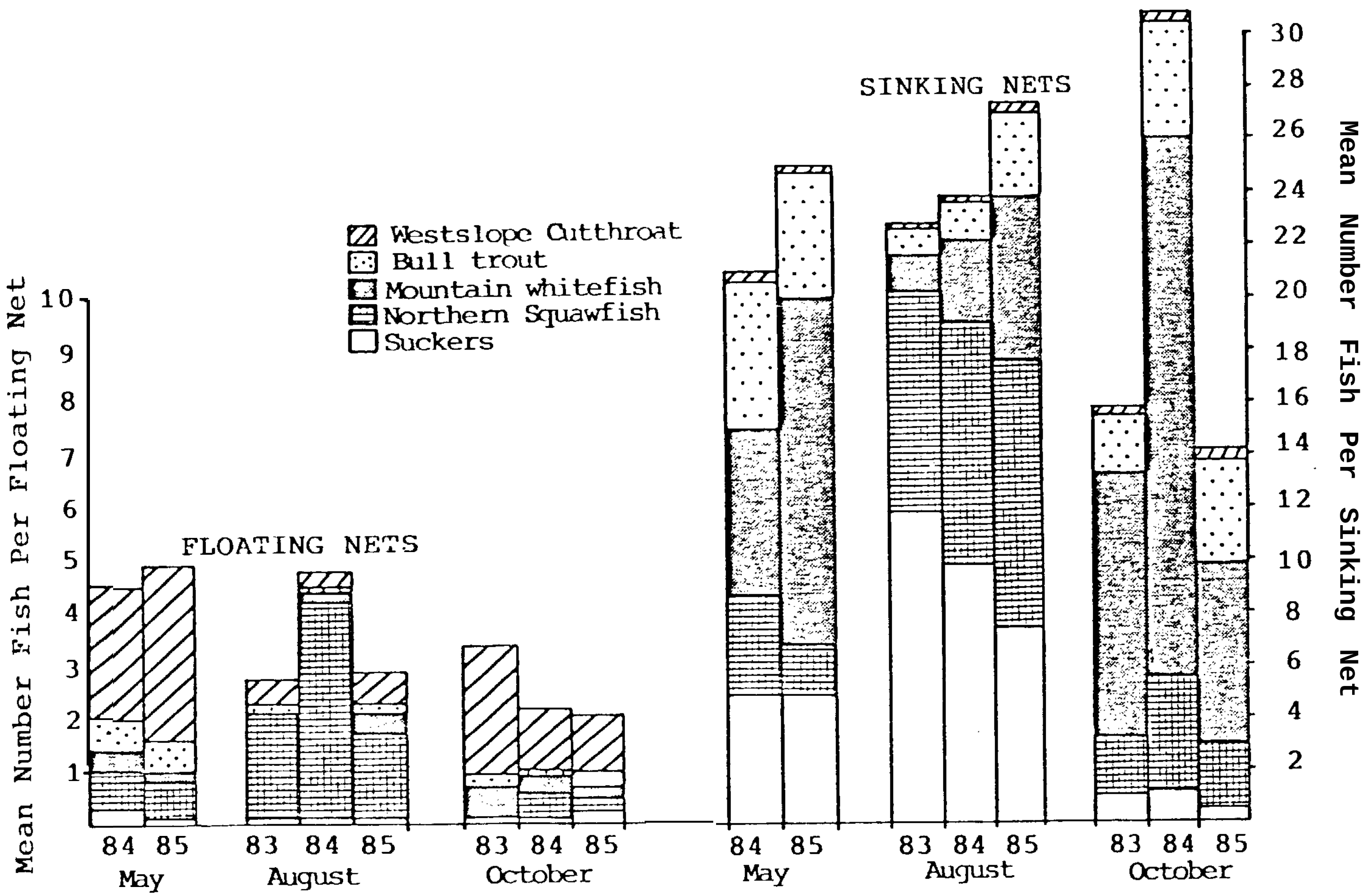


Figure 27. The seasonal catches of fish caught in floating and sinking nets in areas combined from Hungry Horse Reservoir 1983, 1984, 1985.

Table 8. Reservoir elevations, surface water temperatures and water transparency for gill net sampling dates in Hungry Horse Reservoir, 1983 and 1984.

Date	Reservoir elevation-ft)	Surface water temperature (°C)			Depth euphotic zone (m)		
		Emery	Murray	Sullivan	Emery	Murray	Sullivan
			1983				
7/26-28	3,560	16.6	17.8	17.2		---	
8/23-25	3,560	20.6	20.6	20.0	18.3	19.1	18.9
9/27-29	3,549-3,547	14.7	14.8	13.9	26.0	18.5	20.5
10/31-11/2	3,534	8.6	8.4	8.0	23.0	16.5	19.3
11/29-30	3,536	7.1	6.5	---	20.5	14.0	
12/14-16	3,534			4.3	20.3	16.5	19.1
			1984				
4/24-27	3,500	4.2	5.6	5.7	15.1	10.3	5.2
5/30-31	3,519-23	10.5	9.9	8.6	14.5	13.0	5.8
6/26-28	3,549-51	17.0	19.6	18.4	17.8	14.3	8.3
8/13-22	3,557-59	20.0	21.0	20.0	18.3	16.7	16.3
10/11-15	3,541-40		12.6	12.1	17.8	19.6	14.6
			1985				
5/14-21	3,512-3,522	7.2	8.1	7.1	12.0	7.5	3.9
8/14-20	3,545-3,544	20.1	18.3	20.1	15.8	14.0	17.0
10/31-11/4	3,524-3,527	7.9	8.3	8.0	13.6	14.8	11.4

resulting from different netting locations and water temperatures between the sampling periods. A reduction in the 1985 spawning run into Hungry Horse Creek fromprevious years and lower catch rates of cutthroat in the fall by anglers indicated a smaller population in the reservoir than in preceeding years. Overall, the various sampling techniques suggested that cutthroat populations in HHR may have declined in recent years.

Westslope cutthroat trout floating net catches in 1985 were different among the reservoir areas, with the Sullivan area recording the highest mean catch followed by the Emery and Murray areas (Figure 28). The mean catches for the three areas were 2.5, 2.1 and 1.3 fish per net, respectively. The larger catch of cutthroat in the Sullivan area was probably due to an extensive littoral zone with associated food resources, and proximity to major spawning streams.

Cutthroat caught in gill nets ranged in total length from 157 to 505 mm (Appendix El). The length frequency of catch varied among the years and seasonally, with fish under 250 mm comprising less of the catch in 1985 than in previous years. The sex ratio of cutthroat varied between 1.8 to 2.8 females per male and averaged 2.4 females/male. This is much lower than the sex ration of cutthroat in the Hungry Horse Creek spawning run which has ranged from 3.7 to 8.6 females per male.

The gill net catches consisted primarily of age four and five fish in the spring (89 percent of the catch) as compared to age three and four fish in the fall (76 to 92 percent of the catch) (Table 9). The cutthroat trout population consisted primarily of migration classes three and two (Table 10). This migration class structure was comparable to that recorded for outmigrant juveniles from Hungry Horse Creek in 1984.

Bull Trout

Bull trout catches in sinking nets varied monthly and seasonally in a pattern similar to cutthroat (Figure 27). The mean catches were largest in the spring, intermediate in the fall and lowest in the summer. The 1985 catch of 4.7 and 3.8 fish per net in the spring and fall, respectively, was 0.6 fish per net less than in 1984. Overall catch rates were similar to those recorded in HHR in the 1970's (Huston, 1972, 1974 and 1975). However, they were higher than recorded in Libby Reservoir (Huston et al. 1984) and Flathead Lake (Leathe and Graham 1982).

Mean catches of bull trout among the three areas in the spring samples were quite similar ranging from 5.4 fish per net in the Murray area to 5.6 fish per net in the Emery area (Figure 29). Fall catches varied between 2.6 to 3.6 fish per net in the Emery and Sullivan areas, respectively. Overall the highest mean catch was recorded in the Sullivan area for the 1983-85 sampling period (Appendix Dl).

Table 9. The percent age composition of westslope cutthroat trout caught in gill nets set in Hungry Horse Reservoir, 1983-84. Number of fish aged is given in parenthesis.

Age of Cutthroat: 1	2	3	4	5	6	7
Fall, 1983						
--	15(11)	33(23)	43(30)	8(6)	1(1)	--
Spring, 1984						
1(1)	4(4)	4(4)	45(43)	44(41)	1(1)	1(1)
Fall, 1984						
--	5(2)	51(21)	41(17)	3(1)	--	--

Table 10, Age at migration for westslope cutthroat trout caught in gill nets in Hungry Horse Reservoir, 1983-84. Number of fish aged is given in parenthesis.

Age at Migration	Fall 1983	Spring 1984	Fall 1984	Combined
I	3% (2)	3% (5)	3% (1)	3% (8)
II	41% (29)	23% (38)	23% (9)	27% (76)
III	51% (36)	63% (107)	68% (27)	61% (170)
Iv	5% (3)	11% (19)	8% (3)	9% (25)

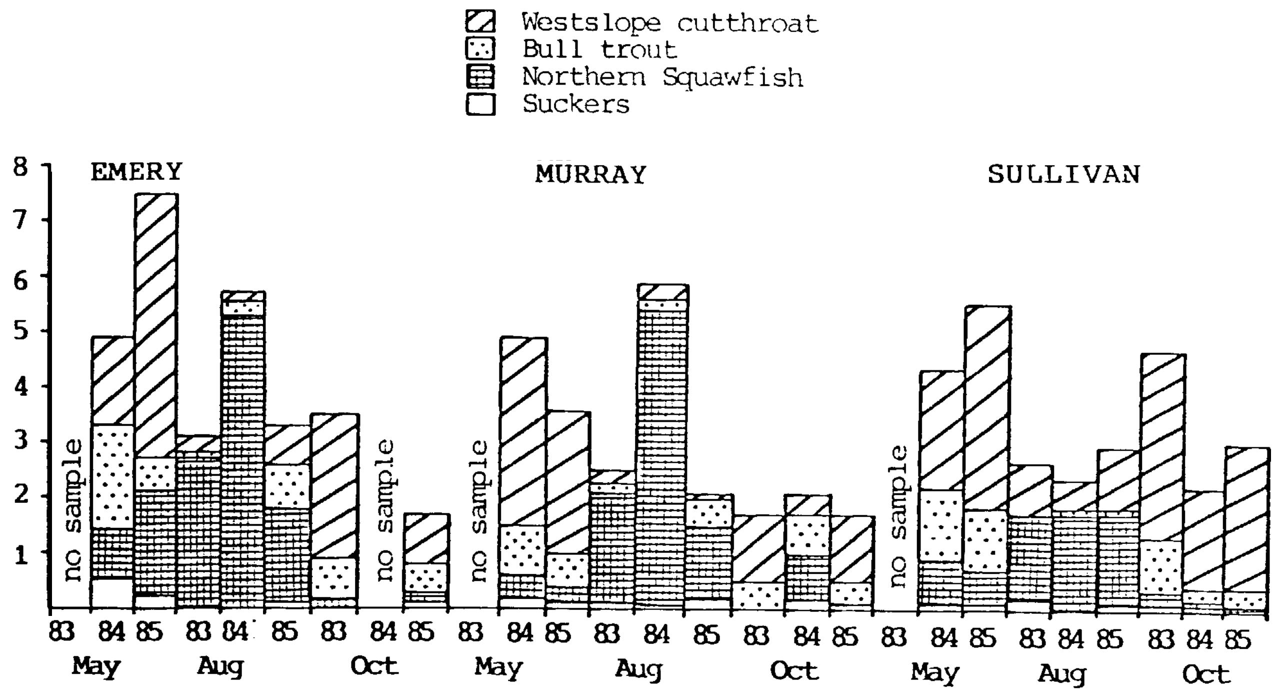


Figure 28. Seasonal catches of fish caught in floating gill nets set in near-shore zones in the Emery, Murray and Sullivan areas of Hungry Horse Reservoir, 1983, 1984 and 1985.

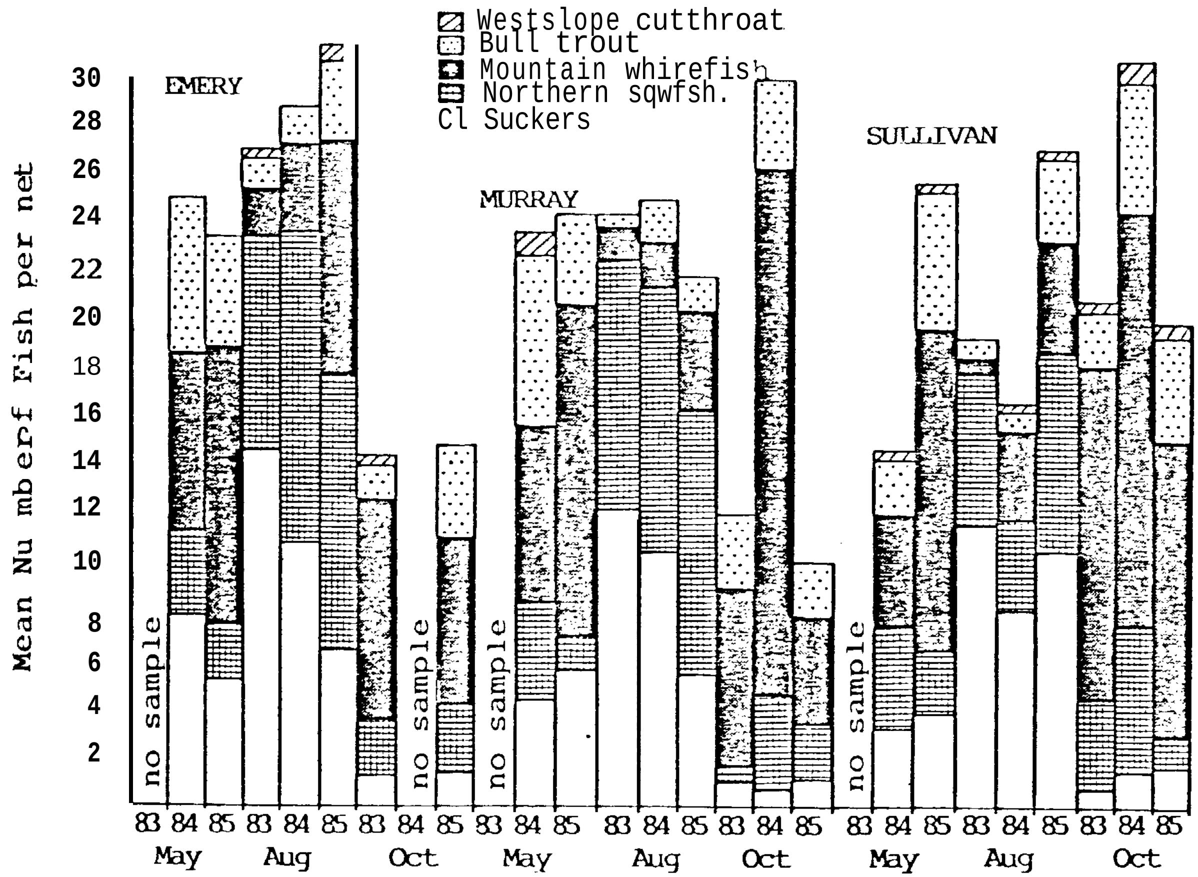


Figure 29. Seasonal catches of fish caught in sinking gill nets set in near-shore zones in the Emery, Murray and Sullivan areas of Hungry Horse Reservoir, 1983,1984 and 1985.

The largest bull trout caught during the 1983-85 sampling period was 910 mm in length and weighed 6808 g. The mean length of bull trout in the spring net catches averaged between 349-350 mm while the fall range was from 349-463 mm (Appendix E2).

Mountain Whitefish

Mountain whitefish have comprised from 38.3 to 40.4 percent of the catch in sinking nets during the present study (Table 7). The seasonal catch varied in response to changes in activity patterns influenced primarily by water temperatures and spawning movements. The largest mean catch of 22.3 fish per net was recorded in the fall of 1984, while the smallest mean catch of 1.3 fish per net occurred in August, 1983 (Figure 27). Catch rates were also quite variable from year to year and among the three reservoir areas. Differences in water temperatures during the fall sampling has contributed to the large variation in catch among the fall samples. Temperatures have ranged from approximately 8.0°C in 1983 and 1985 to 12.0°C in 1984 (Table 8). Standardization of the fall sampling to the last part of October when surface water temperatures are approximately 8.0°C should help reduce the variance in the catch of mountain whitefish and other species.

Overall catch rates of mountain whitefish in the spring and fall were higher in the Murray and Sullivan area than in the Emery area (Appendix Dl and Figure 29). Mountain whitefish and bull trout appear to have similar temperature and habitat preferences which results in the two species being closely associated. This accounts for whitefish being an important food item in the diet of bull trout.

The length frequency distributions of mountain whitefish collected in the spring and fall are given in Appendix E3. Mountain whitefish caught in gill nets have varied from 125 to 505 mm in total length. The mean length of the gill net catches ranged from 274 mm in May, 1984 to 306 mm in October, 1985.

Northern Squawfish

Northern squawfish have comprised a substantial part of both sinking and floating gill net catches (Table 7). The catch of squawfish has been consistently higher in the summer than in the spring and fall (Figure 27). Squawfish become less active when water temperatures decline below 12°C, and move into deeper offshore waters in the fall and remain there throughout the winter (Scott and Crossman, 1983). Mean catches during the summer ranged from 8.3 to 10.0 fish per sinking net as compared to 1.5-4.1 per floating net. The catch in sinking nets was much more consistent among the years than in floating nets. Average catches of squawfish were comparable in the Emery and Murray areas, but markedly less in the Sullivan area (Figures 28 and 29).

The length-frequency distributions of northern squawfish collected during the study in the summer sampling period are given in Appendix E4. Squawfish ranged in total length from 63 to 585 mm with the largest fish weighing 1,723 g. The distribution was skewed with the vast majority of the fish caught under 250 mm. Fish in this category comprised 69.3, 83.3 and 80.8 percent of the catch in 1983, 1984 and 1985, respectively.

Suckers

Suckers comprised approximately 24 percent of the catch in sinking nets and only 2 percent of the floating net catch (Table 7), indicating that they are closely associated with the substrate in nearshore areas. Overall, longnose suckers were more abundant in the net catch than largescale suckers (Figure 27 and Appendix Dl). The catch of suckers was much higher in the summer than in other seasons. Sucker catches were fairly consistentamongthe areas except the catch of longnose suckers which was markedly higher in the Emery area than in the other two areas. Annual catches varied from means of 2.9 to 4.1 fish per net for large-scale suckers as compared to 4.6 to 7.8 fish per net for longnose suckers. The length frequency distributions for the two species are given in Appendix E5.

Purse Seine Sampling

A total of 50 randomly selected purse seine hauls were made in the Sullivan area from May 6-17, 1985. The catch consisted of 8 westslope cutthroat trout, 16 bull trout and 176 mountain white-fish. Floating gill net catches of 3.7 cutthroat per net during the same period indicated that cutthroat were abundant in the nearshore areas. However, these littoral areas could not be sampled with the 30-foot deep purse seine. In addition, cutthroat appeared to be distributed patchily rather than randomly in the Sullivan area during the spring. This combination of patchy distribution and higher nearshore densities of cutthroat violate the assumptions for the area density estimator (Everhart and Young 1975) and made it impossible to obtain a valid population estimate for cutthroat. Purse-seine sampling was not suitable for estimating bull trout and mountain whitefish populations, because these were benthic oriented species which were not collected efficiently.

Electrofishing

Shoreline habitat in the Sullivan area was electrofished seasonally in 1984, and in the spring of 1985. Westslope cutthroat trout catches were highest in spring of 1984 ranging from 4.6 to 10.0 fish per hour of electrofishing (Table 11). Cutthroat were not collected in July, 1984 when surface water temperatures were 19.4% indicating they had moved offshore into

Table 11. Electrofishing catch from shoreline habitat in Sullivan area of Hungry Horse Reservoir, 1984, 1985.

Date	Hours fished	Surface Water Temperature (C°)	Cutthroat Trout Adults	Cutthroat Trout Juveniles	Bull Trout Adults	Bull Trout Juveniles	Mountain Whitefish Adults	Mountain Whitefish Juveniles	Northern Squawfish	Suckers
					1984					
5/2	1.6	6.9	2.5	3.1	0.6	1.9	4.4	39.4	1.3	10.7
5/9	2.0	8.2	8.0	2.0	1.0	---	6.5	10.0	---	25.0
5/10	2.6	8.4	2.7	1.9	---	---	3.1	1.9	---	20.4
7/17	2.1	19.4	---	---	---	---	---	0.8	---	a/
7/18	1.5	19.4	---	---	---	---	---	18.5	3.1	108.5
9/11	1.8	16.1	1.1	---	---	---	2.2	29.4	---	a/
9/12	2.2	16.1	.05	.05	---	.05	3.6	26.4	---	a/
					1985					
5/22	2.7	7.5	---	---	1.9	1.5	b/		b/	b/
5/28	2.0	8.0	1.5	---	---	0.5				
5/29	2.9	8.0	1.4	---	0.3	0.3				
5/30	2.0	8.0	---	---	0.5	---				

a/ Suckers not collected but they were numerous in the littoral habitat.
b/ Mountain whitefish, northern squawfish and suckers were not collected in May 1985.

deeper (cooler) waters. Cutthroat were again caught in the nearshore habitat in September when surface water temperatures had declined to 16.1°C.

During the spring and fall, mountain whitefish juveniles were generally the most abundant fish in the nearshore areas. In contrast, suckers were very numerous during the summer and early fall months. Comparatively few northern squawfish and bull trout were captured during the electrofishing sampling.

Population Estimate

An attempt was made to obtain a mark-recapture estimate for westslope cutthroat trout in HHR. The migratory nature of cutthroat in the reservoir makes it difficult to obtain an estimate. Adult fish marked in 1985 were not available to anglers in the reservoir from mid-May until August because they were in the tributaries spawning. Most fish tagged in 1984, on the other hand, were in the reservoir in 1985 since most cutthroat spawn in alternate years (Huston,1974). Thus, our estimate was based on cutthroat marked in 1984 as spawners or spent spawners and recaptured in 1985 by anglers and gill net catches. This methodology made it difficult to meet the assumptions of a mark-recapture estimate. Nevertheless, it did provide us with a rough approximation of the number of adult cutthroat in HHR. We estimated a population of 17,818 adult cutthroat in HHR in the spring of 1984. Thenumber of recaptures was low, consequently the standard deviation was high, (6,690 fish). We will attempt to make more reliable estimates of cutthroat trout numbers in 1986 and 1987.

Fish Trapping

Hungry Horse

The upstream trap was operated in Hungry Horse Creek in 1985 from May 29 through June 30. A total of 154 adult westslope cutthroat trout were passed through the trap during the spawning run. The peak of the upstream run took place from June 5 to June 20 (Figure 30). The highly skewed sex ratio of 8.6 females to LO males (Table 12) indicates the first part of the run, which is primarily males, was not sampled. High water during this period precludedefficientoperation ofthetrap. Spent spawners were first collected in the downstream trap on June 14 and nearly all spent fish had left the stream by July 17. The sex ratio of adults caught in the downstream trap was 4.7 femalses: 1.0 males. The total estimated run in 1985 was 370 fish with an average size of 375 and 370 mm for males and females, respectively. Most of the fish were longer than 350 mm in total length (Appendix Fl).

The emigration of juvenile westslope cutthroat trout was monitored from June 13 to September 12 when high flows forced the trap to be removed. A total of 1212 juvenile cutthroat were

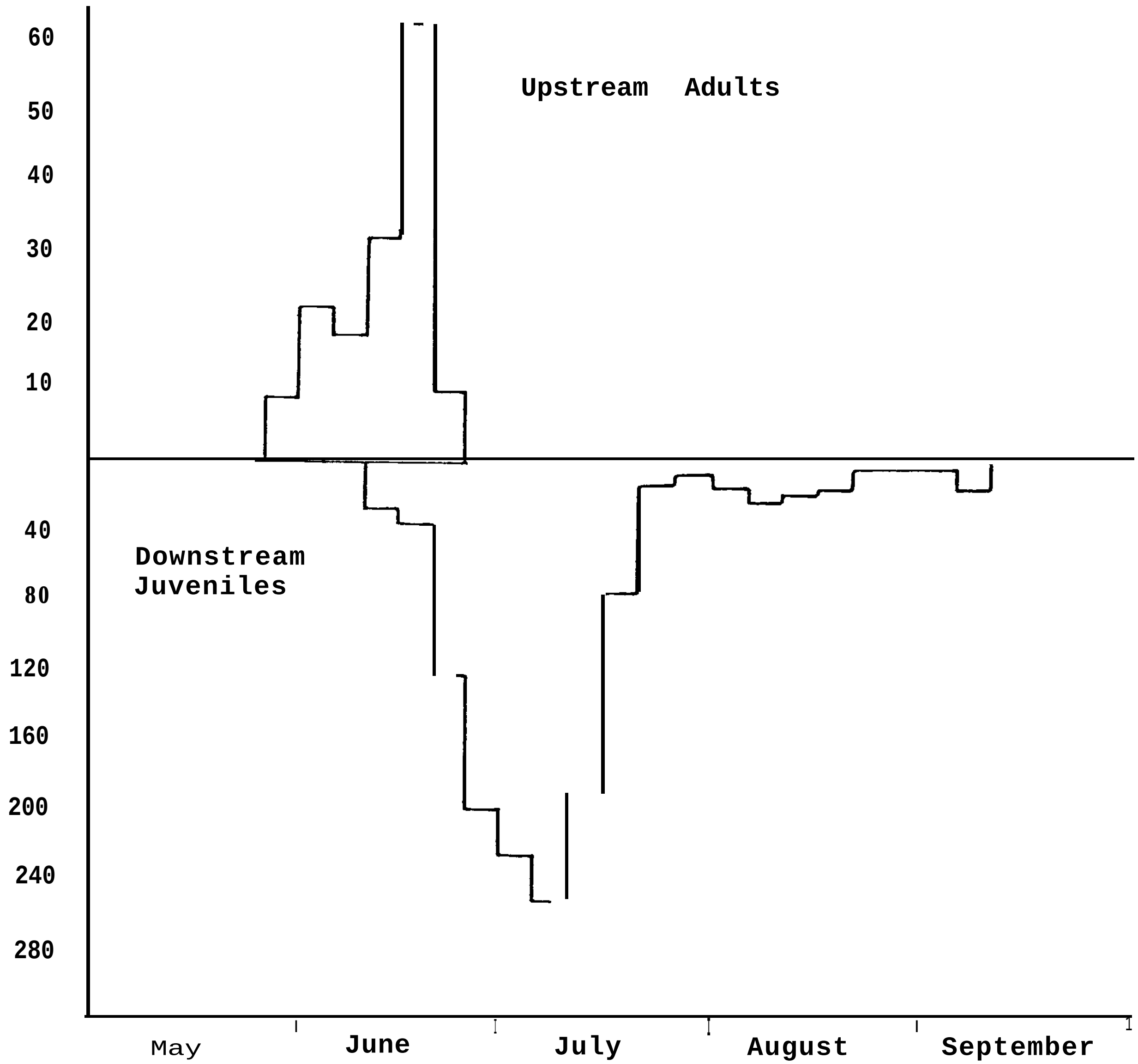


Figure 30. Upstream and downstream trap catches of westslope cutthroat trout in Hungry Horse Creek trap by five-day periods, 1985.

Table 12, Estimated number of spawners, sex ratio and mean length of westslope cutthroat trout spawning runs into Hungry Horse Creek. The 95% confidence limits is given in parentheses as the percent of the point estimate.

Year	Estimated run	Sex ratio Male : Female	Mean length (mm) Male	Mean length (mm) Female
1968	1160	1.0 : 3.7	373	368
1969	1050 (3.7)	1.0 : 5.3	368	371
1970	1001 (3.9)	1.0 : 5.6	358	361
1971	702 (3.2)	1.0 : 6.2	350	358
1972	590 (3.6)	1.0 : 4.0	371	358
1984	388 (13.8)	1.0 : 4.4	375	370
1985	370 (14.8)	1.0 : 8.6	374	374

passed through the downstream trap during this period (Table 13). These fish averaged 146 mm in total length and ranged between 46 and 240 mm. The length frequency distributions are given in Appendix F2. The mean length of the jweniles declined each month from June to September, indicating that older fish migrated earlier in the summer with younger fish moving downstream later in the summer and fall. Age II (21 percent) and III (68 percent) fish comprised most of the 1984 juvenile migrants and probably most of the 1985 emigrants.

The number of juveniles caught in the downstream trap has declined from a high of 2,700 in1969 to 912 in 1984 and 1,213 in 1985 (Figure 31). A corresponding decline in the number of fish in the spawning run has occurred from 1968 (1,160 spawners) to 1985 (370 spawners). These reductions in the numbers of spawners and juveniles has probably resulted from a combination of factors which include changes in reservoir operation, habitat degradation In Hungry Horse creek from logging activities and angler caused mortality of spawners. Huston (1973) attributed the reduction in the spawning runs from 1968-71 to an increase in the reservoir mortality rates of juvenile and adult cutthroat. Reservoir operation changed beginning in 1966 when a fall drawdown was introduced and maximum drawdown increased (Figure 2). The spawning runs two years subsequent to the drawdown are depicted in Figure 32. The assumption was made that most of the mortality would accrue to the juveniles during their first year in the reservoir and this would be reflected in a lower spawning run two years later.

A moderate fall drawdown in 1967 coupled with a maximum annual drawdown of 115 feet appeared to effect reservoir mortalities. The spawning run in 1969 declined by 110 fish from 1968.

The jwenile emigration in 1969 of 2,700 fish was the highest recorded, yet the spawning run two years later in 1971declined 300 fish from 1970. The fall drawdown in 1969 was the largest recorded and probably caused increased juvenile mortality. The fall drawdown in 1970 was also quite large and the spawning run in 1972 declined by 112 fish from the previous year.

The spawning continued to decline from 590 fish in 1972 to 388 in 1984. The maximum and fall drawdowns during this period ranged from 40 to 110 ft. and 0.0 to 64 ft, respectively. The average fall drawdown from 1973-83 of 24 feet was identical to the 1966-72 mean, whereas the mean maximum drawdown of 73 feet was 17 feet less from 1973-83 than from 1966-72. This indicates that the fall drawdown may influence survival of cutthroat juveniles.

The decline in the juvenile recruitment from the early 1970% to 1984-85 was probably related to inadequate seeding due to reductions in the spawning run and habitat degradation resulting from logging activities in the drainage. In addition, removal of

Table 3. The catch of adult and juvenile westslope cutthroat trout in downstream traps fished in tributaries to Hungry Horse Reservoir, 1984, 1985.

Stream	Period trap operated	Days operated	Juveniles: Range and mean length of catch (mm)	June	July	Aug.	Sept	Total	Adult: Range and mean length of catch (mm)	June	July	Aug.	Total
					1984								
Clark	07/11-07/[illegible]	20	117<152<205	—	64	—	—	64 3)a/	—	—	- -	-	—
Emery	06/26-08/03	37	92<142<215	53	355	1	--	409	311<360>395	6	18	-	24
Forest	07/11-08/14	33	118<170<258		143	7	—	150 8)	350<385>405	—	10	-	10
Hungry Horse	06/30-08/09	40	52<143<225	11	912	57	—	980	285<369>593	—	162	1	183
Quintonkon	07/13-07/30	17	104<164<208	—	23	—	—	23 6)	341<375>410	—	[illegible]	—	7
				1985									
Emery	06/08 07/29	42	96<139<202	109	92	--	-	201	345<369>410	11	4	-	15
Hungry Horse	06/13 09/12	91	46<146<240	359	760	67	26	1212	273<374>430	165	75	2	242

a/ Juvenile bull trout caught in parentheses.

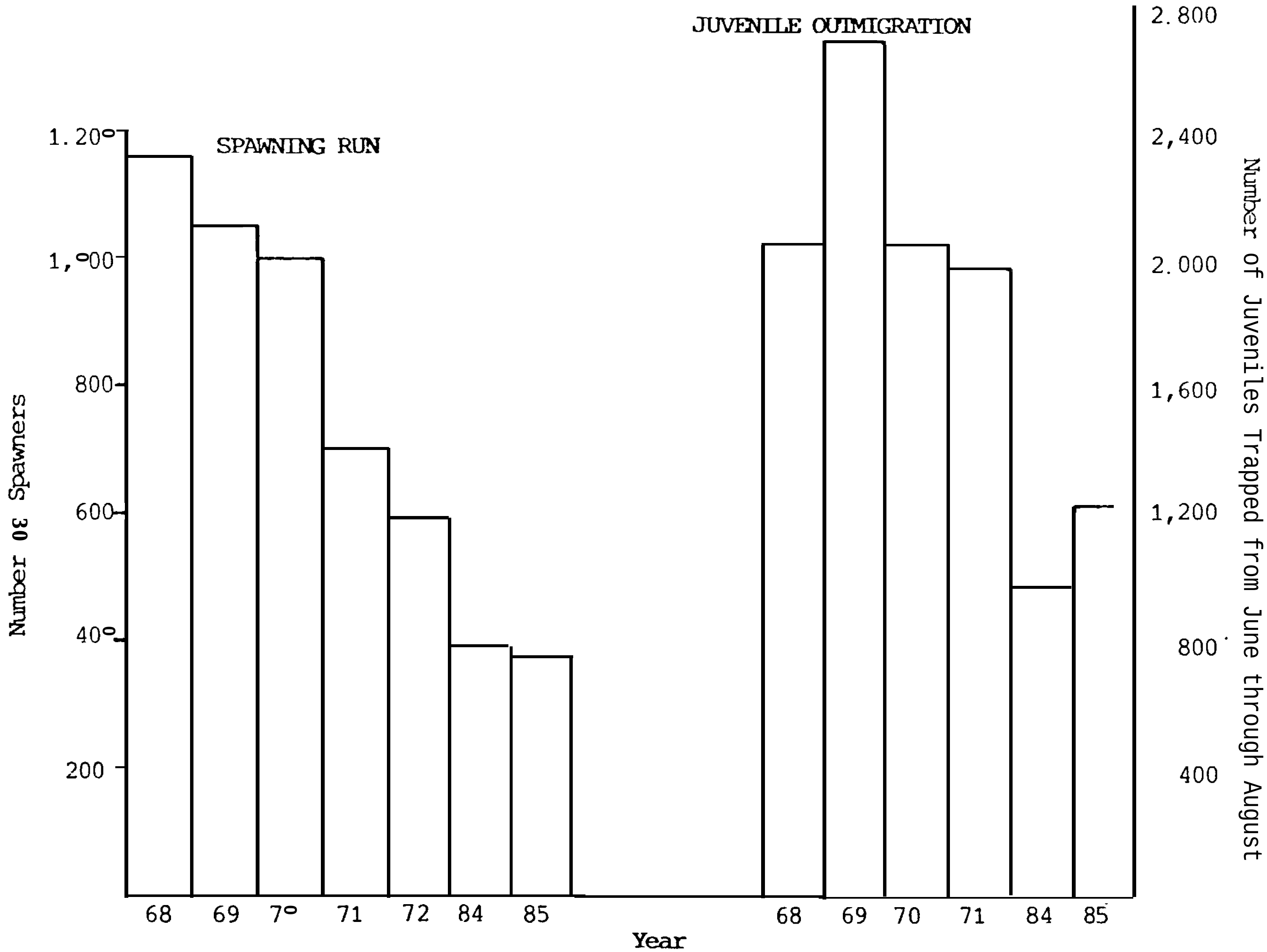


Figure 31. The spawning runs of adfluvial westslope cutthroat trout from Hungry Horse Reservoir into Hungry Horse Creek and subsequent juvenile emigration, 1968-85.

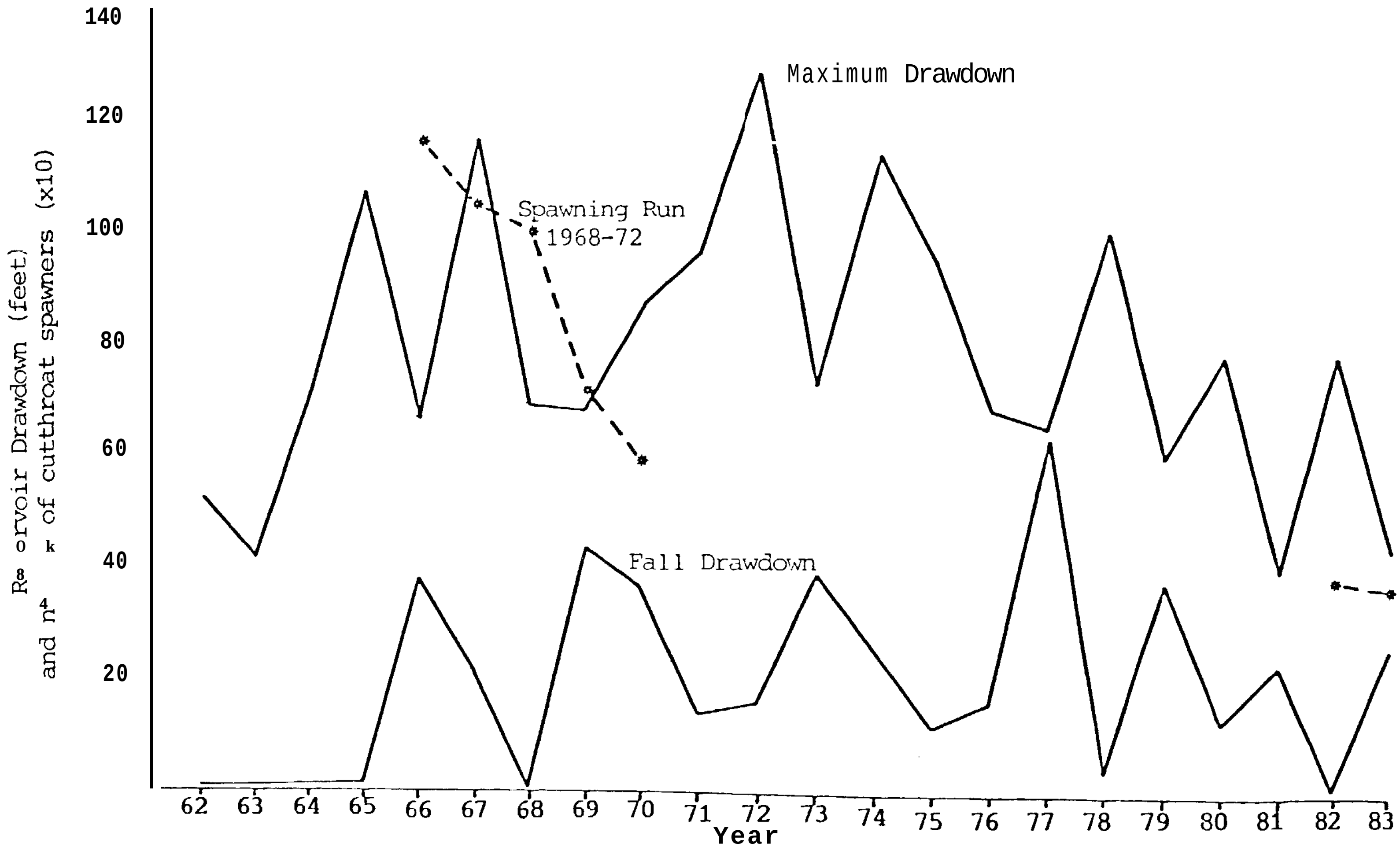


Figure32. Maximum drawdown and end of October drawdown for Hungry Horse Reservoir compared to spawning runs of westslope cutthroat trout into Hungry Horse Creek two years following the drawdowns.

juveniles for brood stock rehabilitation at the Murray Springs Hatchery in 1983 and 1984 resulted in a reduction of approximately 400 outmigrant juveniles in 1984 and 100 in 1985.

Emery Creek

Prior to dam construction Emery Creek and Hungry Horse Creek flowed together before entering the South Fork River. Emery Creek has historically been an important spawning and nursery stream for adfluvial westslope cutthroat trout. A total of 201 juvenile cutthroat and 15 adults were caught in 1985 in a downstream trap operated from June 18 through July 29 (Table 13). This catch represents only a minor part of the juvenile emigration. The mean range in length for the juveniles were comparable to those recorded for juveniles in Hungry Horse Creek.

FISH MOVEMENT PATTERNS

Westslope Cutthroat Trout

A total of 5,612 juvenile and 772 adult westslope cutthroat trout were tagged from 1983-85 in HHR, tributaries to HHR, and the South Fork of the Flathead River (SFFR) from the head of the reservoir to Meadow Creek (Table 14). Movement information was obtained on 31 juvenile and 89 adults from fish tagged in HHR and the lower SFFR Anglers returned 75 of the tags with the remainder of the recaptures coming from fish traps and gill nets.

Recaptures were caught throughout the reservoir and its tributaries, with 49 percent of the fish caught within one kilometer of tagging origin. Approximately 23 percent of fish exhibited upstream movement as compared to 28 percent which were caught downstream from tagging location (Table 15). Only nine cutthroat moved more than 30 km from where they were tagged. The longest upstream and downstream movements were 49.9 and 52.3 km, respectively. The fish which moved furthest upstream was tagged in Hungry Horse Creek on June 28, 1983 and recaptured near Clark Creek on December 15, 1983 (Appendix Gl). The record downstream movement was a fish tagged in Lower Twin Creek on August 9, 1983 and recaptured about one year later near Lid Creek (Appendix G2 and G3).

The downstream movement of cutthroat trout was probably influenced by the dewatering of the upper reservoir. Cutthroat trout moved upstream in the spring to spawn in tributaries located in the upper part of the reservoir and in the SFFR The return of tagged fish by anglers was effected by differences in fishing pressure among the reservoir areas. Pressure was highest in the Murray area followed by the Emery and Sullivan areas.

Cutthroat trout were captured and tagged in the upper part of the SFFR to evaluate interchange of these populations with reservoir fish. The upper SFFR drainage is speculated to provide

Table 14. The number of westslope cutthroat trout tagged in the Emery, Murray and Sullivan areas of Hungry Horse Reservoir and the lower South Fork of the Flathead River from HHR to Meadow Creek (37 km), and the upper South Fork from Meadow Creek to Youngs Creek (106 km upstream from HHR).

	Location Tagged				
	Emery area	Murray area	Sullivan area	Lower South Fork area	Upper South Fork area
			1983		
Juvenile	755	402	637	374	--
Adults	34	37	25	27	--
			1984		
Juvenile	858	0	920	12	--
Adults	204	0	93	6	--
			1985		
Juvenile	1413	0	242	0	712
Adults	256	0	69	36	319
Totals					
Juveniles	3026	402	1789	386	712
Adults	494	37	187	69	319

Table 15. Movement of recaptured westslope cutthroat trout tagged in Hungry Horse Reservoir and the lower part of the South Fork of the Flathead River, 1983-85. Table includes only fish which moved more than one kilometer.

	Upstream Movement (km)					
	10	11-20	21-30	31-40	41-50	51-60
			1983			
Juvenile	1	0	0	0	0	0
Adult	1	0	1	0	1	0
			1984			
Juvenile	6	0	0	0	0	0
Adult	1	0	0	0	0	0
			1985			
Juvenile	0	0	0	0	0	0
Adullt	3	5	4	1	3	0
			Total			
Juvenile	7	0	0	0	0	0
Adult	5	5	5	1	4	0
	Downstream Movement (km)					
	10	11-20	21-30	31-40	41-50	51-60
			1983			
Juvenile	6	1	1	0	0	0
Adult	2	1	0	0	0	0
			1984			
Juvenile	7	1	1	0	0	0
Adult	3	2	1	0	1	1
			1985			
Juvenile	1	0	0	0	0	0
Adult	1	0	2	1	1	0
			Total			
Juvenile	14	2	2	0	0	0
Adult	6	3	3	1	2	1

spawning and nursery habitat for reservoir cutthroat. The first documented movement of cutthroat through Meadow Creek Gorge into the upper SFFR was obtained in July, 1985.

A total of 712 juvenile and 319 adult westslope cutthroat trout were tagged in the upper SFFR in 1985 (Table 14). Movement information was provided on 22 of these fish by tag returns from anglers (Appendix G5). Only four of these tag returns exhibited significant movement. Two cutthroat moved upstream approximately 35 km and two relocated downstream between 6-8 km.

CREEL CENSUS

Creel census data collected from HHR in 1985 are summarized in Tables 16 and 17. Atotalof 794 anglers were contacted during the survey. The catch rate of westslope cutthroat ranged from a low of 0.11 fish per man-hour of effort in June to 0.31 fish per-hour in October. The October catch rate in 1985 was less than recorded by anglers during the 1961-69 fall period (Huston 1971). The overall average of 0.17 fish per hour of effort for the year was higher than recorded in Libby Reservoir for cutthroat trout from 1977-1981, and much higher than estimated for Flathead Lake in 1981-82 (Graham and Fredenberg 1983).

Cutthroat comprised approximately 76 percent of the catch followed by bull trout (15.2 percent) and mountain whitefish (8.9 percent). The mean total length of cutthroat and bull trout creeled was 329 mm and 455 mm, respectively. The largest fish creeled was a bull trout which was 630 mm in length and weighed 2,221g (Table 18).

There was a considerable difference in fishing pressure and catch rates among the areas (Table 16). The majority of the fishing pressure took place in the Murray area, (55.0 percent) followed by the Emery area (34.6 percent) and the Sullivan area (10.4 percent). The catch rate of cutthroat and bull trout was highest in the Sullivan area, intermediate in the Murray area and lowest in the Emery area. Gill net catches of these two species were also higher in the Sullivan area than in the other two areas.

Approximately 70.4 percent of the anglers contacted fished from boats with the remainder fishing from shore (Table 17). Most anglers fished with lures (64.8 percent) followed by a combination of method, (natural bait, and flies). Cutthroat trout was the preferred fish sought by the vast majority of the anglers with 74.1 percent expressing a preference for this species. It was surprising that none of the anglers contacted expressed a preference for bull trout. Almost all of the anglers were from Flathead County (88.4 percent), and only 3.7 percent were from outside of Montana.

Table 16. Summary of contact creel census conducted on Hungry Horse Reservoir, 1985.

Month	Number Anglers	Hours Fished	Number caught and percent (%) of catch: Cutthroat	Bull trout	Mountain Whitefish	Catch per Man hour of effort: Cutthroat	Bull trout	Mountain Whitefish
Areas Combined								
May	273	1303	264(83.5)	40(12.7)	12(3.8(	0.20	0.03	0.01
Jun	202	831	89(50.6)	48(27.2)	39(22.2)	0.11	0.06	0.05
Jul	169	635	95(72.5)	25(19.1)	11(8.4)	0.15	0.04	0.02
Aug	81	315	62(88.6)	3(4.3)	5(7.1)	0.20	0.01	0.02
Sep	43	186	34(97.1)	_ _	l(2.9)	0.18	---	0.01
Oct	26	113	35(100)	___	___	0.31	---	- -
Reservoir Total	794	3383	579(75.9)	116(152)	68(8.9)	0.17	0.03	0.03
Emery Area								
Area Total	288(36.3)	1170(34.6)	161(73.2)	26(11.8)	33(15.0)	0.14	0.02	0.03
Murray Area								
Area Total	427(53.8)	1859(55.0)	342(79.9)	61(14.3)	25(5.8)	0.18	0.03	0.03
Sullivan Area								
Area Total	79 (9.9)	354(10.4)	76(66.1)	29(25.2)	10(8.7)	0.21	0.08	0.03

Table 17. Fishing method, residency and species sought by anglers contacted during the creel survey conducted on Hungry Horse Reservoir, 1985.

	Percent Anglers fishing with				Percent anglers fishing from		Percent of anglers from				Percent anglers fishing for		
Month	Natural	Flies	Lures	Combination	Shore	Boat	Flthd. County	Western Montana	Eastern Montana	Non-Residents	Wct	DV	Any
May	23 (19.3)	--	85 (71.4)	11 (9.3)	35 (29.4)	84 (70.6)	113 (95.0)	3 (2.5)	3 (2.5)	--	101 (84.8)	--	18 (15.2)
Jun	15 (15.2)	3 (3.0)	60 (60.6)	21 (21.2)	32 (32.3)	67 (67.7)	94 (95.0)	2 (2.0)	3 (3.0)	--	81 (81.8)	--	18 (18.2)
Jul	11 (14.1)	4 (5.1)	43 (55.1)	20 (25.7)	24 (30.8)	54 (69.2)	57 (73.0)	6 (7.7)	5 (6.4)	10 (12.9)	39 (50.0)	--	39 (50.0)
Aug	2 (6.7)	1 (3.3)	17 (56.7)	10 (33.3)	11 (36.7)	19 (63.3)	22 (73.3)	2 (6.7)	3 (10.0)	3 (10.0)	17 (67.7)	--	13 (43.3)
Sep	2 (11.8)	--	14 (82.4)	1 (5.8)	3 (17.6)	14 (82.4)	16 (94.1)	--	1 (5.9	--	13 (76.5)	--	4 (23.5)
Oct	--	--	11 (91.7)	1 (8.3)	--	12 (100)	12 (100)	--	--	--	12 (100)	--	--
Total	53 (14.9)	8 (2.3)	230 (64.8)	64 (18.0)	105 (29.6)	250 (70.4)	314 (88.4)	13 (3.7)	15 (4.2)	13 (3.7)	26 (74.1)	--	92 (35.9)

Table 18. Average length (mm) and weight (grams) of westslope cutthroat trout (WCT) and bull trout (DV) harvested by anglers from Hungry Horse Reservoir in 1985. Standard deviation of the mean length is given in parenthesis.

Species	Range and mean length	Range and mean weight
WCT	150 < 329 < 440 (+46)	31 < 349 < 857
DV	340 < 455 < 630 (+95)	306 < 780 < 2,222
MWF	285 < 322 < 480 (+55)	197 < 286 < 966

GROWTH

The growth of cutthroat trout was analyzed using samples collected from the 1984 spring spawning run into Hungry Horse Creek and the June 1984 gillnet catches from HHR (Table 19). Annulus formation usually occurs in May and June in HHR Thus, empirical lengths of cutthroat caught during this period should represent growth at annulus formation. The fish collected in the spawning run averaged 367 mm in total length at age V and 380 mm at age VI. Gillnetted cutthroat had a mean length of 301 mm at age IV and 343 mm at age V. The growth of cutthroat in HHR was less than recorded in Libby Reservoir (Shepard 1985), but greater than found in Flathead Lake (Leathe and Graham 1982).

The monthly growth increments of westslope cutthroat trout entering HHR in 1985 are presented in Table 20. The growth from April through July is primarily stream growth as the peak emmigration of juvenile cutthroat from tributary streams to the reservoir occurs from mid-June to the end of July. Reservoir growth was fastest in August and September, then gradually declined in October and November. The period from September through November accounted for 41, 51, and 53 percent of the total growth accrued by the migration class 2, 3, and 4 fish, respectively. The importance of this fall period for growth of cutthroat indicates that fall drawdowns must be carefully evaluated to determine their impact upon food availability and fish growth.

TRIBUTARY HABITAT

Habitat Surveys

Stream surveys were completed on 52 tributaries to HHR during the 1983-84 field season. This data which included 84 reaches in 229 km of stream has been coded and entered into the Montana interagency stream fishery data base. The 1983-84 information was summarized by May and Zubik (1985). A Total of 160.3 km of streams with gradients of less than 10 percent are accessible to adfluvial westslope cutthroat trout. This doesn't include the South Fork River Drainage above HHR. Tributaries with the best spawning habitat were Emery, Hungry Horse, McInernie, Wheeler and Lost Johnny Creeks.

Graves Creek was surveyed in 1985. This drainage not only had a barrier at its mouth, but also a series of three falls in its lower 3 km which were barriers to upstream fish migration.

Culvert Evaluations

Fish passage was evaluated at 12 culverts located in tributary streams to HHR during the cutthroat trout spawning run in 1984. Upstream migration was not possible at the culverts located in

Table 19. Average total-length at capture of westslope cutthroat trout by age and migration class in Hungry Horse Creek, 1984 and in Hungry Horse Reservoir for June, 1984. Number of fish aged is given in parenthesis.

Migration Class	Length at capture (mm)				
	II	III	IV	V	VI

Hungry Horse Creek

Migration Class	II	III	IV	V	VI
X_1	--	--	322(1)	375(1)	
X_2	--	--	319(1)	377(6)	362(1)
X_3	--	--	346(7)	365(35)	383(8)
X_4	--	--	--	362(1)	377(1)
Mean	--	--	340(9)	367(43)	380(10)

Hungry Horse Reservoir

Migration Class	II	III	IV	V	VI
X_1	--	207(2)	313(1)	345(2)	--
X_2	167(1)	230(6)	305(20)	354(11)	--
X_3	--	191(16)	305(57)	340(34)	--
X_4	--	--	252(7)	340(12)	--
Mean	167(1)	202(24)	301(85)	343(59)	--

Table 20. The monthly growth increment (mm) of westslope cutthroat trout in Hungry Horse Reservoir, 1985, as determined by otolith analysis. The increments were calculated from fishes first year of growth in the reservoir. Percent of total growth contributed by each month is given in parenthesis.

Migration Class	Number of fish	Rack calculated growth increments (mm) Apr-Jul	Aug	Sept	Oct	Nov	Total
2	5	42 (34.4)	30 (24.6)	23 (18.9)	16 (13.1)	11 (9.0)	122
3	19	29 (25.0)	28 (24.1)	25 (21.6)	20 (17.2)	14 (12.1)	166
4	13	21 (20.6)	27 (26.5)	22 (21.6)	19 (18.6)	13 (12.8)	102

Clayton, Felix and Paint creeks, whereas culverts in Clark, Margaret, Forest and the South Fork Logan Creek provided good conditions for fish passage (Table 21). Culvert sites on five additional streams were recommended for further study in 1985 to determine the magnitude of the passage problem (Table 22).

The hydraulic conditions at the culverts which block upstream movement of trout include; 1) high downstream lip of the culvert 2) lack of jump pool, 3) high water velocities at the upstream and downstream ends of culvert, and 4) combination of culvert length and water velocity exceeding the sustained swimming capability of fish (Gebhards and Fisher 1972). Metsker (1971) noted that water velocity through a culvert should be no greater than six feet per second to insure passage for a 15-inch trout. The sustained swimming speeds of trout range between 2.0-6.4 feet per second depending on the size of the fish (Watts 1974). He suggested that velocities in culverts should be less than 6.0 fps to pass a 12-inch trout. In addition, vertical jumps of more than two or three feet often prevent trout from accessing a culvert. These criteria were used to evaluate passage at the culverts surveyed in 1985.

Water velocities in the Harris Creek culvert approached six fps when flows were greater than 25 cfs (Appendix Hl). Flows were above 25 cfs in 1984-85 from the end of May until about mid-June The spawning run of westslope cutthroat trout in Hungry Horse Creek which is typical of eastside tributaries begins the last week of May and continues through the first week of July (May and Zubik 1985). Using these criteria cutthroat runs into Harris Creek were delayed by about three weeks in 1984-85.

The water velocities at the downstream end of McInernie Creek exceeded 6.0 fps when flows were above approximately 5.0 cfs (Appendix Hl). However, velocities at the upstream end did not approach 6.0 fps until flows were 30 cfs.Therefore, passage was probably possible when flows were below 20 cfs. The run was delayed in 1984-85 from the end of May to about mid-June, or approximately three weeks.

The flows in Murray Creek exceeded 15 cfs from the end of May until approximately the last week of June in 1984-85. During this period, water velocities were above 6.0 fps at the upstream and downstream ends of the culvert (Appendix H2). Thus, it appears that the cutthroat spawning run was delayed approximately four weeks.

Water velocities at the downstream end of the North Fork of Logan Creek were above 6.0 fps when flows were above 60 cfs (Appendix H3). The upstream end velocities exceeded 6.0 fps at flows larger than 20 cfs. Fish passage was probably not possible when flows were above 40-50 cfs. Using this criteria the run was delayed about three weeks in 1984-85.

Table 21. Evaluation of westslope cutthroat trout passage at culverts in 12 tributary streams to Hungry Horse Reservoir. Measurements were taken from June 5 - July 13, 1984 during the cutthroat trout spawning run. The culverts were located on the main access road around the reservoir.

Stream	Culvert Length (ft)	Culvert Width (ft)	Culvert Vertical jump (ft)	Culvert Pool depth (ft)	Velocity Upper end	Velocity Lower end	Flow (cfs)	Fish passage
Clayton	138	8.0	3.0	5.0	5.0-6.0	7.9-10.0	27-80	No
Clark	40	3.0	none	none	1.7-4.4	0.6-2.8	5-29	Yes
Felix	140	10.0	3.0	none	>lO.0	6.0>10	62-65	No
Forest	80	5.0	none	none	5.0-6.8	1.7-4.9	20-58	Yes
Harris	85	5.0	1.0	2.0	2.1-6.4	3.5-6.0	7-25	Marginal at flows >20 cfs
Margaret	70	4.0	1.0	2.5	4.0-4.2	5.0-5.8	20-45	Yes
McInerrie	89	5.0	1.0	2.3	3.3-7.9	5.0-7.9	2.0-22	Marginal at flows >15 cfs
Murray	77	4.0	none	none	3.2-7.8	3.7-9.7	6-21	Marginal at flows >15 cfs
Logan, N.Fk.	77	8.0	0.7	3.0	8.0>10.0	2.7-6.5	19-54	Marginal at flows >20-25 cfs
Loqan, S.Fk.	60	5.0	none	none	5.4-5.8	3.0-3.6	17-22	Yes
Paint	130	4.5	8.0	1.5	5.6	6.7	10.5	No
Riverside	95	10.0	3.0	4.0	5.2>10.0	2.5>10.0	13-72	No at flcws >30 cfs

Table 22. Evaluation of westslope Cutthroat trout passage at culverts in 5 tributary streams to Hungry Horse Reservoir. Measurements were taken from May 28 - June 27, 1985 during the cutthroat trout spawning run. The culverts were located on the main access road around the reservoir.

	Culvert							
Stream	Length (ft)	Width (ft)	Vertical jump (ft)	Pool depth (ft)	Velocity Upper end	Velocity Lower end	Flow (cfs)	Fish passage
Harris	85	5.0	None	1.5	0.9-6.4	1.6-7.0	9.8-29.4	Flows <25
McInerrie	89	5.0	1.1	3.0	0.3-6.7	5.0>10.0	3.5-27.4	Flows <20
Murray	77	4.0	None	2.1	4.1-8.1	3.7>10.0	6.2-43.5	Flows <15
Logan, N.Fk.	77	8.0	0.8	2.7	4.0-9.8	5.0-8.0	15.5-76.2	Flows <40
Riverside	95	10.0	2.5	4.7	2.8-7.6	1.8-8.4	13.4-98.0	Flows <40

The entrance into the Riverside culvert was quite difficult with a vertical jump of approximately three feet and water velocities of greater than six feet per second during most of the spawning run (Appendix H3). This culvert was probably inaccessible during most of the cutthroat spawning run period.

The spawning act is triggered by a combination of degree days and water temperature and spawning must occur at a particular time (Watts 1974). If mature fish are denied access to historical spawning areas, they will often deposit their eggs in undesirable habitat downstream from the barrier. This may result in low survival of egg to fry emergence. For this reason, biologists generally specify an allowable delay interval of six to ten days at most culverts.

TRIBUTARY FISH POPULATIONS

Population Estimates

An attempt was made to obtain population estimates for three reaches in Hungry HorseCreek during September-October of 1985. However, record fall rains resulted in high stream flows which made efficient sampling impossible. Insufficient recaptures were obtained to make valid estimates. The electrofishing has been rescheduled for fall 1986.

IMPACTS OF RESERVOIR OPERATION

Model Development

The goal of this project is to provide decision makers with the information needed to develop a reservoir operation program which will enhance or maintain gamefish populations. To meet this goal, we are in the process of developing a model which will predict the impact of various reservoir operation regimes upon habitat, primary productivity, secondary productivity and gamefish populations. We initially contacted experts in the field of aquatic modeling including members of the Fish and Wildlife Reservoir Research Group, Fish and Wildlife Services Habitat Evaluation Procedures Group, Gene Ploskey (Aquatic Ecosystems Analyst) James Kitchell (University of Wisconsin), Dr. Dan Goodman (Montana State University) , and others within our department and the university system.

The approach selected was one proposed by Dr. Goodman. It entails the use of several rudimentary component models corresponding specifically to the hypothesized mechanisms of the effects of dam operation upon the reservoirs biota. The component models, by virtue of their simplicity are less likely to generate inappropriate predictions and are more accessible to assessment of reliability, than a complex full system models. The model will use particulate carbon to track energy flow through the trophic levels, identify limiting factors and include a sensitivity analysis. It will indicate the direction of change caused by reservoir operation in production of organisms in the various trophic levels.

A thermal predictive model developed by Adams (1974) will be used to predict the effects of reservoir operation upon thermal regimes in both reservoirs. We have contracted with the United States Geological Survey (USGS) to adapt this model for Libby and Hungry Horse Reservoirs. The model will be modified for the Libby selective withdraw1 system beginning in August, 1985. The final report is scheduled for completion on September 30, 1986 and will include a users manual for operation of the model, results of validation tests, and a summary of the simulation tests.

Physical Framework Model

Evaluation of the consequences of the various reservoir management options requires a common physical framework within which the submodels can operate. This framework must be a three-dimensional representation of the reservoir basin, coupled to a day-by-day representation of the inflow, turbidity, solar radiation and air temperature. The model will have a provision for specifying the annual schedule of water withdrawals. The structure of the model will allow for a day-by-day inventory of the amount of reservoir area representing each depth of water column with a temperature profile for that water colurm.

The effect of reservoir operation upon thermal regimes within the reservoir will be evaluated using the predictive thermal model. The modelwillenable us to hold environmental variables (volume of inflow, temperature of inflow, and solar radiation) constant, while determining impacts of operational variables (discharge volume, depth of discharge and timing of discharge) on the thermal regime in the reservoir. We can evaluate the effect of these predicted thermal regimes on primary productivity, secondary productivity and fish growth by incorporating them into the physical framework model.

PrimaryProduction

The primary production submodel includes area, stratification and washout effects. The area component predicts the annual schedule of primary productivity for the entire lake by area. The input data include local primary production estimates by area, season and depth of water column. These data will be provided by a primary productivity study conducted in 1986. A generalized seasonal fish growth model will be used to estimate fish growth via a two-step average conversion efficiency from primary production through secondary to tertiary production. Particulate carbon will be used to track energy flow through the trophic levels.

The stratification component uses a physical framework to generate a description of profiles of temperature and light with passive distribution of nutrients. Diatom biomass is assigned to the mixed layer and primary production is calculated from light, temperature, and nutrients. The intermediate output is a schedule of depth of light compensation, and depth, and temperature of the mixed layer. The final output is an annual schedule of primary productivity.

The "washout effect" part of the model may not be applicable to HHR It computes net biomass loss to washout and incorporates this loss in an annual primary production model. The final output is a schedule of primary production as affected by washout loss. The model data-needs include: 1) phytoplankton biomass concentrations throughout the reservoir and at the inflows and outflows, and 2) schedule of depths and volumes of withdrawal.

Secondary Production

The benthos submodel uses a life history model of aquatic dipteran to obtain the rate of production of emergers by date. This rate is calibrated against the observed standing stock of emergers. Data required for the model consists of local benthic insect standing crop estimates and local insect pupae and emerger standing stock in water column. The output will be a schedule of incremental dipteran production for the entire lake over the course of the year. If adequate sampling of the emerging forms is achieved, the results should be reliable and readily interpreted.

The generalized seasonal fish growth will be used to carry through secondary production to tertiary production. The estimate is refined by allocating the increased productiontoparticular species on the basis of food habits data.

The zooplankton submodel for Libby Reservoir will include a "washout effect" which may not be part of the HHR model. The zooplankton model will produce a schedule of zooplankton production by area and month as influenced by primary production, living space, and temperature. Data needed to run the model will be bi-weekly zooplankton densities and biomass concentrations in each area throughout the growing season. Production estimates will be by genera except for Daphnia pulex. The generalized seasonal fish growth model will carry through zooplankton production to fish growth.

Fish Community

The fish component model is comprised of four parts. A recruitment subroutine will estimate the number of juvenile westslope cutthroat emigrating to the reservoir from selected tributary streams. Data needs include number of spawners ascending selected tributaries, fecundity of individual fish and instream mortalities of juvenile cutthroat.

A growth model will produce a trajectory of differential growth for the salmonid stocks in the reservoir. Fish stocks will be allowed to grow in response to food availability and to place proportionate demands on food resources as indicated by food habits data. Treating the competition between the salmonids as resource-based scramble competition only should lead to reasonable predictions with respect to growth for a period of one growing season.

The effect of volume (living space) reductions on juvenile trout predation will be estimated. The model will compute consumption rates on the basis of diet composition and temperature corrected metabolic rates. The final output will be a loss rate of young trout due to winter predation. A range of reservoir drawdown levels will be needed to accurately attribute the predation losses to dam operation.

We are also evaluating a population simulation model developed for adfluvial rainbow trout (Serchuk et al. 1980). This is an age-structured simulation model of the growth and population dynamics of a migratory rainbow trout population, It includes all principal life-history intervals and incorporates food-density and temperature relationships of salmonid growth efficiency. The core of the simulation involves individual fish growth rather than growth of the population. Factors directly affecting the growth processes of trout such as food availability, water temperature, and intraspecific competition have been incorporated. Population size, mean weight and biomass are estimated monthly in age, sex and location catagories. A variety of environmental and biological parameters are utilized in the simulation which can be altered as a user option. The utility of this model will be dependent upon sufficient data to allow us to alter the parameters to represent local conditions.

RECOMMENDATIONS

Continue the study with the following modifications:

1. Obtain population estimates for westslope cutthroat trout in reaches of Hungry Horse and Emery Creeks to determine relationship between habitat quality and standing crops of trout.

2. Evaluate substrate composition in Hungry Horse and Emery Creeks to determine its suitability for incubation of salmonid eggs.

3. Reduce sampling frequency of zooplankton and surface insects in Murray area to biweekly rather than weekly. Increasing the sampling frequency in 1985 did not reduce the variability of the data.

4. Install and run Diptera emergence traps in Murray area weekly.

5. Collect zooplankton samples biweekly from the Murray area for carbon particulate analysis.

6. Sample in South Fork Flathead River below Hungry Horse Dam for zooplankton drift from the reservoir to evaluate the downstream loss of secondary production.

7. Conduct the creel census again in 1986 to determine catch rates, species composition of catch and catch of tagged fish by anglers.

8. Collect northern squawfish and bull trout in the spring to evaluate predation on westslope cutthroat trout juveniles at different reservoir elevations.

9. Conduct a monitoring study for approximately 10 years after this study is completed to provide the data necessary to validate the model. Ten years would enable us to examine how reservoir operation effectstwolife cycles of westslope cutthroat and bull trout.

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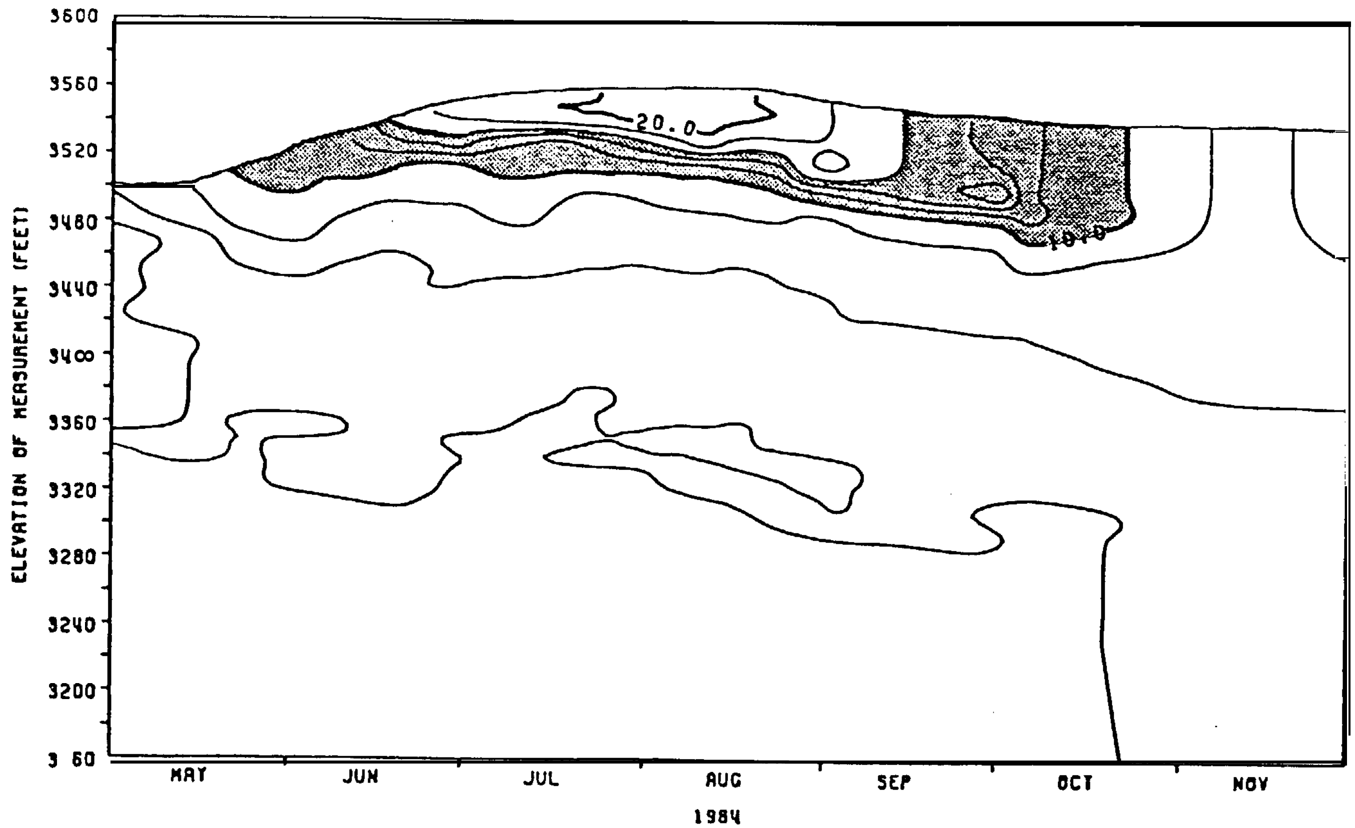
A P P E N D I C E S

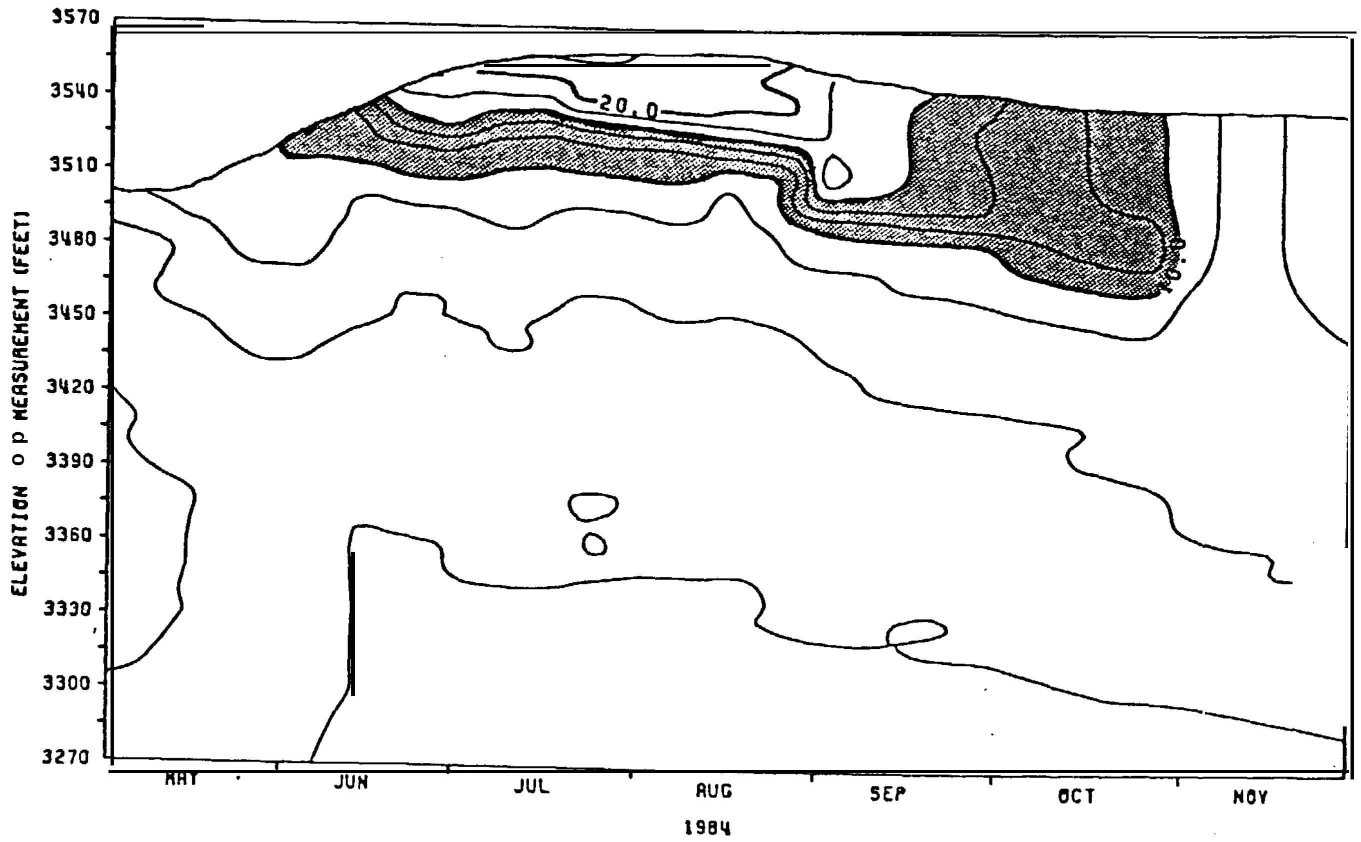
To

Quantification of Hungry Horse Reservoir Water
Levels Needed to Maintain or Enhance Reservoir Fisheries

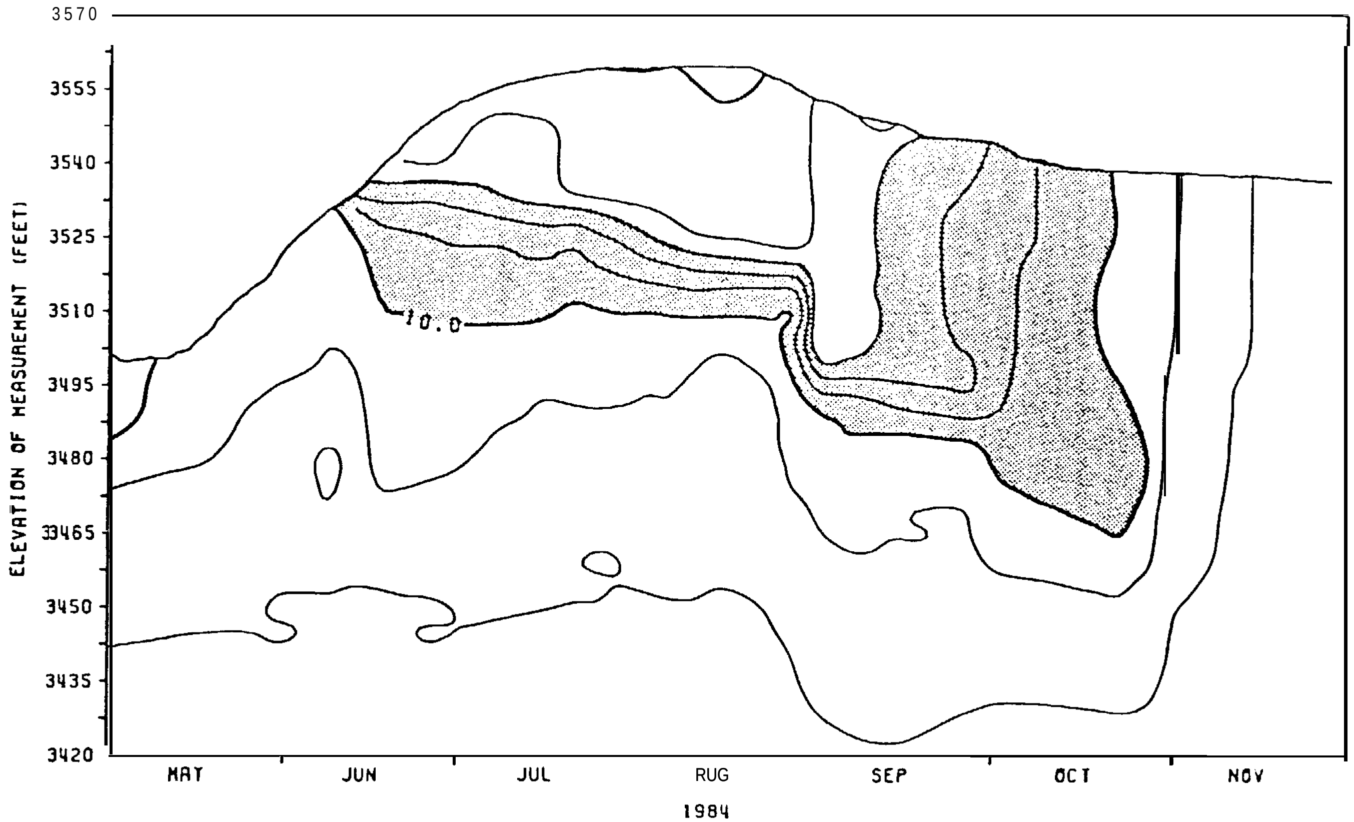
Annual Report 1985



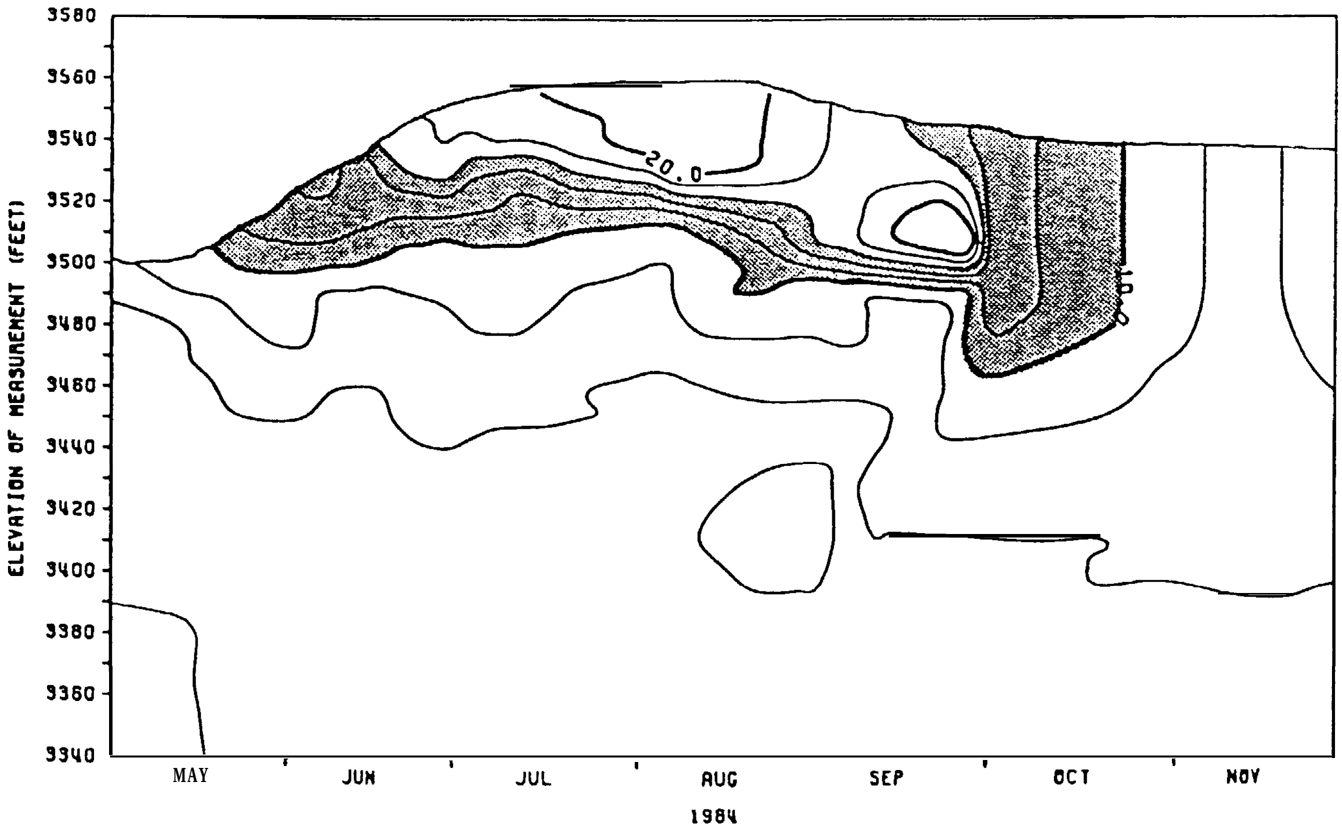
Appendix A1. Isopleths of water temperatures (2°C) from the Emery Station, Hungry Horse Reservoir, 1984. Shaded areas are preferred temperature strata for cutthroat trout (10°-16°).



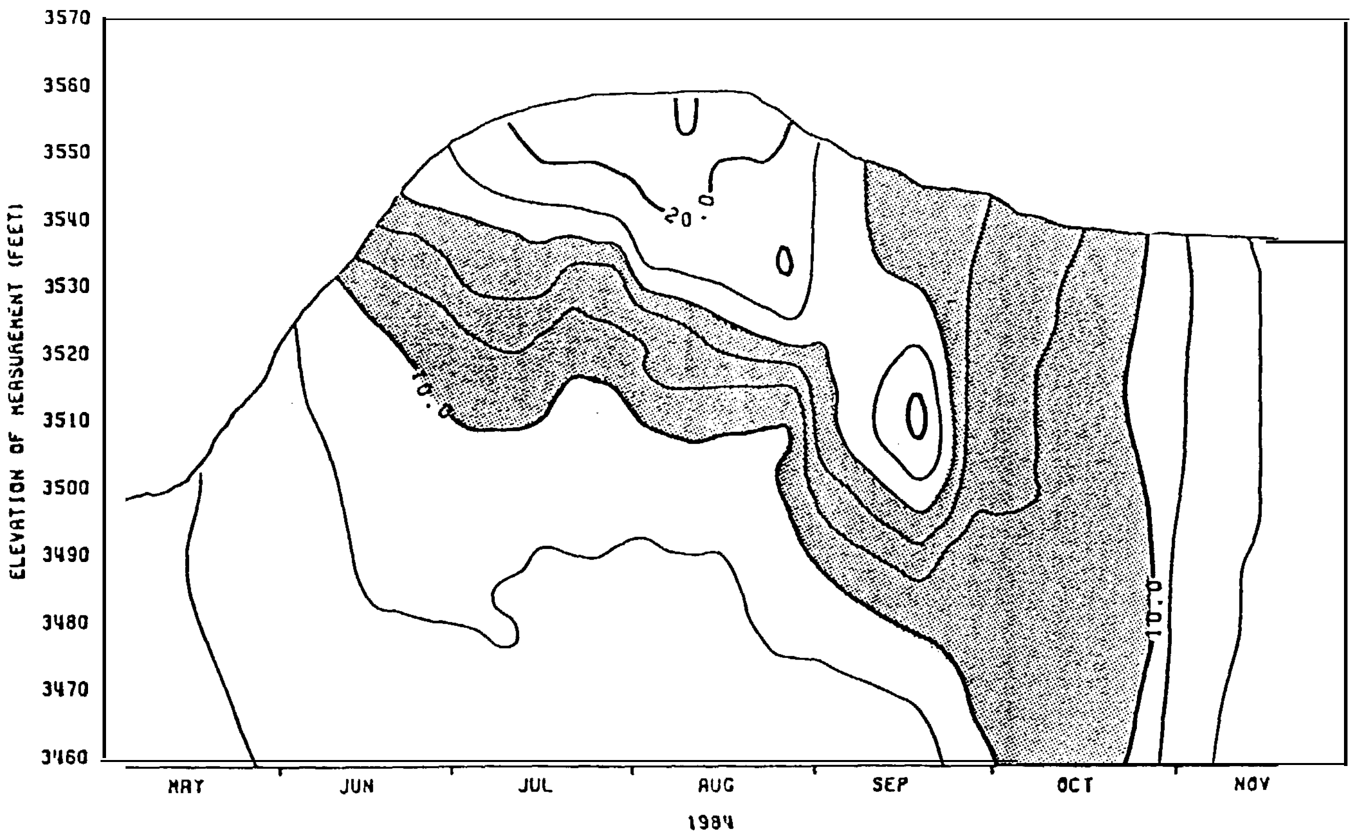
Appendix A2. Isopleths of water temperatures 2°C) from the Murray Station, Hungry Horse Reservoir, 1984. Shaded areas are preferred temperature strata for cutthroat trout (10°-16°).



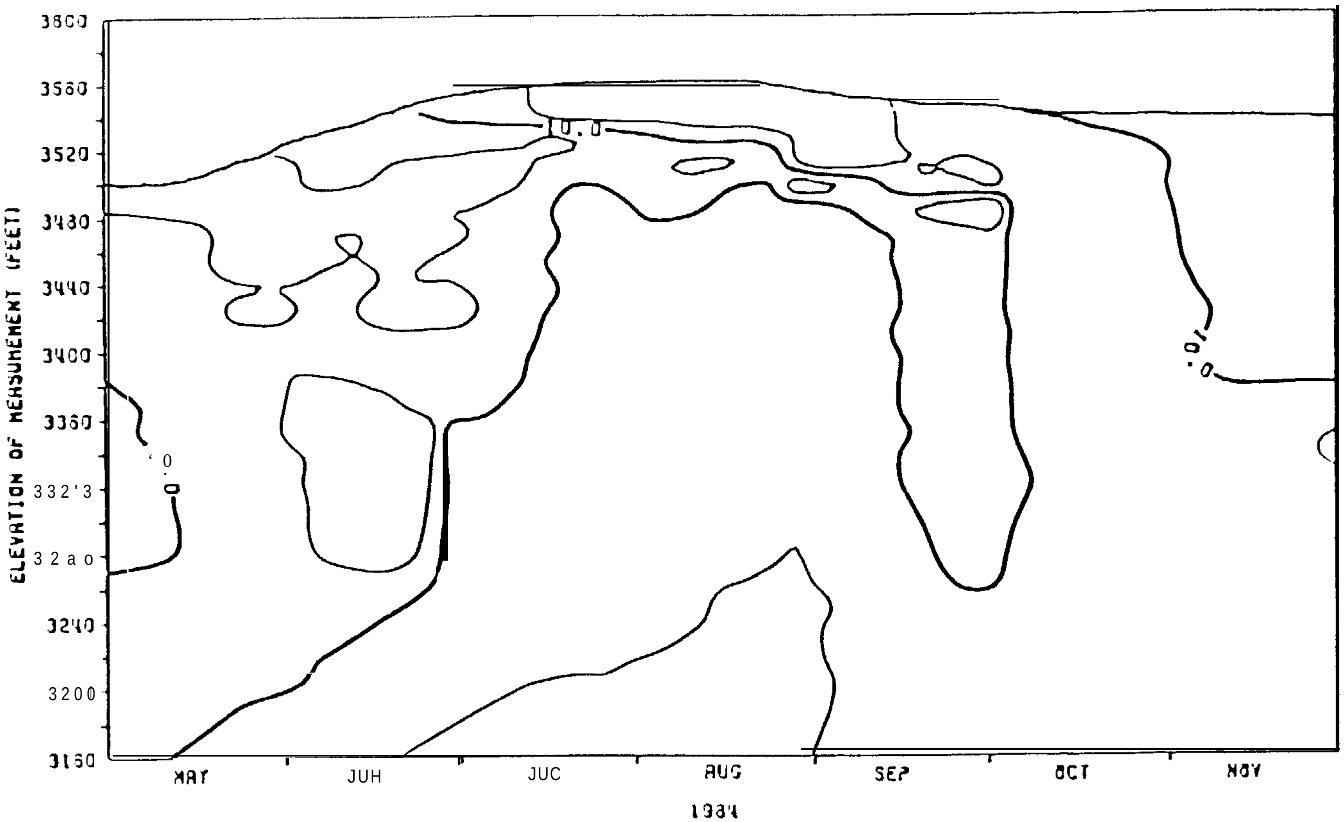
Appendix A3. Isopleths of water temperature (2°C) from the Sullivan Station, Hungry Horse Reserovir, 1984. Shaded areas are preferred temperature strata for cutthroat trout (10°-16°).



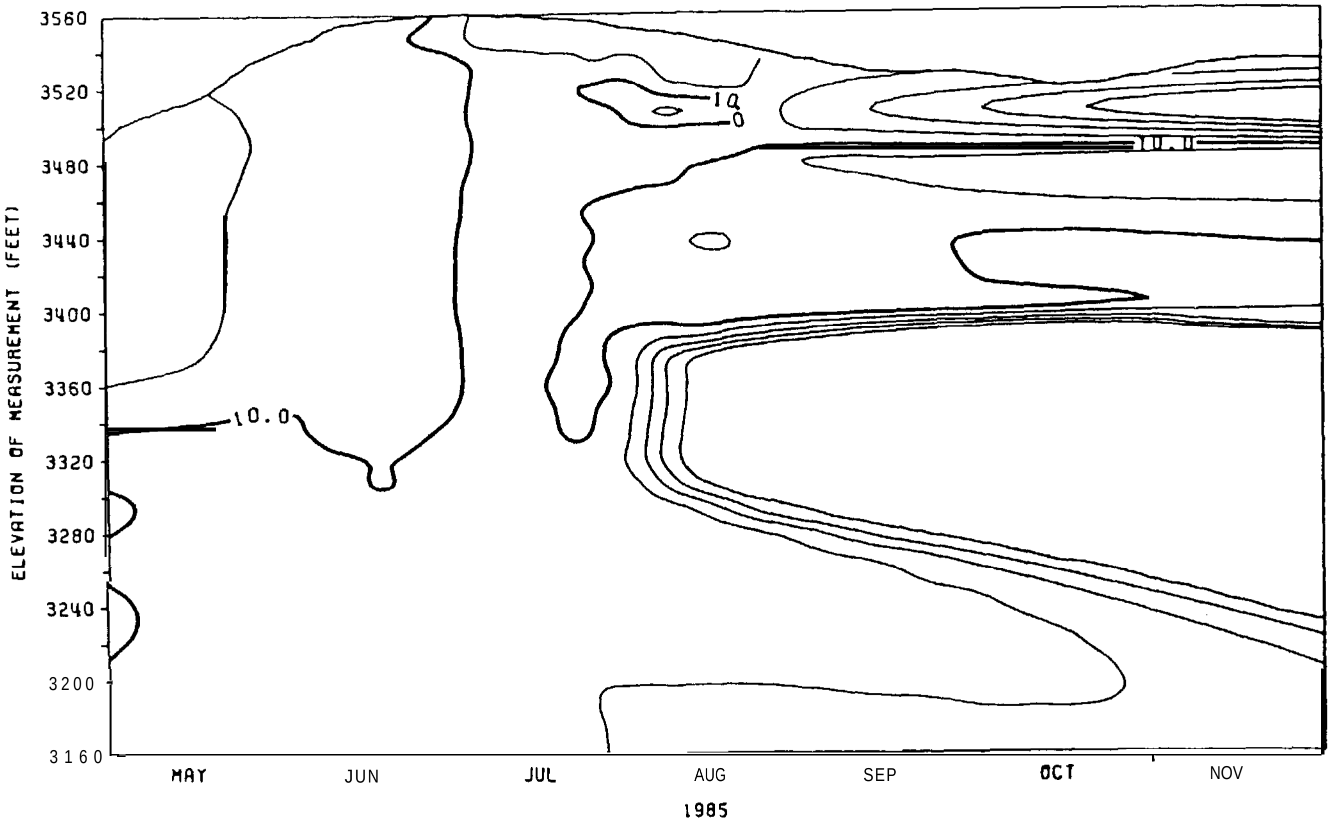
Appendix A4. Isopleths of water temperature ($2^{\circ}C$) from the Emery Bay Station, Hungry Horse Reservoir, 1984. Shaded areas are preferred temperature strata for cutthroat trout (10°-16°).



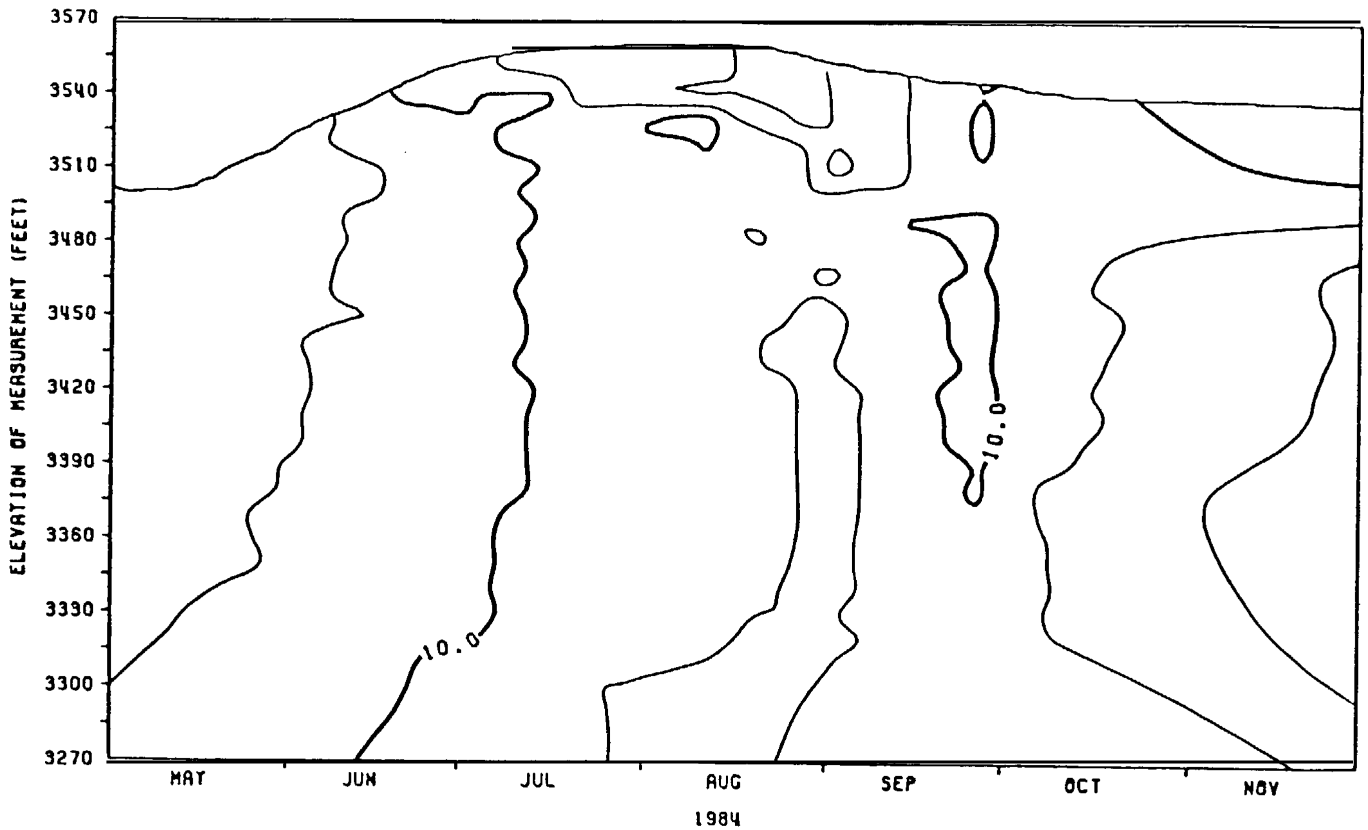
Appenix A5. Isopleths of water temperature (2^{O}C) from the Graves Bay Station, Hungry Horse Reservoir, 1984. Shaded areas are preferred temperature strata for cutthroat trout (10^{O}-16^{O}).



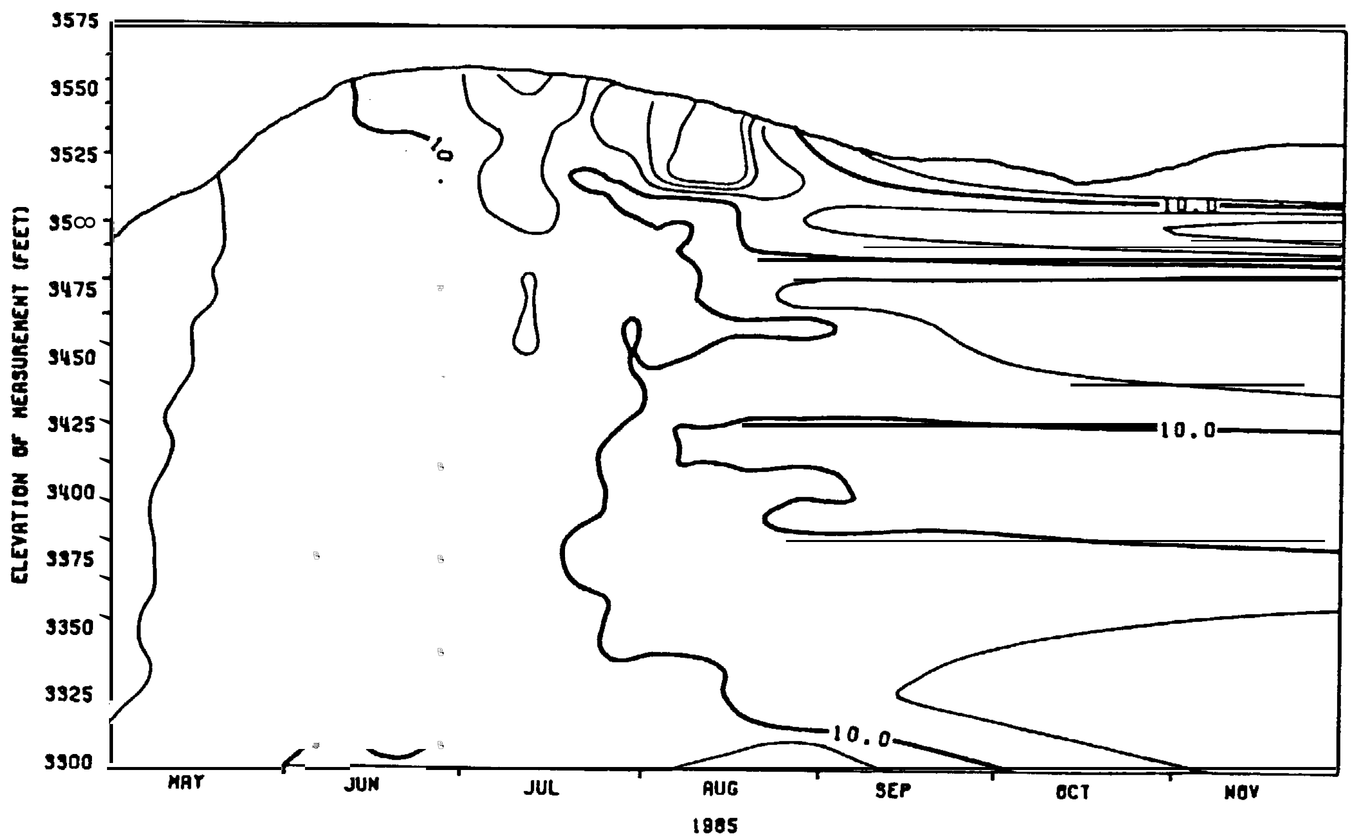
Appendix A6. Isopleths of dissolved oxygen (1 $mg \cdot l^{-1}$) from the Emery Station Hungry Horse Reservoir, 1984.



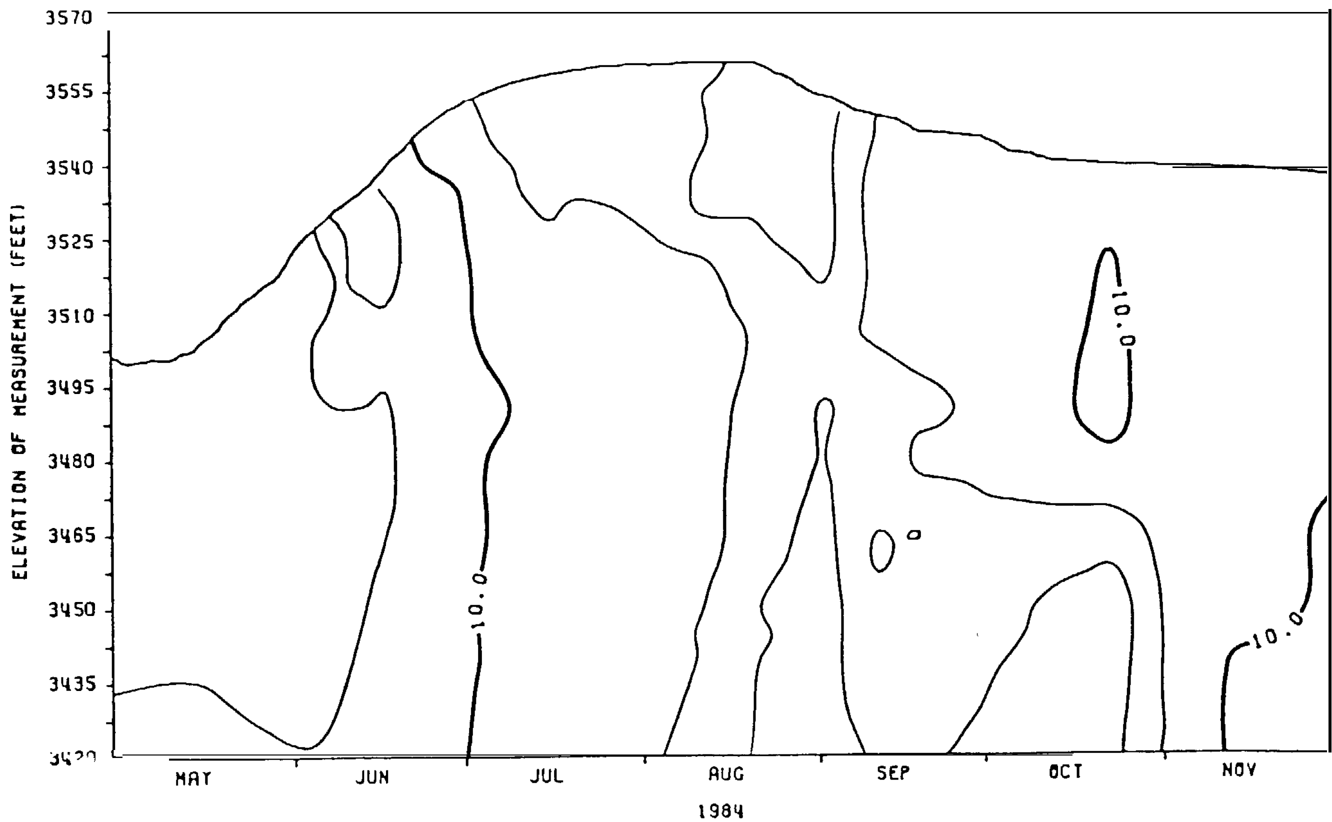
Appendix A7. Isopleths of dissolved oxygen (1 $mg \cdot l^{-1}$) from the Emery Station Hungry Horse Reservoir, 1985.



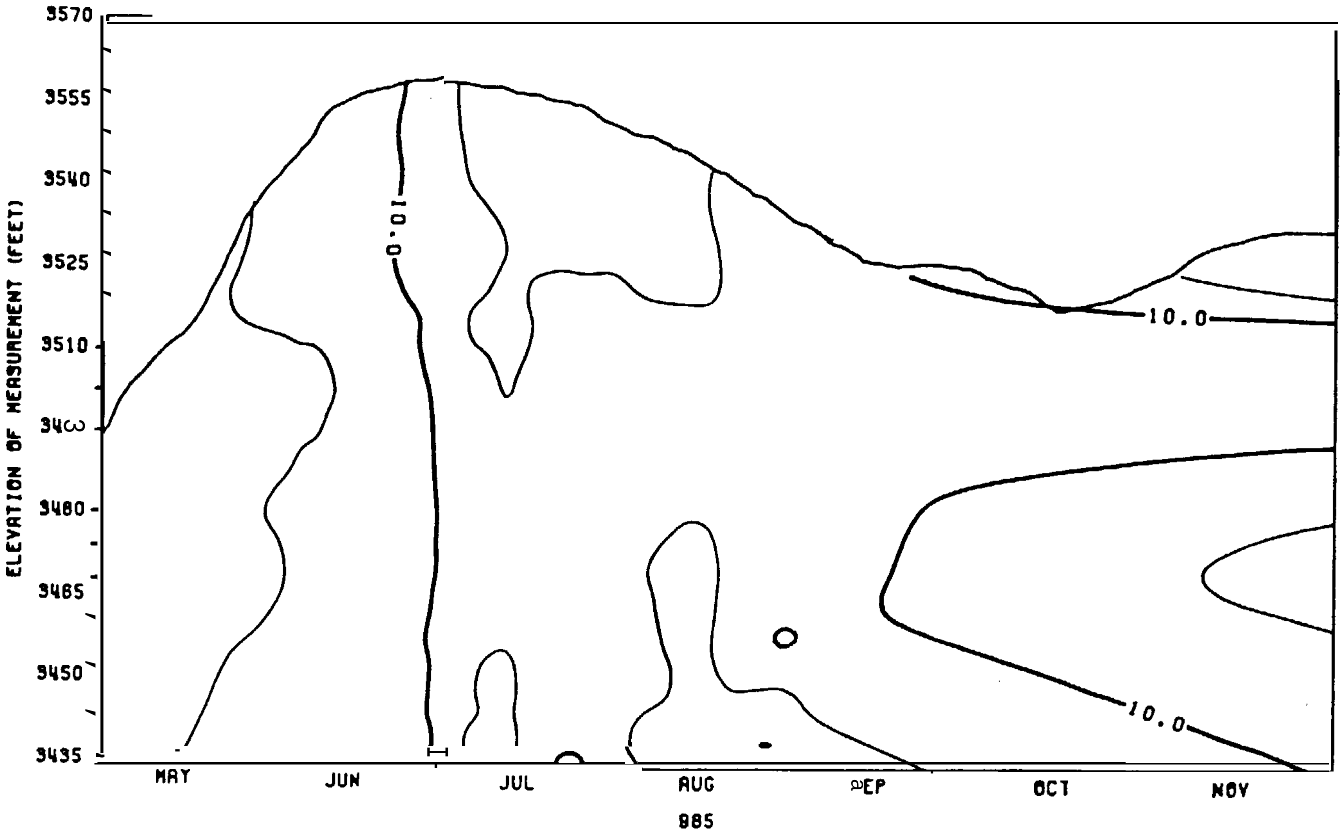
Appendix A8. Isopleths of dissolved oxygen (1 mg·l^{-1}) from the Murray Station, Hungry Horse Reservoir, 1984.



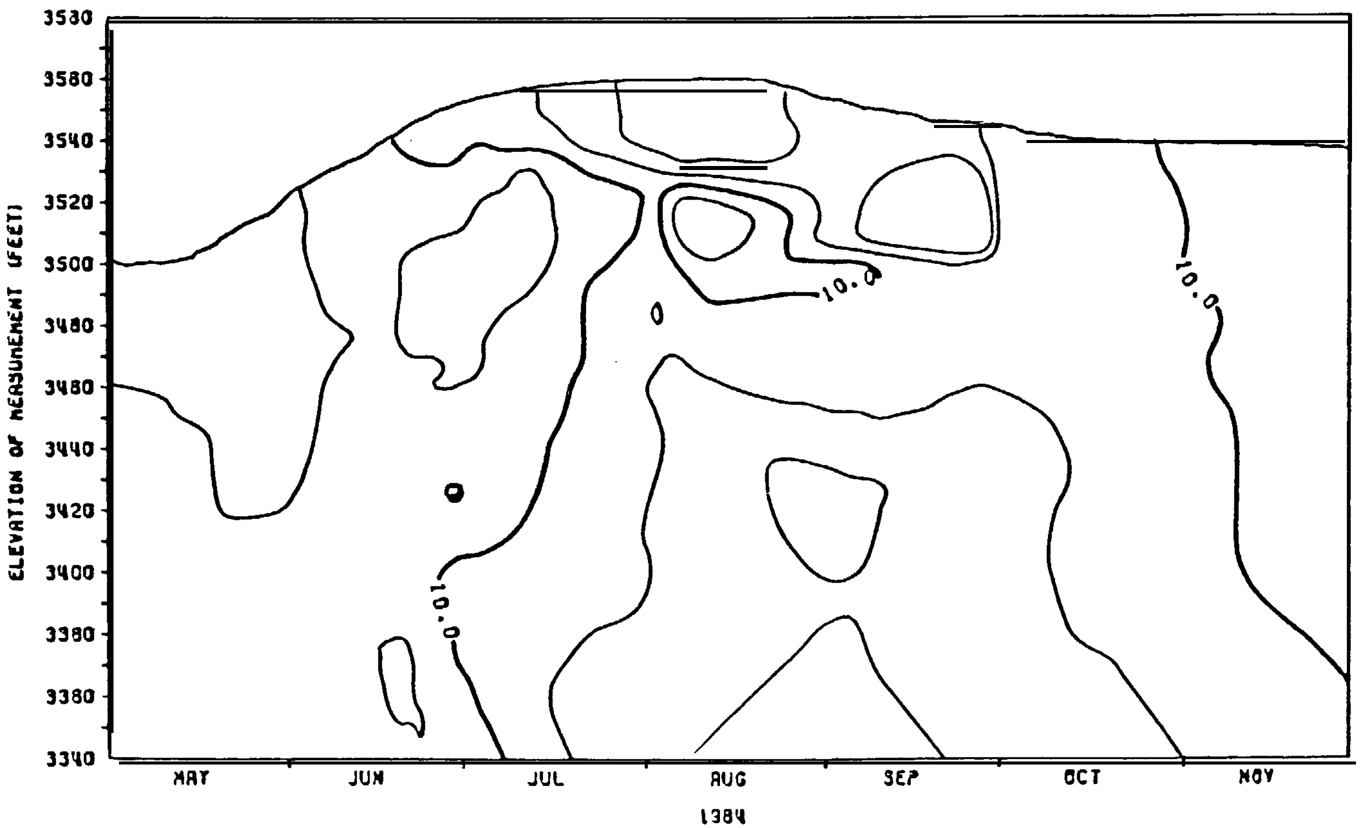
Appendix A9. Isopleths of dissolved oxygen ($1\ mg \cdot l^{-1}$) from the Murray Station, Hungry Horse Reservoir, 1985.



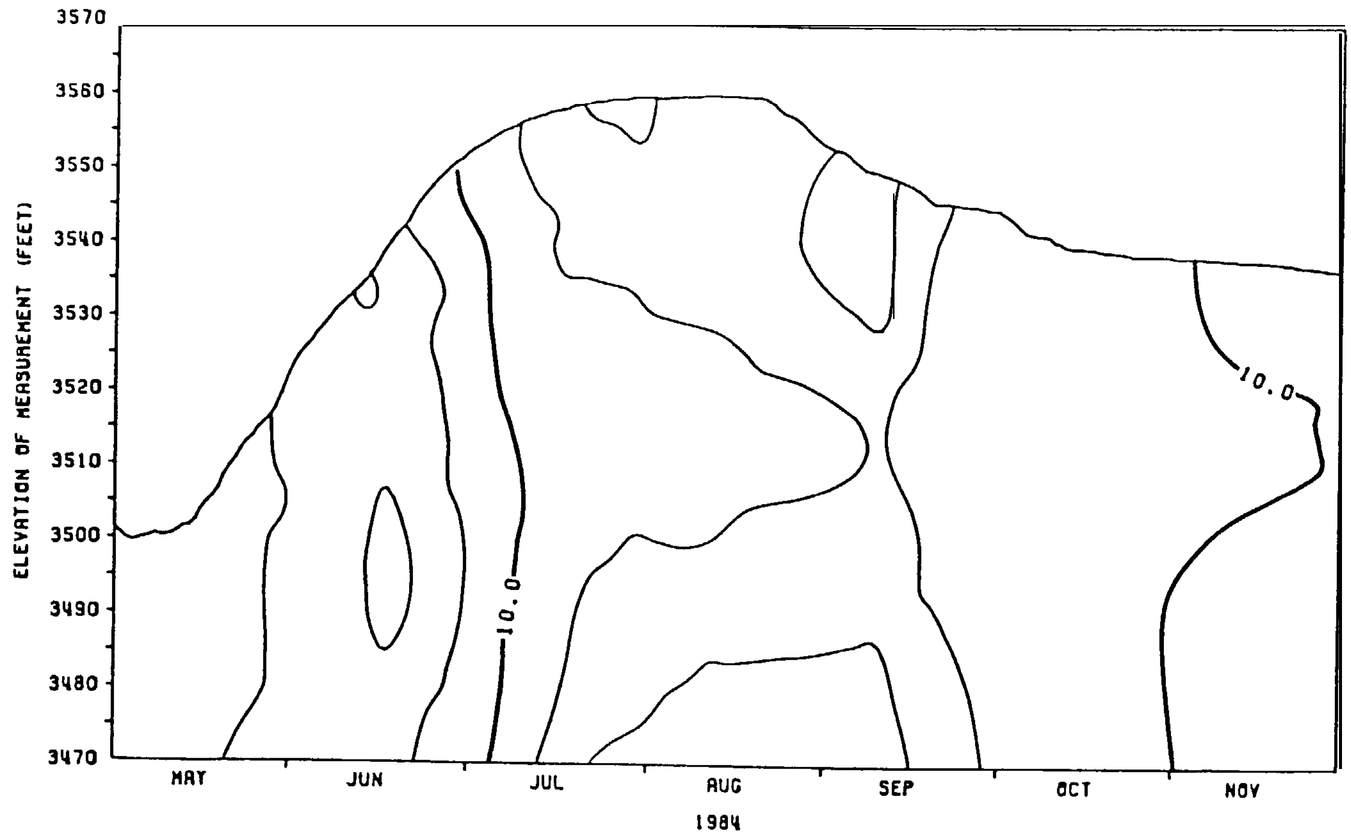
Appendix A10. Isopleths of dissolved oxygen (1 mg·l^{-1}) from the Sullivan Station, Hungry Horse Reservoir, 1984.



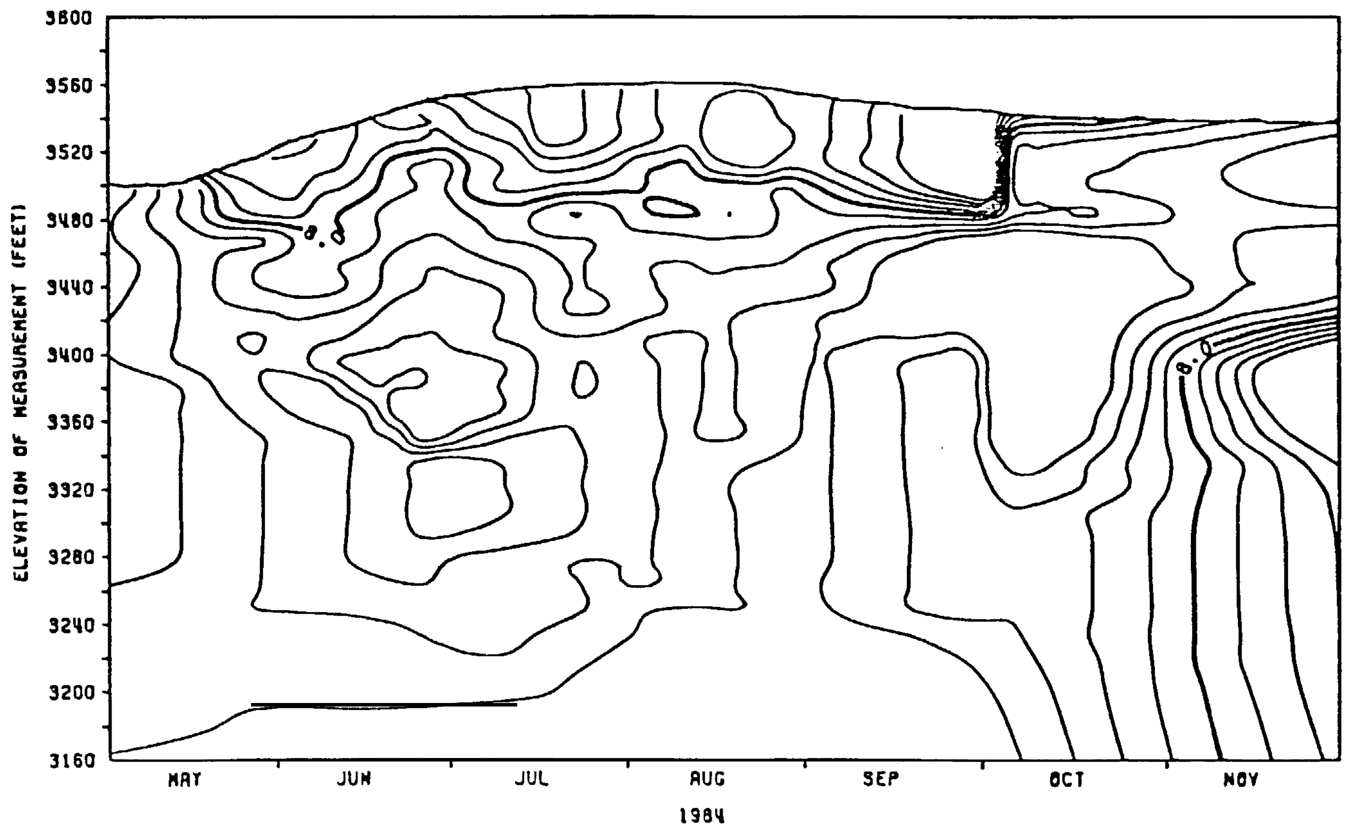
Appendix A11. Isopleths of dissolved oxygen (1 mg$\cdot$l^{-1}) from the Sullivan Station, Hungry Horse Reservoir, 1985.



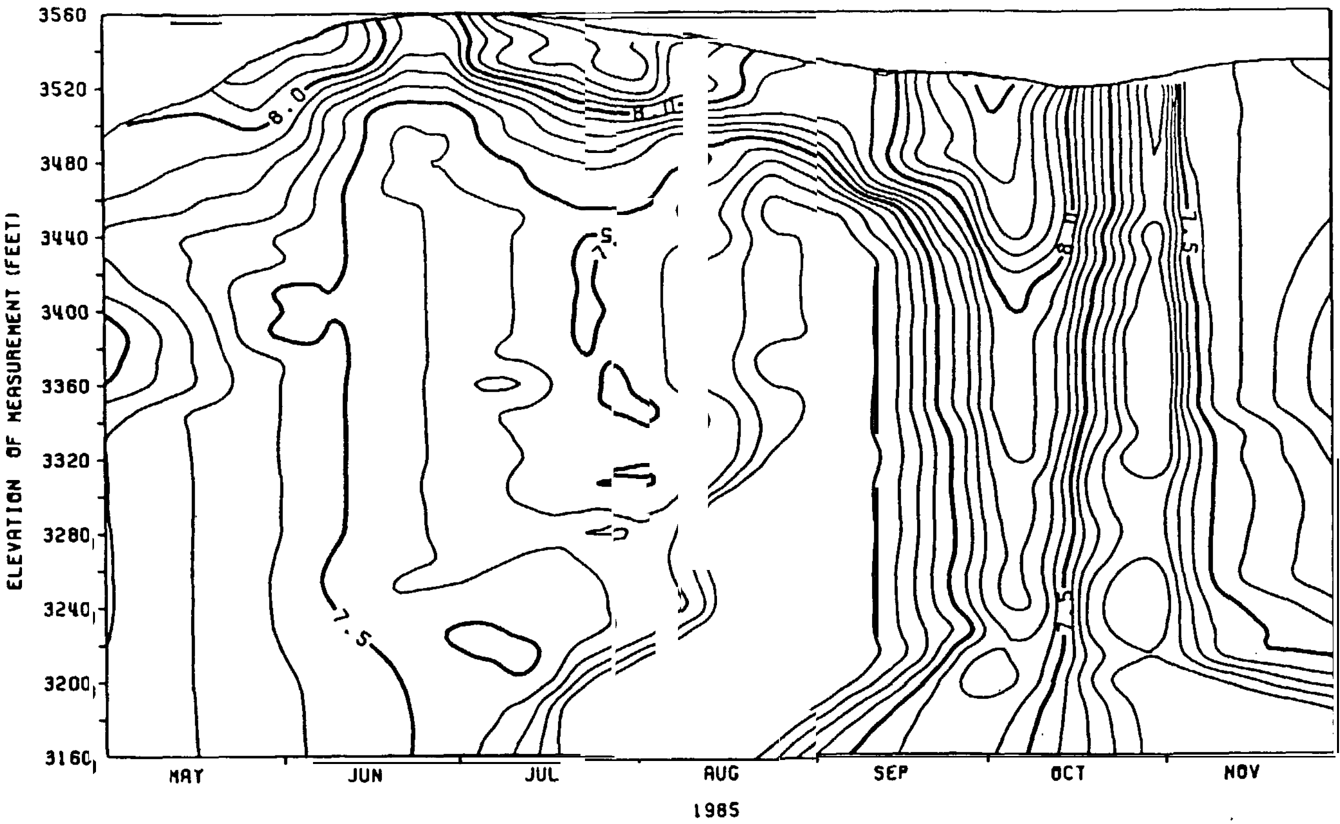
Appendix A12. Isopleths of dissolved oxygen 1 mg·l^{-1}) from the Emery Bay Station, Hungry Horse Reservoir, 1984.



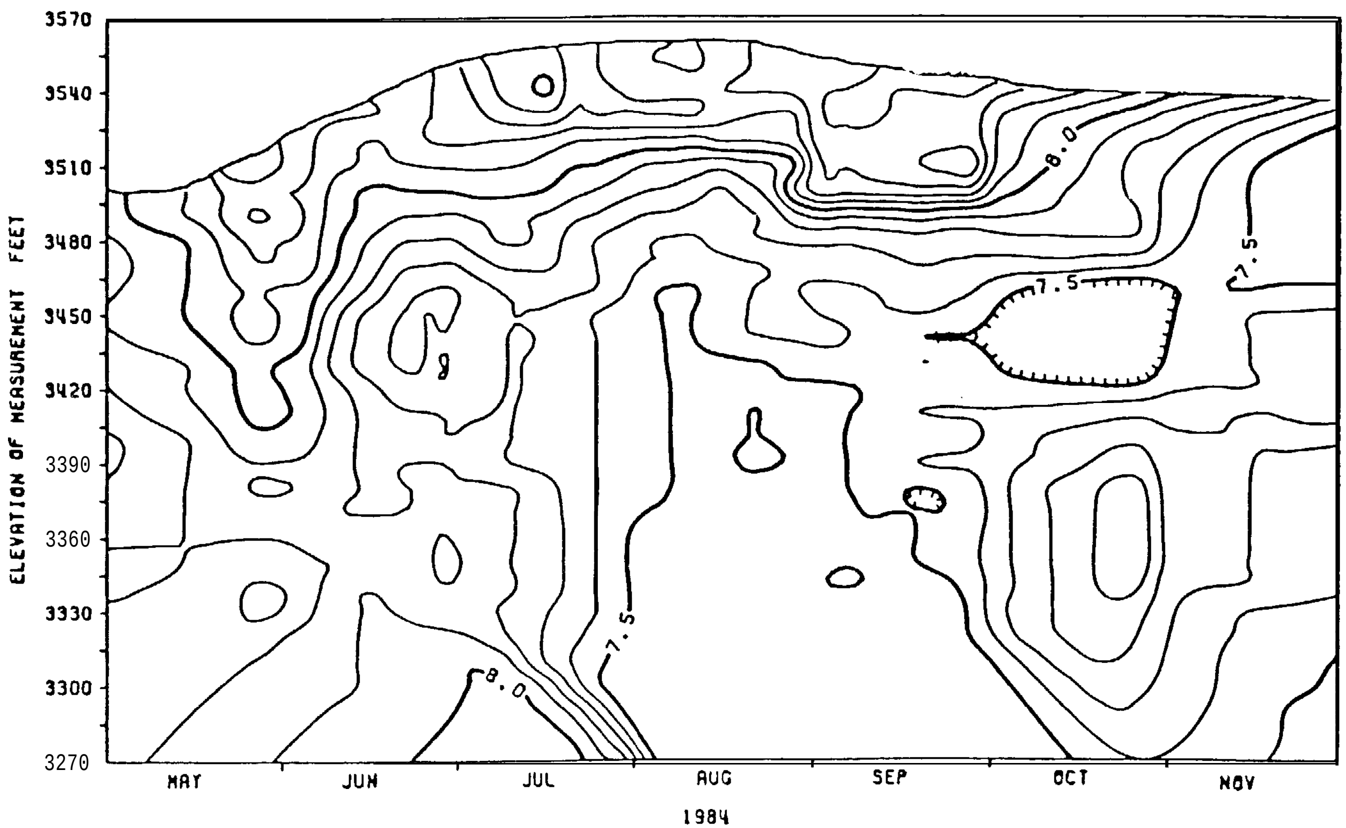
Appendix A13. Isopleths of dissolved oxygen ($1 \text{ mg} \cdot l^{-1}$) from the Graves Bay Station, Hungry Horse Reservoir, 1984.



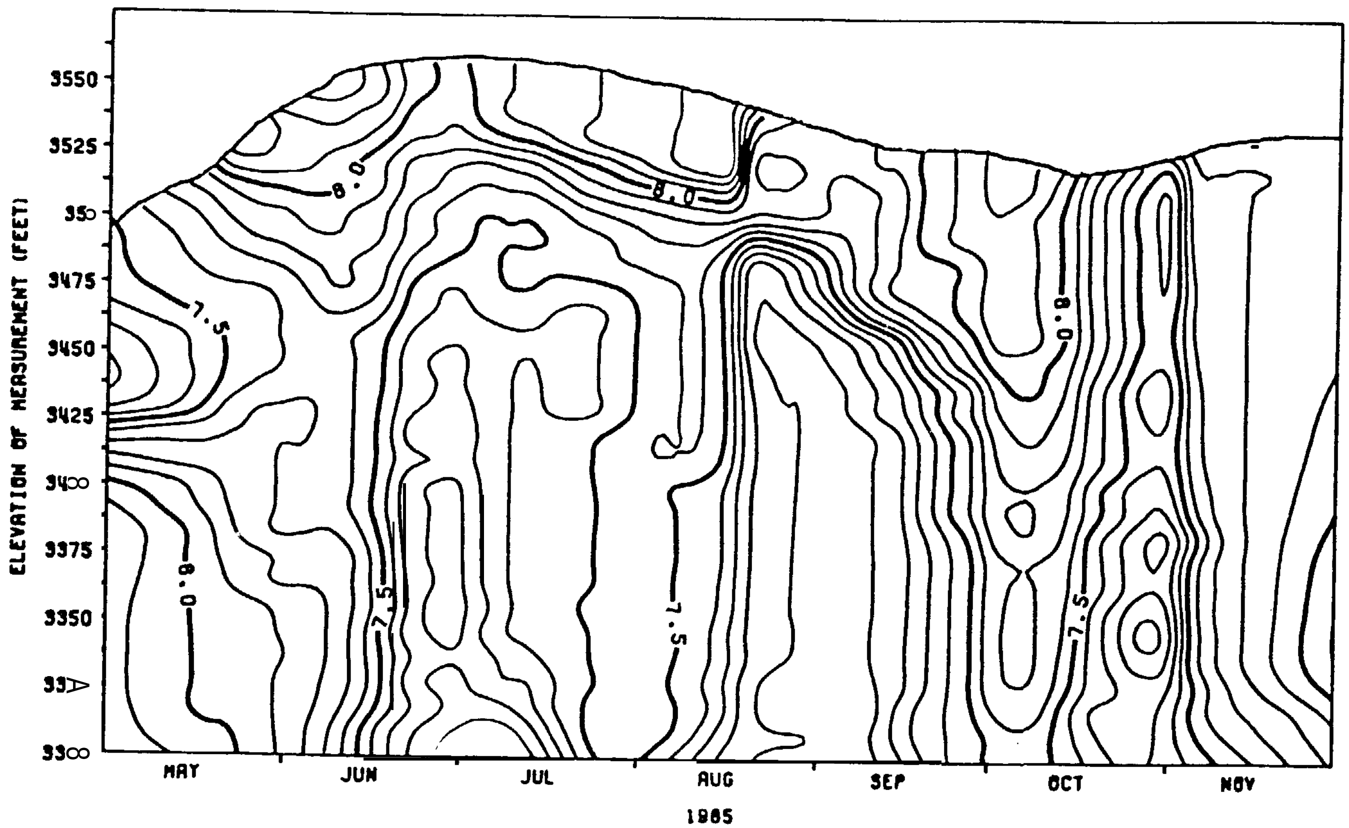
Appendix A14. Isopleths of pH standard units 0.1) from the Emery Station, Hungry Horse Reservoir, 1984.



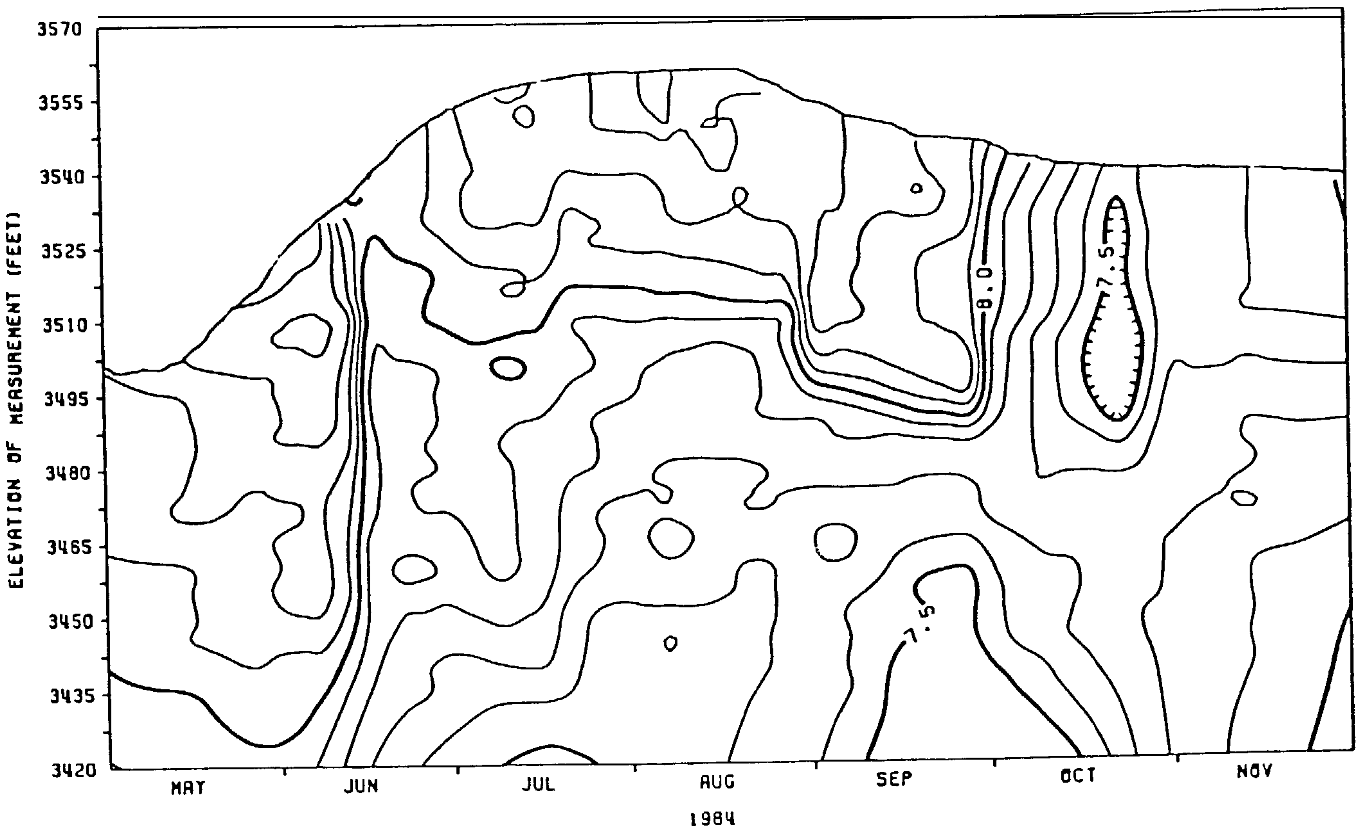
Appendix A15. Isopleths of pH standard units 0.1) from the Emery Station, Hungry Horse Reservoir, 1985.



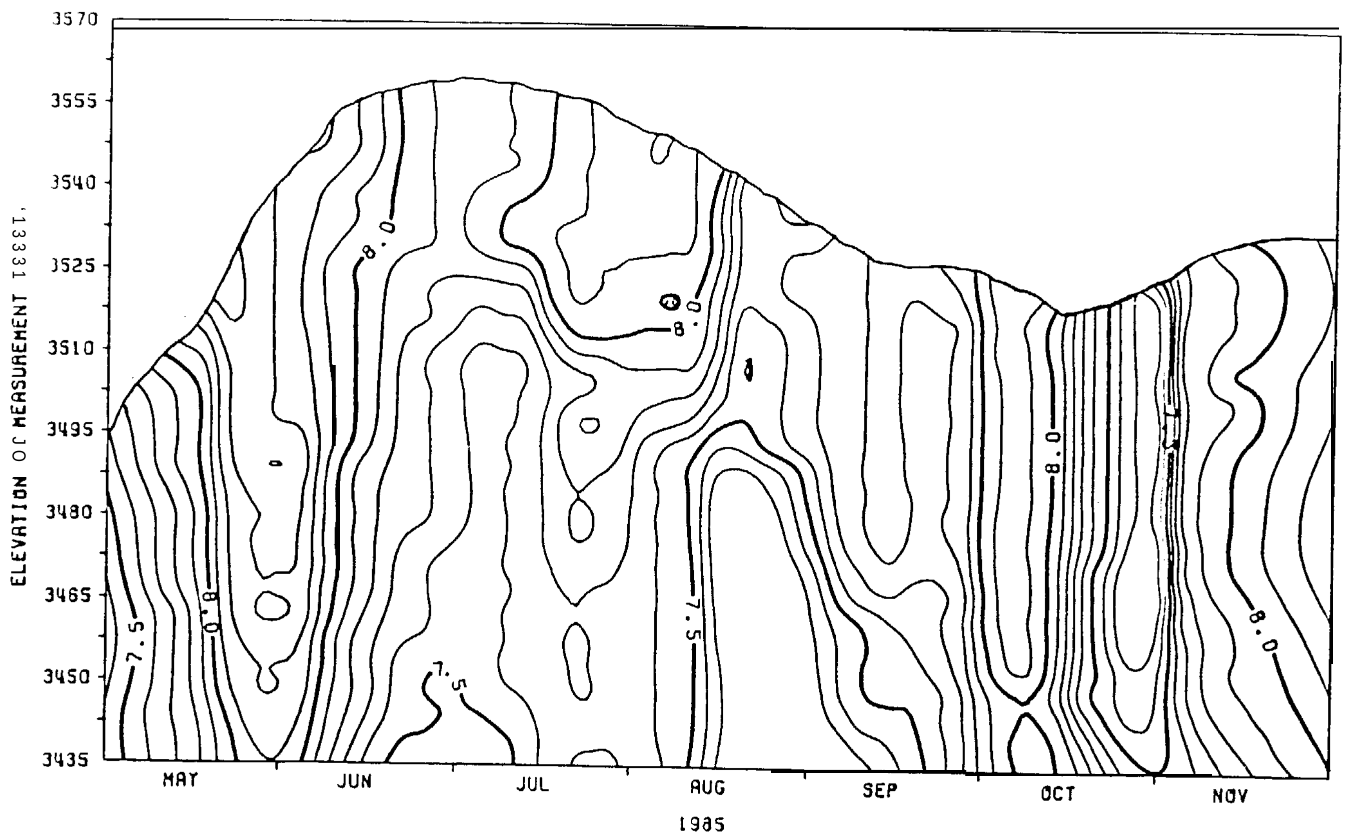
Appendix Isopleths of pH standard units (0.1) from the Murray Station, Hungry Horse Reservoir, 1984.



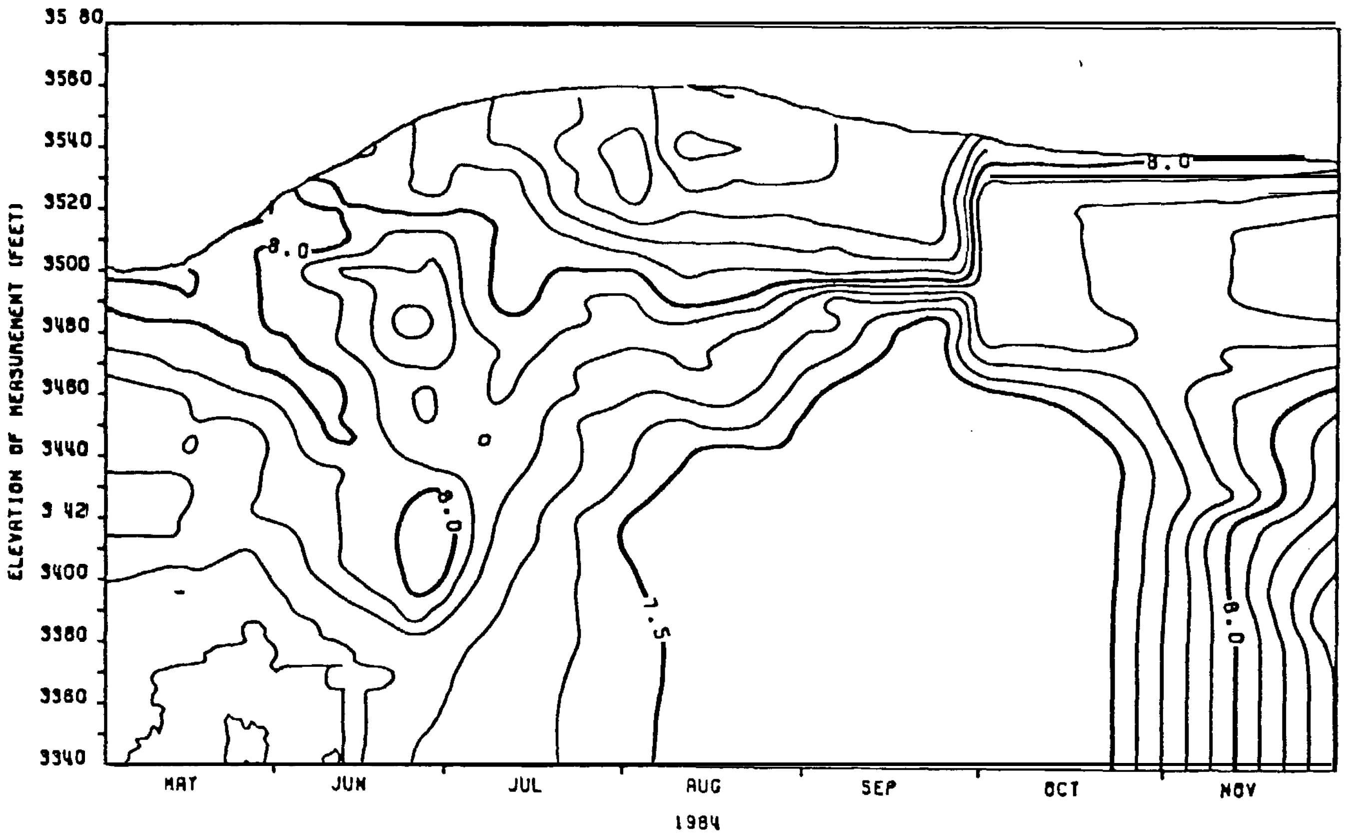
Appendix A17. Isopleths of pH standard units (0.1) from the Murray Station, Hungry Horse Reservoir, 1985.



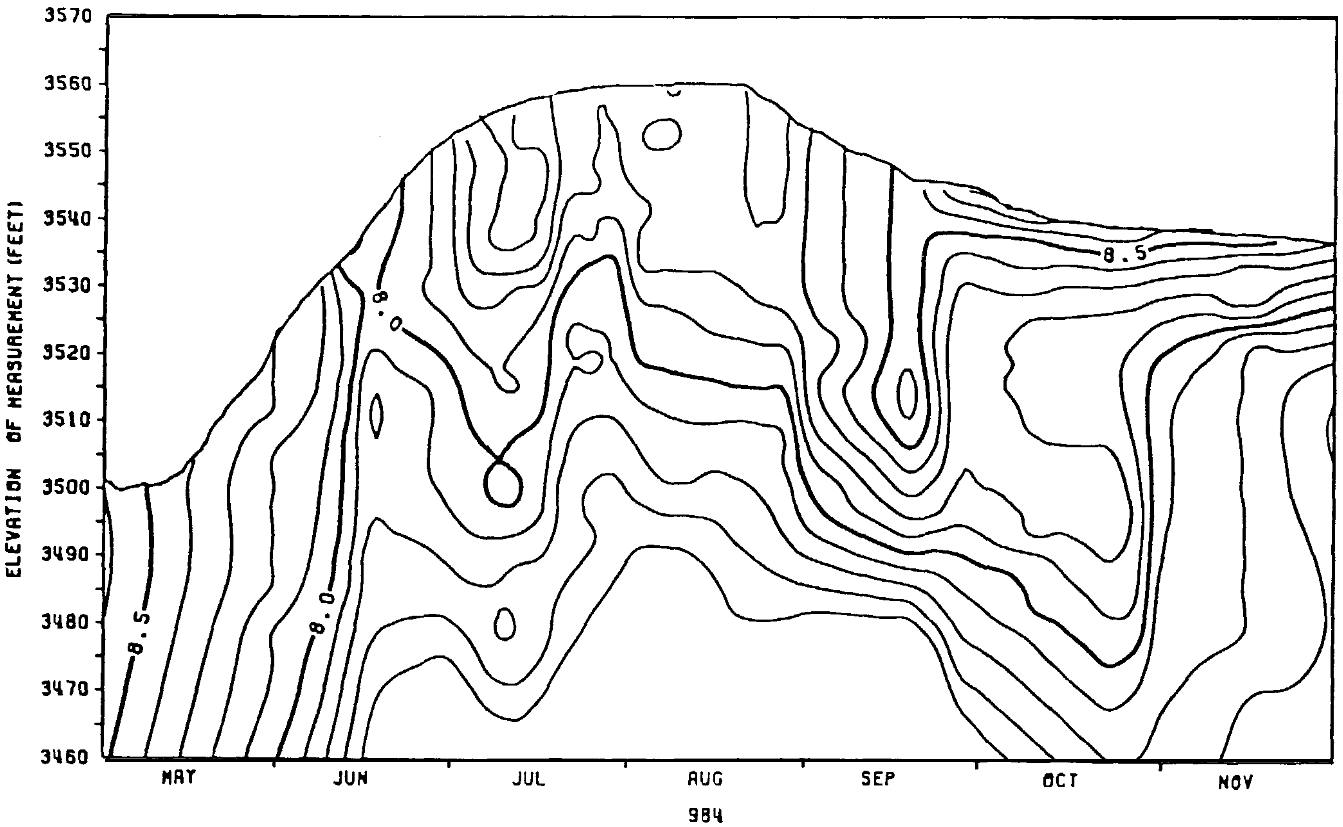
Appendix A18. Isopleths of pH standard units 0.1) from the Sullivan Station, Hungry Horse Reservoir, 1984.



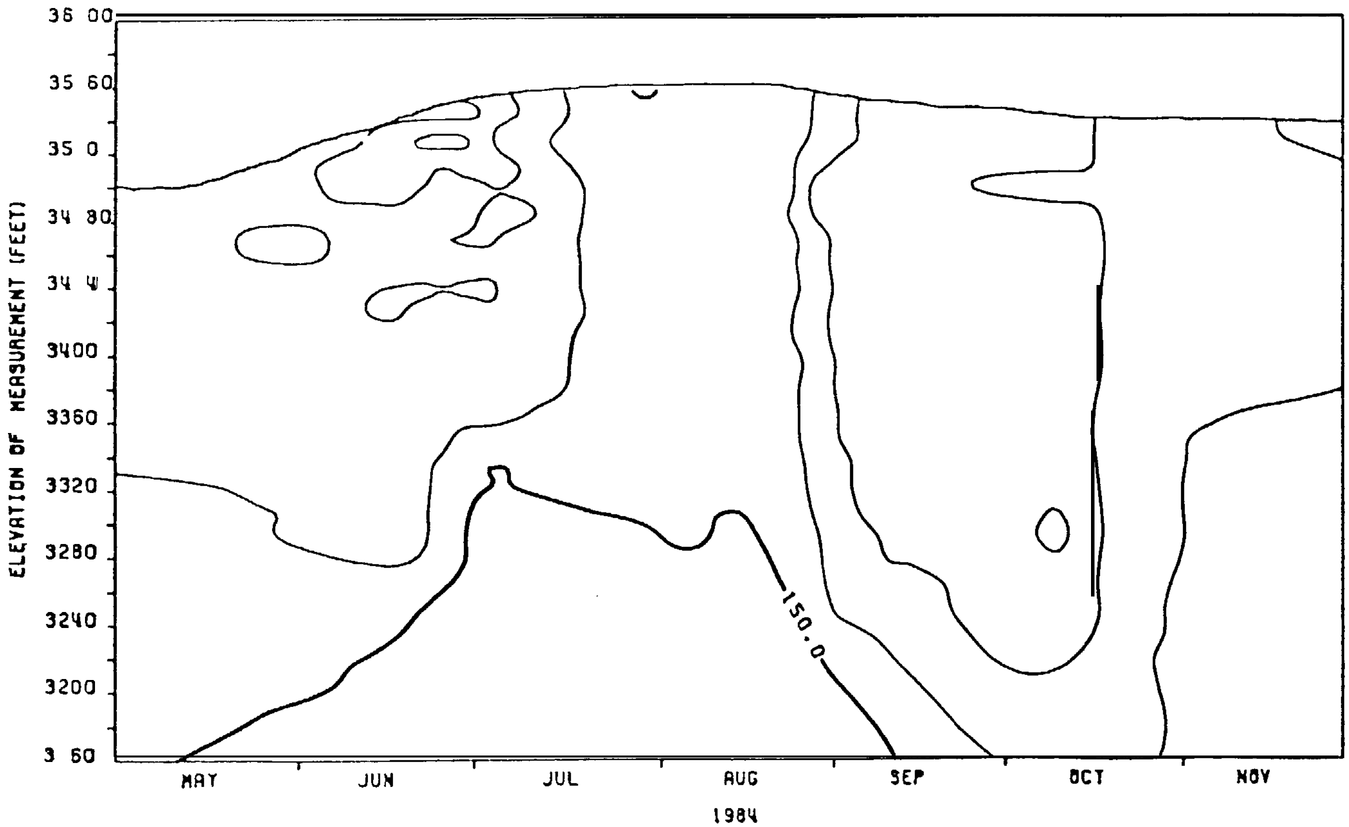
Appendix A19. Isopleths of pH standard units (0.1) from the Sullivan Station, Hungry Horse Reservoir, 1985.



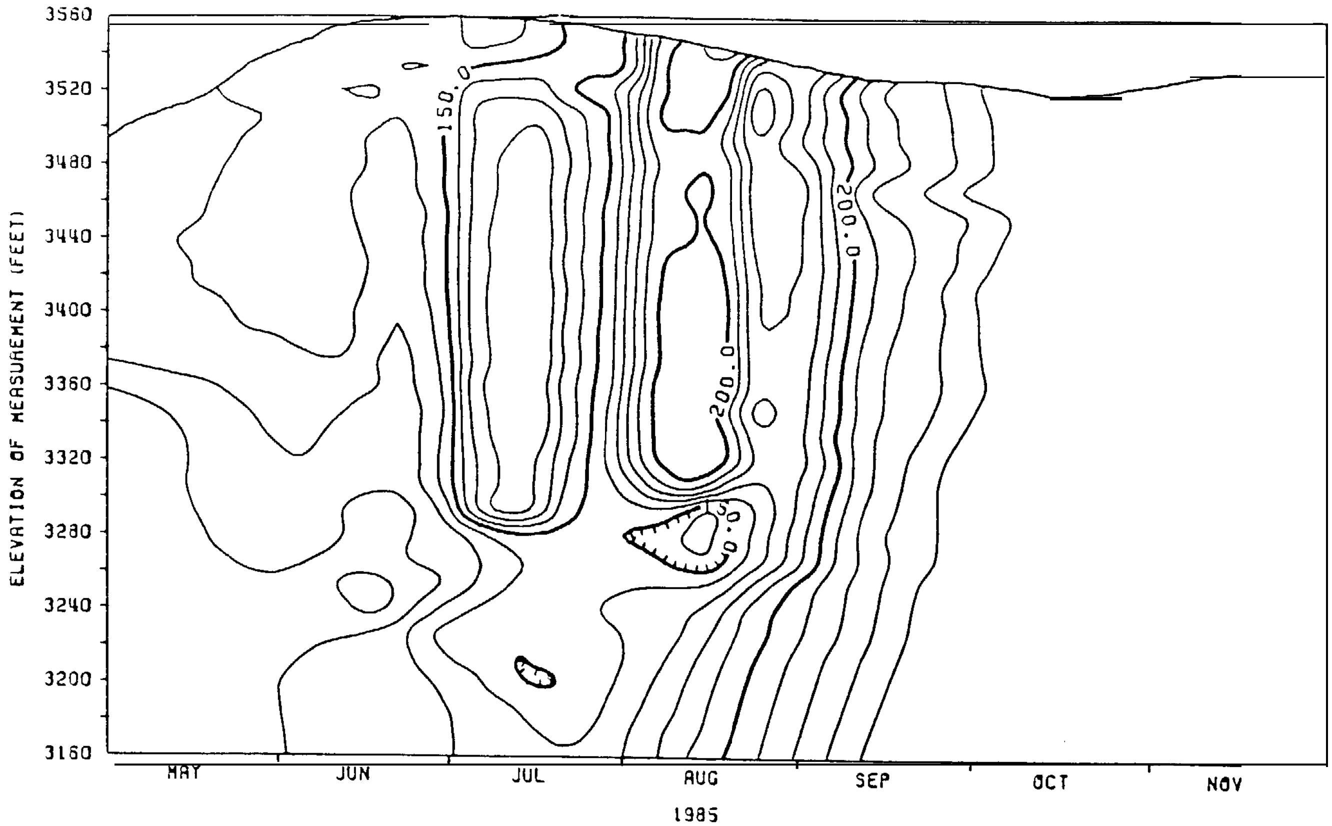
Appendix A20. Isopleths of pH standard units (0. from the Emery Bay Station, Hungry Horse Reservoir, 1984.



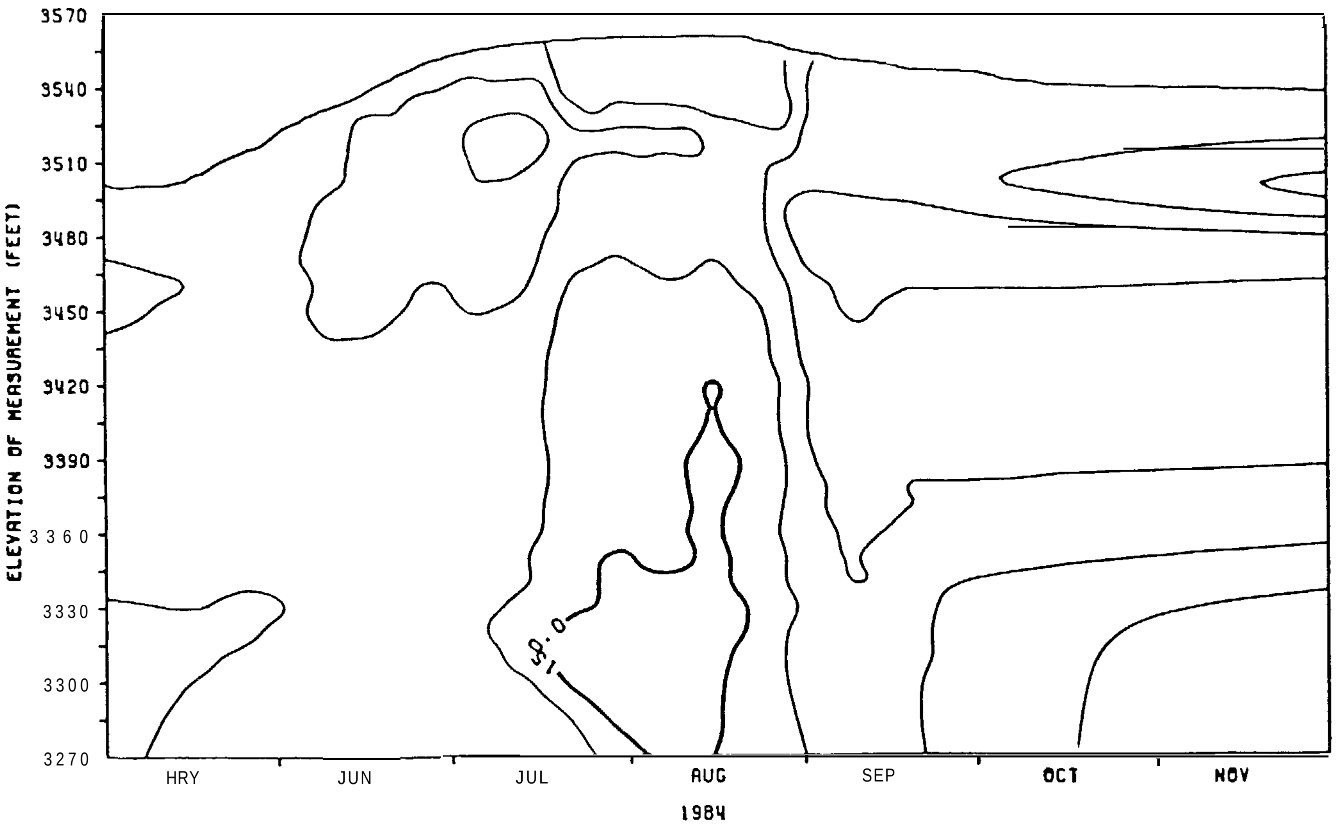
Appendix A21. I ·pδ.eths of pH standa rd ·ts (0.1) from the Graves Bay S taon, Hungry Horse Res oiv, 1984.



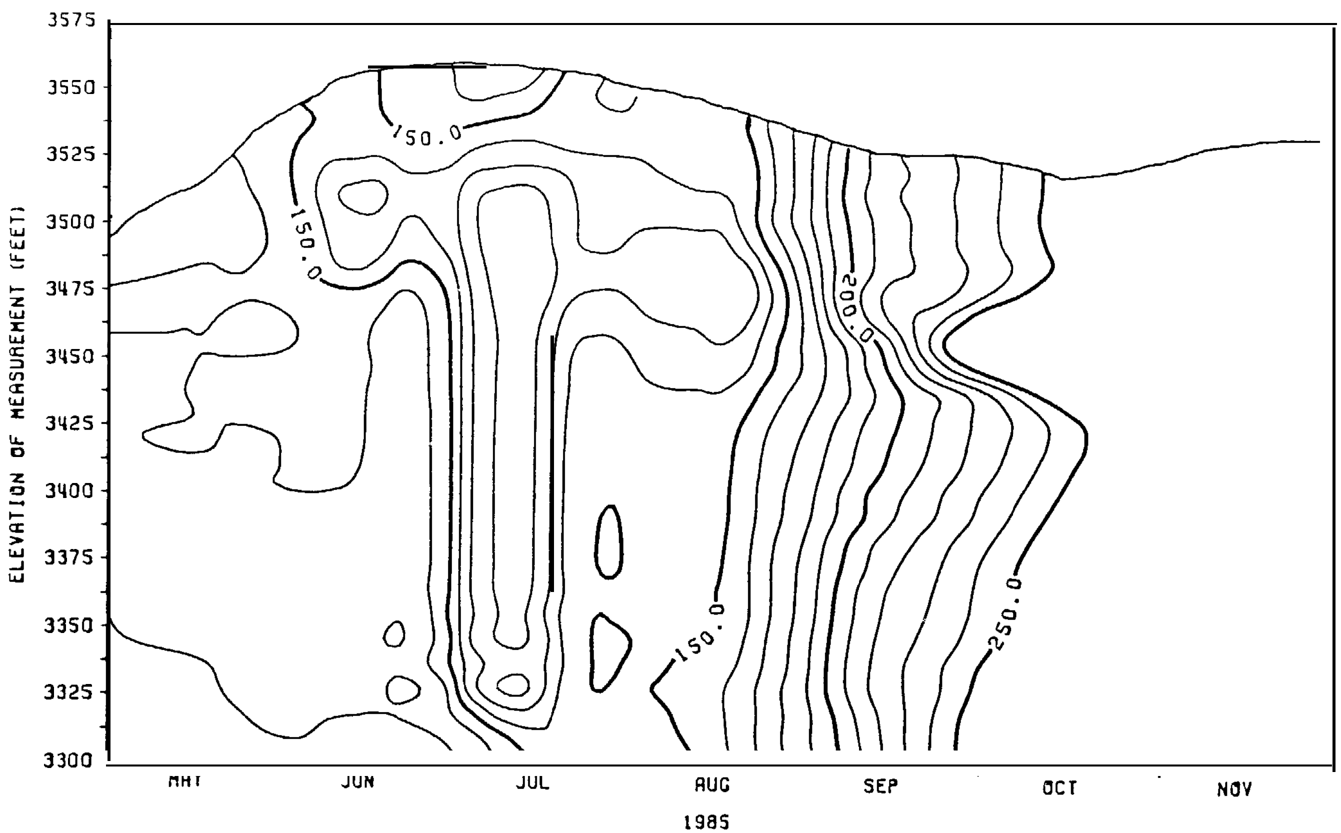
Appendix A22. Isopleths of specific conductance (10 mmhos) from the Emery Station, Hungry Horse Reservoir, 1984.



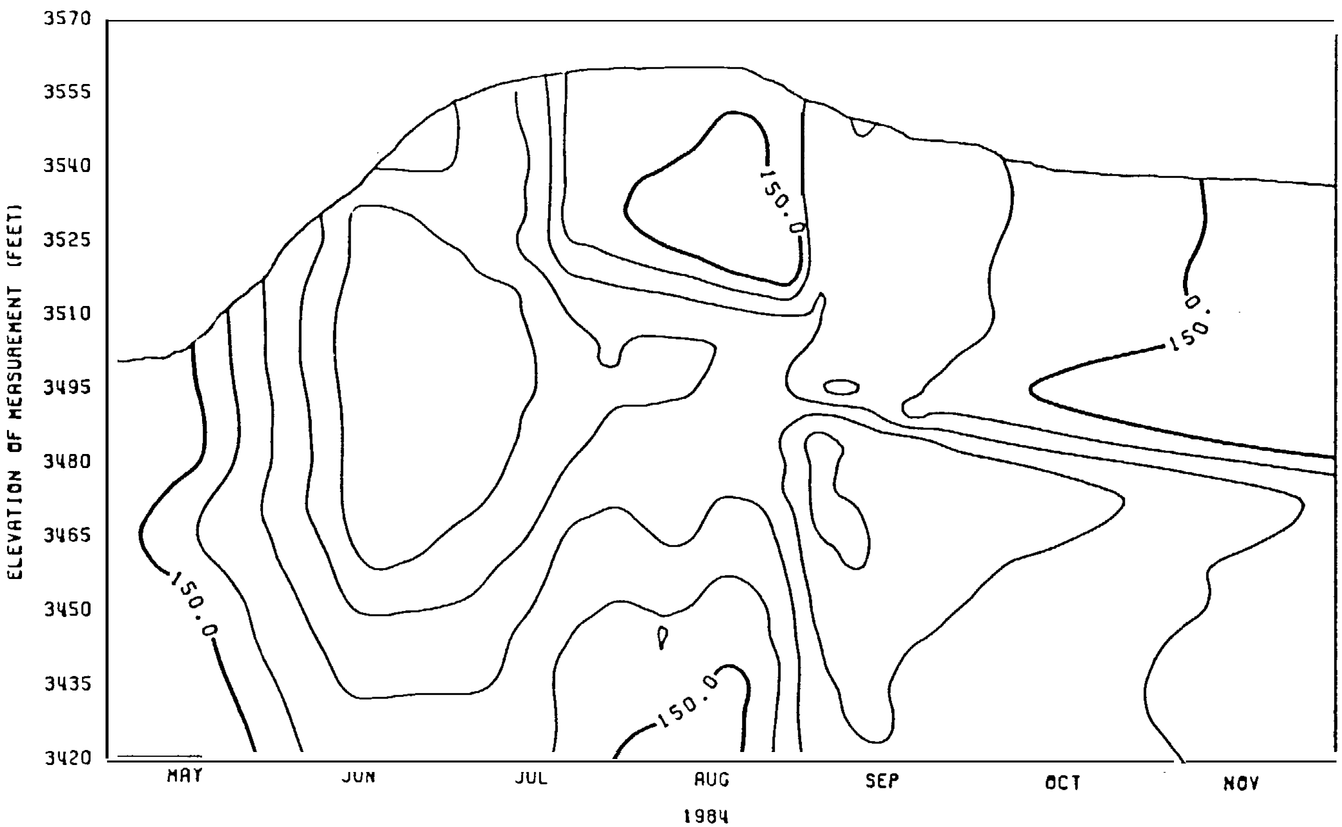
Appendix A23. Isopleths of specific conductance (10 mmhos) from the Emery Station, Hungry Horse Reservoir, 1985.



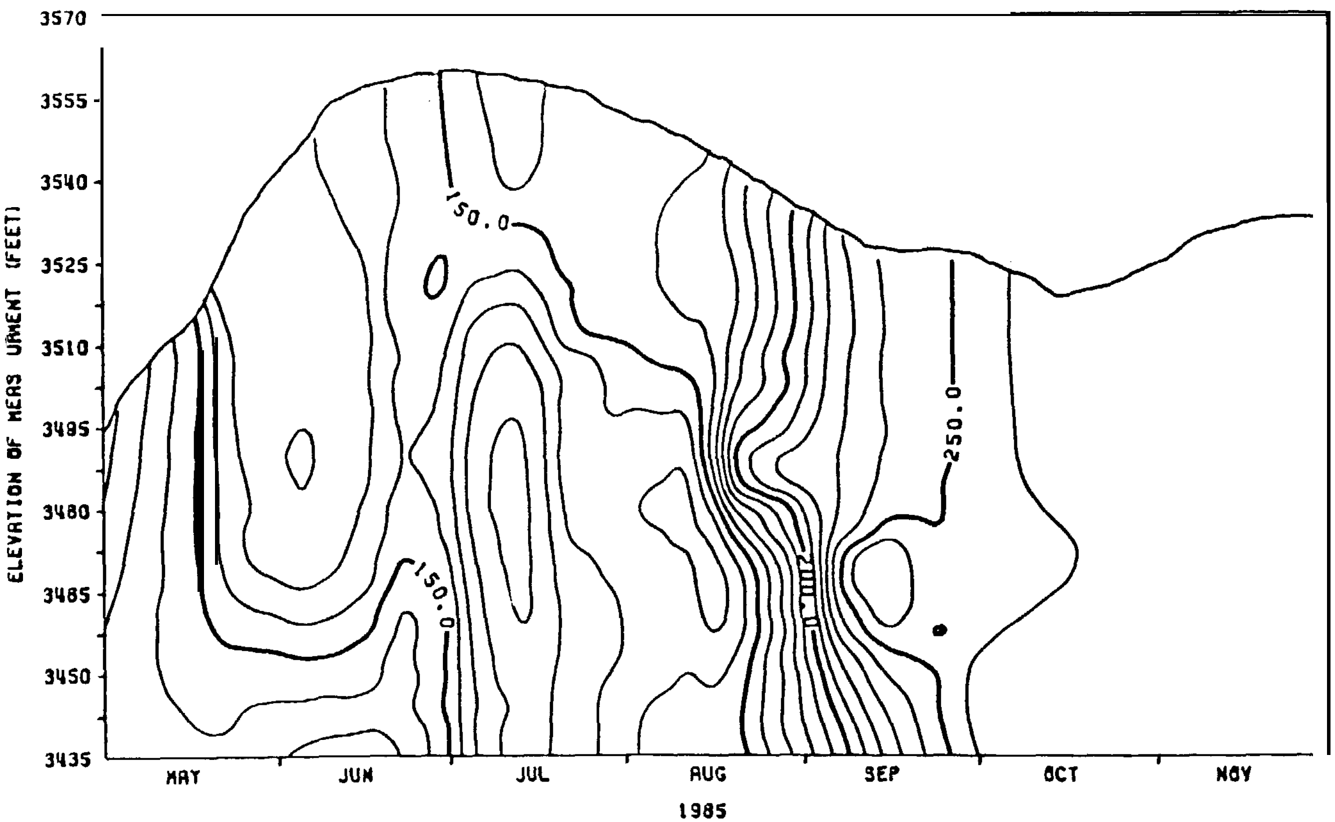
Appendix A24. Isopleths of specific conductance (10 mmhos) from the Murray Station, Hungry Horse Reservoir. 1984.



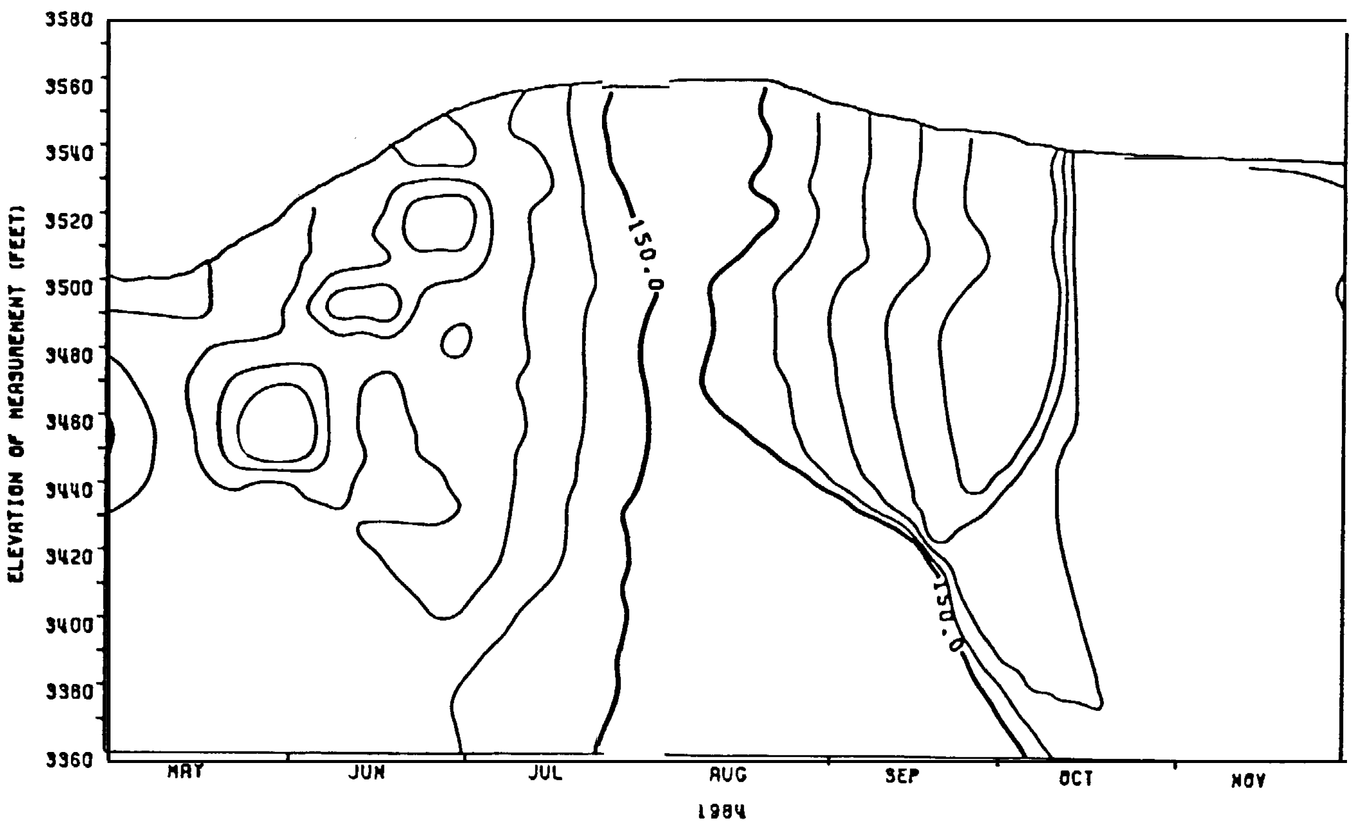
Appendix A25. Isopleths of specific conductance (10 mmhos) from the Murray Station, Hungry Horse Reservoir, 1985.



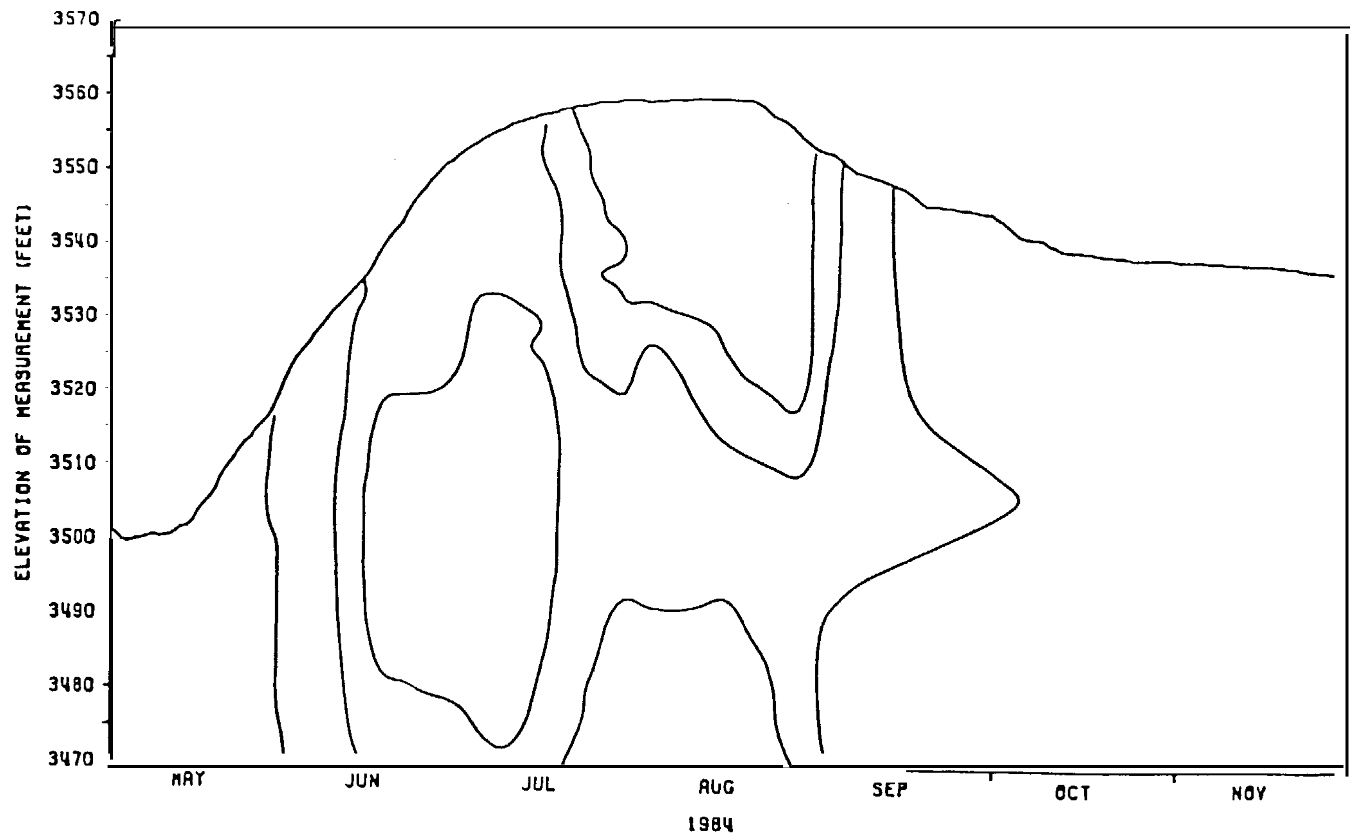
Appendix A26. Isopleths of specific conductance (10 mmhos) from the Sullivan Station, Hungry Horse Reservoir, 1984.



Appendix A27. Isopleths of specific conductance (10 mmhos) from the Sullivan Station, Hungry Horse Reservoir, 1985.



Appendix A28. Isopleths of specific conductance (10 mmhos) from the Emery Bay Station, Hungry Horse Reservoir, 1984.



Appendix A29. Isopleths of specific conductance (10 mmhos) from the Graves Bay Station, Hungry Horse Reservoir, 1984.

Appendix B1 Weighted mean zooplankton densities (#·M^{-3}) and weights (mg·M^{-3}) estimated from 30 m vertical tows during 1984 in Emery Area, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
April	2	155 (5)	380 (11)	45 (1)	0 (0)	580 (17)	2180 (64)	665 (19)	0 (0)	2845 (83)	3425
May	4	205 (7)	380 (14)	11 (<1)	0 (0)	596 (21)	1616 (57)	633 (22)	0 (0)	2249 (79)	2845
June	4	665 (8)	773 (8)	98 (1)	0 (0)	1495 (17)	6658 (75)	733 (8)	2 (<1)	7392 (83)	8887
July	6	840 (18)	692 (15)	108 (2)	0 (0)	1640 (35)	2050 (43)	1037 (22)	0 (<0)	3087 (65)	4727
August	6	982 (12)	968 (12)	1402 (18)	0 (0)	3352 (42)	1503 (19)	3037 (38)	30 (<1)	4570 (58)	7922
September	5	306 (4)	288 (3)	1420 (16)	0 (0)	2014 (23)	1574 (18)	5032 (59)	16 (<1)	6622 (77)	8636
October	3	313 (5)	117 (2)	467 (8)	0 (0)	897 (15)	827 (14)	4143 (71)	5 (<1)	4975 (85)	5872
November	2	285 (4)	200 (2)	315 (4)	0 (0)	800 (10)	1075 (14)	6015 (76)	0 (<0)	7090 (90)	7893
December	2	55 (2)	30 (1)	105 (4)	0 (0)	190 (7)	865 (30)	1780 (63)	0 (0)	2645 (93)	283[illegible]
Year	34	526 (9)	512 (8)	55[illegible] (9)	0 (0)	1595 (26)	2147 (34)	2483 (40)	8 (<1)	4538 (74)	6233
						Weight					
April	2	9.0 (4)	95.9 (42)	0.7 (<1)	0.0 (0)	105.6 (46)	102.4 (45)	21.0 (9)	0.0 (0)	123.4 (54)	230.0
May	4	6.1 (5)	53.9 (41)	0.3 (<1)	0.0 (0)	60.3 (46)	48.4 (36)	23.6 (18)	0.0 (0)	72.0 ([illegible]4)	132.3
June	4	30.8 (12)	86.9 (32)	1.1 (<1)	0.0 (0)	118.8 (44)	137.9 (52)	11.0 (4)	0.8 (<1)	149.7 ([illegible]6)	268.5
July	6	42.6 (22)	103.4 (53)	1.4 (1)	0.0 (0)	147.4 (75)	27.2 (14)	20.7 (10)	0.0 (0)	47.9 (24)	19[illegible].3
August	6	38.0 (15)	108.9 (43)	13.1 (5)	0.0 (0)	160.0 (63)	24.1 (10)	57.5 (23)	10.2 (4)	91.8 (37)	251.8
September	5	17.6 (7)	55.1 (23)	16.0 (7)	0.0 (0)	88.7 (37)	53.1 (23)	90.8 (38)	4.0 (2)	147.9 (63)	236.6
October	3	27.5 (16)	15.0 (9)	5.9 (4)	0.0 (0)	48.4 (29)	23.3 (14)	94.3 (56)	1.5 (1)	119.1 (71)	167.5
November	2	29.6 (12)	29.6 (12)	3.4 (1)	0.0 (0)	62.6 (25)	43.0 (17)	145.0 ([illegible]8)	0.0 (0)	183.0 (75)	250.6
December	2	2.2 (3)	8.2 (12)	0.8 (1)	0.0 (0)	11.2 (16)	19.8 (29)	38.2 (55)	0.0 (0)	58.0 (84)	69.2
Year	34	26.0 (13)	71.3 (34)	5.9 (3)	0.0 (0)	103.2 (50)	50.5 (24)	51.5 (25)	2.6 (1)	104.6 (50)	207.8

Appendix B2. Weighted mean zooplankton densities ($\#\cdot M^{-3}$) and weights ($mg\cdot M^{-3}$) estimated from 30 m vertical tows during 1984 in Murray Area, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
April	2	55 (2)	30 (1)	105 (4)	0 (0)	190 (7)	865(30)	1780(63)	0 (0)	2645(93)	2835
May	3	520(11)	150 (3)	77 (2)	0 (0)	746(16)	2443(54)	1383(30)	0 (0)	3827(84)	4573
June	4	767(12)	540 (9)	110 (2)	0 (0)	1417(23)	3123(49)	1742(28)	1(<1)	4866(77)	6283
July	6	1362(24)	1042(19)	208 (4)	0 (0)	2612(47)	1113(20)	1852(33)	0 (0)	2965(53)	5577
August	6	1185(16)	1312(18)	990(13)	0 (0)	3487(47)	1123(15)	2827(38)	8(<1)	3958(53)	7445
September	6	265 (5)	403 (7)	642(12)	2(<1)	1312(24)	1235(22)	2993(54)	8 (0)	4236(76)	5548
October	3	260 (5)	197 (3)	317 (5)	0 (0)	774(13)	814(14)	4250(73)	3(<1)	5067(87)	5841
November	4	480 (8)	397 (7)	335 (5)	0 (0)	1212(20)	1487(24)	3500(56)	2(<1)	4990(80)	6202
December	4	175 (4)	105 (3)	175 (4)	0 (0)	455(11)	1288(33)	2240(56)	3(<1)	3530(89)	3985
Year	38	678(12)	587(10)	395 (7)	<1	1660(29)	1533(27)	2516(44)	3(<1)	4052(71)	5712
						Weight					
April	2	13.9 (5)	55.5(22)	6.4 (2)	0.0(0)	75.8(29)	127.4(50)	54.2(21)	0.0 (0)	181.6(71)	257.4
May	3	19.0(12)	21.5(14)	1.1 (1)	0.0(0)	41.6(27)	86.0(55)	27.6(18)	0.0 (0)	113.6(73)	155.2
June	4	34.7(17)	73.7(35)	0.7(<1)	0.0(0)	109.1(52)	65.9(31)	35.0(17)	<0.0 (0)	100.9(48)	210.0
July	6	61.8(24)	139.9(56)	2.4 (1)	0.0(0)	204.1(81)	12.4 (5)	34.0(14)	0.0 (0)	46.4(19)	250.5
August	6	48.6(15)	183.3(59)	9.2 (3)	0.0(0)	241.1(77)	19.8 (6)	48.0(16)	2.6 (1)	70.4(23)	311.5
September	6	16.7 (8)	86.7(43)	6.8 (3)	2.6(1)	112.8(55)	39.3(19)	49.1(24)	2.6 (1)	91.0(45)	203.8
October	3	17.4(11)	12.4 (8)	4.0 (3)	0.0(0)	33.8(22)	23.0(15)	96.8(63)	0.5(<1)	120.2(78)	154.0
November	4	35.1(14)	71.0(28)	3.6 (1)	0.0(0)	109.7(43)	59.6(24)	84.4(33)	0.8(<1)	144.8(57)	254.5
December	4	23.4(17)	32.0(24)	1.4 (1)	0.0(0)	56.8(42)	29.4(22)	48.1(36)	0.8(<1)	78.3(58)	135.1
Year	38	33.5(15)	88.9(40)	4.2 (2)	0.5(0)	127.1(57)	42.9(19)	51.0(23)	1.1 (1)	95.0(43)	222.1

Appendix B3. Weighted mean zooplankton densities ($\#\cdot M^{-3}$) and weights ($mg\cdot M^{-3}$) estimated from 30 m vertical tows during 1984 in Sullivan Area, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
April	2	70 (5)	10 (1)	10 (1)	0 (0)	90 (7)	270(21)	945 (72)	0 (0)	1215(93)	1305
May	4	73 (4)	175 (8)	65 (3)	0 (0)	313(15)	908(44)	848(41)	0 (0)	1755(85)	2068
June	2	225 (8)	145 (5)	130 (5)	0 (0)	500(18)	695(25)	1575(57)	2(<1)	2272(82)	2772
July	6	748(23)	517(16)	292 (9)	0 (0)	1557(48)	1065(33)	590(18)	12 (1)	1667(52)	3224
August	6	1980(25)	1285(17)	992(13)	0 (0)	2457(55)	1268(16)	2258(29)	9(<1)	3535(45)	7792
September	6	562(10)	388 (7)	375 (6)	0 (0)	1325(23)	1262(22)	3208(55)	3(<1)	4473(77)	5798
October	3	473 (6)	267 (3)	273 (3)	0 (0)	1013(12)	1510(18)	5773(70)	4(<1)	7287(88)	8300
November	4	1512(11)	743 (6)	778 (6)	0 (0)	3033(23)	3983 (29)	6395 (48)	20(<1)	10398(77)	13431
Year	33	851(14)	543 (9)	437 (8)	0 (0)	1831(31)	1442(24)	2657(45)	7(<1)	4106(69)	5937
						Weight					
April	2	3.3 (6)	1.9 (3)	0.4(<1)	0.0(0)	5.6 (9)	16.9(28)	37.4(63)	0.0 (0)	54.3(91)	59.9
May	4	3.9 (5)	32.8(37)	1.1 (1)	0.0(0)	37.7(43)	31.0(35)	20.0(22)	0.0 (0)	51.0(57)	88.8
June	2	11.6(16)	17.4(23)	1.7 (2)	0.0(0)	30.7(41)	16.0(21)	28.1(38)	0.7 (0)	44.8 (59)	75.5
July	6	25.2(20)	57.8(46)	3.3 (3)	0.0(0)	86.3(69)	24.6(20)	12.4(10)	1.3 (1)	38.3(31)	124.6
August	6	108.9(30)	173.4(48)	8.6 (2)	0.0(0)	290.9(80)	20.4 (6)	51.7(14)	1.8(<1)	73.9(20)	364.8
September	6	72.9(29)	76.9(31)	4.0 (2)	0.0(0)	153.8(62)	39.5(16)	54.7(22)	0.8(<1)	95.0(38)	248.8
October	3	21.1 (9)	45.8(19)	3.4 (1)	0.0(0)	70.3(29)	42.5(17)	131.4(54)	0.9(<1)	174.8(71)	245.1
November	4	138.7(23)	136.1(23)	8.3 (1)	0.0 (0)	283.1(47)	159.4(26)	154.2(26)	4.5 (1)	318.1(53)	601.2
Year	33	57.7(23)	81.8(33)	4.5 (2)	0.0(0)	144.0(58)	44.3(18)	58.6(24)	1.4(<1)	104.3(42)	243.3

Appendix 84. Weighted mean zooplankton densities ($\#\cdot M^{-3}$) and weights ($mg\cdot M^{-3}$) estimated from 30 m vertical tows during 1984 in Hungry Horse Reservoir, areas combined. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
April	6	213 (7)	223 (7)	72 (3)	0 (0)	503(17)	1495(30)	993(33)	0 (0)	2488(83)	2997
		[194][1]	[242]	[71]		[436]	[1349]	[459]		[1592]	[2015]
May	11	243 (8)	243 (8)	49 (2)	0 (0)	534(18)	1584(32)	916(30)	0 (0)	2499(82)	3033
		[227]	[196]	[46]		[305]	[1015]	[624]		[1323]	[1513]
June	10	618 (9)	538 (8)	109 (2)	0 (0)	1265(19)	4051(61)	1305(20)	2(<1)	5358(81)	6623
		[395]	[391]	[103]		[768]	[2503]	[645]	[1]	[2413]	[2959]
July	18	933(22)	750(17)	203 (4)	0 (0)	1936(43)	1409(31)	1159(26)	4(<1)	2573(57)	4509
		[463]	[819]	[135]		[1091]	[1089]	[682]	[6]	[1278]	[2009]
August	18	1382(18)	1188(15)	1128(15)	0 (0)	3698(48)	1298(17)	2707(35)	15(<1)	4021(52)	7719
		[535]	[550]	[517]		[921]	[553]	[782]	[11]	[1220]	[1654]
September	17	382 (5)	364 (6)	777(12)	1 (0)	1524(23)	1344(21)	3659(56)	8(<1)	5021(77)	6545
		[246]	[147]	[532]	[1]	[639]	[536]	[1731]	[5]	[2194]	[2429]
October	9	349 (5)	193 (3)	352 (5)	0 (0)	894(13)	1050(15)	4722(71)	4(<1)	5776(87)	6670
		[178]	[113]	[205]		[370]	[571]	[1585]	[1]	[2137]	[2461]
November	10	851 (9)	495 (5)	508 (6)	0 (0)	1858(20)	2403(25)	5151(55)	9(<1)	7573(80)	9431
		[1267]	[429]	[450]		[2020]	[2202]	[2135]	[9]	[3342]	[5731]
December	6	135 (4)	80 (2)	152 (4)	0 (0)	367(10)	1147(32)	2087(58)	2(<1)	3235(90)	3602
		[112]	[63]	[73]	<1	[230]	[453]	[509]	[1]	[946]	[1171]
Year	105	682(11)	549 (9)	451 (8)	<1(<1)	1682(28)	1703(29)	2549(43)	5(<1)	4258(72)	5950
		[658]	[525]	[513]		[1394]	[1502]	[1332]	[8]	[2501]	[3235]
						Weight					
April	6	8.7 (5)	51.1(29)	2.5 (1)	0.0(0)	62.3(34)	82.2(45)	37.5(21)	0.0 (0)	119.7(66)	182.1
		[6.0]	[57.9]	[3.0]		[62.3]	[73.4]	[20.0]		[84.4]	[130.5]
May	11	8.8 (7)	37.4(30)	0.8 (1)	0.0(0)	47.0(38)	52.3(43)	23.4(19)	0.0 (0)	25.7(62)	122.7
		[7.6]	[31.1]	[0.3]		[31.5]	[35.0]	[19.5]		[42.6]	[59.3]
June	10	28.5(14)	67.7(33)	1.1(<1)	0.0(0)	97.3(47)	84.5(41)	24.0(12)	0.5(<1)	109.2(53)	206.5
		[17.4]	[47.3]	[1.2]		[51.5]	[54.1]	[14.3]	[0.2]	[43.2]	[102.0]
July	18	43.2(23)	100.3(53)	2.4 (1)	0.0(0)	145.9(77)	21.4(11)	22.4(12)	0.4(<1)	44.2(23)	190.1
		[19.7]	[94.9]	[1.5]		[97.2]	[19.4]	[11.3]	[0.5]	[21.1]	[103.9]
August	18	65.1(21)	155.2(50)	10.3 (4)	0.0(0)	230.5(75)	21.4 (7)	52.4(16)	4.9 (2)	78.7(25)	309.3
		[38.5]	[74.6]	[5.1]		[90.4]	[10.3]	[20.5]	[3.9]	[29.9]	[96.7]
September	17	36.3(16)	73.9(32)	8.5 (4)	0.9(<1)	120.1(52)	43.4(19)	63.4(28)	2.4 (1)	109.2(48)	229.3
		[41.0]	[28.7]	[5.7]	[1.3]	[59.6]	[23.7]	[39.5]	[1.3]	[61.7]	[61.4]
October	9	22.0(12)	24.4(13)	4.5 (2)	0.0(0)	51.1(27)	29.5(16)	107.5(57)	1.0(<1)	138.1(73)	189.2
		[9.3]	[19.9]	[2.6]		[25.1]	[16.1]	[38.3]	[0.4]	[51.2]	[73.03]
November	10	75.4(19)	88.8(23)	5.4 (1)	0.0(0)	169.6(43)	96.2(24)	124.4(32)	2.2 (1)	222.8(57)	392.4
		[116.8]	[79.3]	[4.9]		[135.5]	[88.1]	[51.5]	[2.0]	[125.9]	[324.7]
December	6	16.3(15)	24.0(21)	1.3 (1)	0.0(0)	41.6(37)	26.2(23)	44.9(40)	0.6(<1)	71.6(63)	113.2
		[16.5]	[19.3]	[0.6]		[33.5]	[10.3]	[10.9]	[0.3]	[20.9]	[53.3]
Year	105	38.7(13)	81.0(36)	4.9 (2)	<1(<1)	124.6(55)	45.3(20)	53.5(24)	1.7 (1)	101.1(45)	225.7
		[47.6]	[70.9]	[5.0]		[105.5]	[47.0]	[43.2]	[2.5]	[73.8]	[144.5]

[1] Standard deviation

Appendix B5. Mean zooplankton densities ($\# \cdot M^{-3}$) and weights ($mg \cdot M^{-3}$) estimated from 30 m vertical tows during 1985 in the Emery Area, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
May	6	23(<1)	52 (1)	99 (1)	0 (0)	174 (3)	3495(52)	3086(46)	1 (<1)	6584(97)	6755
June	6	155 (2)	493 (5)	707 (9)	0 (0)	1355(17)	3318(42)	3185(40)	11.0(<1)	6514(83)	7869
July	6	625 (3)	2410(15)	4654(28)	0 (0)	7690(47)	3605(22)	5165(31)	5(<1)	8775(53)	16465
August	6	248 (3)	2682(34)	290 (4)	0 (0)	3220(41)	1438(18)	3128(40)	14(<1)	4580(59)	7800
Year	24	263 (3)	1409(14)	1438(15)	0 (0)	3110(32)	2964(30)	3641(37)	8(<1)	6613(63)	9722
						Weight					
May	6	0.8(<1)	2.3 (1)	1.4(<1)	0 (0)	4.5 (2)	117.0(53)	100.5(45)	0.1(<1)	217.6(98)	221.1
June	6	13.5 (5)	15.4 (5)	6.0 (2)	0 (0)	34.9(12)	162.3(58)	82.8(29)	1.3(<1)	246.4(88)	281.3
July	6	60.4 (8)	217.0(28)	128.2(17)	0 (0)	405.6(53)	165.5(21)	197.7(26)	1.4(<1)	364.6(47)	770.2
August	6	25.0 (5)	326.7(69)	3.6 (1)	0 (0)	355.3(75)	35.7 (8)	76.5(16)	3.9 (1)	116.1(25)	471.4
Year	24	24.9 (6)	140.4(32)	34.8 (8)	0 (0)	200.1(46)	120.1(28)	114.4(26)	1.7(<1)	236.2(54)	436.3

Appendix B6. Mean zooplankton densities ($\# \cdot M^{-3}$) and weights ($mg \cdot M^{-3}$) estimated from 30 m vertical tows during 1985 in the Murray Area, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus			Total	Total
						Number					
May	9	2(<1)	11(<1)	41 (1)	0 (0)	54 (2)	1593 (54)	1317(44)	3(<1)	2913(98)	2967
June	12	51 (1)	235 (4)	413 (7)	0 (0)	699(12)	2555(43)	2693(45)	14(<1)	5262(88)	5961
July	15	639 (4)	1823(12)	6871(44)	0 (0)	9333 (59)	2804(18)	3549 (23)	17(<1)	6370(41)	15703
August		665 (7)	2431(25)	1281(13)	0 (0)	4377(45)	2213(23)				
Year	48	379 (4)	1238(13)	2578(27)	0 (0)	4196(45)	2367(25)	2826(30)	13(<1)	5207(55)	9402
						Weight					
May	9	0.6(<1)	0.4(<1)	0.7 (1)	0 (0)	1.7 (2)	55.7(56)	42.6(43)	0.2(<1)	98.5(98)	100.2
June	12	4.9 (3)	8.4 (4)	4.0 (2)	0 (0)	17.3 (9)	106.6(56)	64.6(33)	1.8 (1)	173 (91)	190.3
July	15	89.8(19)	123.2(26)	43.9 (9)	0 (0)	256.9(54)	114.3(24)	97.5(21)	4.2 (1)	216 (46)	472.9
August	12	113.4(19)	297.2(51)	16.8 (3)	0 (0)	427.4(73)	66.2(11)	84.6(15)	3.9(<1)	154.7(27)	582.1
Year	48	57.8(16)	115.0(32)	19.1 (5)	0 (0)	191.8(53)	89.4(25)	75.8(21)	2.8 (1)	167.9(47)	359.7

Appendix B7. Mean zooplankton densities (#·M^{-3}) and weights (mg·M^{-3}) estimated from 30 m vertical tows during 1985 in the Sullivan Area, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
April											
May	4	1(<1)	0 (0)	4(1)	0 (0)	5 (1)	99(27)	264(72)	0 (0)	363(99)	368
June	6	13 (1)	98 (5)	175 (9)	0 (0)	285(15)	1087(56)	556(29)	4(<1)	1647(85)	1933
July	7	166 (2)	1286(17)	2450(33)	0 (0)	3902(53)	2079(28)	1381(19)	39(<1)	3499(47)	7401
August	6	236 (3)	1604(17)	2005(21)	0 (0)	3845(41)	3295(35)	2239(24)	28(<1)	5562(59)	9407
Year	23	116 (2)	835(16)	1315(25)	0 (0)	2266(43)	1793(34)	1195(23)	20(<1)	3009(57)	5275
						Weight					
April											
May	4	0.1(<1)	0 (0)	0.1(<1)	0 (0)	0.2 (1)	4.5(31)	9.7(67)	0 (0)	14.2(99)	14.4
June	6	1.2 (2)	2.4 (4)	1.8 (3)	0 (0)	5.4(10)	38.4(70)	10.6(19)	0.5 (1)	49.5(90)	54.9
July	7	20.9 (7)	93.9(33)	26.2 (9)	0 (0)	141.0(50)	96.5(67)	42.3(15)	4.7 (2)	143.5(50)	284.5
August	6	45.9(10)	155.5(34)	18.0 (4)	0 (0)	219.4(48)	82.5(18)	54.7(12)	101.1(22)	238.3(52)	457.7
Year	23	18.7 (8)	69.8(31)	13.1 (6)	0 (0)	101.6(46)	61.7(28)	31.6(14)	27.9(13)	121.2(54)	222.8

Appendix B8. Mean zooplankton densities ($\# \cdot M^{-3}$) and weights ($mg \cdot M^{-3}$) estimated from 30 m vertical tows during 1985 in all areas, Hungry Horse Reservoir. Percents of total zooplankton are in parentheses.

Month	Number of Samples	Daphnia Pulex	Daphnia Non-pulex	Bosmina	Leptodora	Total Cladocerans	Diaptomus	Cyclops	Epischura	Total Copepods	Total Zooplankton
						Number					
May	19	9(<1)	21(<1)	48 (1)	0 (0)	78 (2)	1729(51)	1556(46)	1(<1)	3286(98)	3364
June	24	73 (1)	275 (5)	432 (9)	0 (0)	780(15)	2320(44)	2145(41)	10(<1)	4475(85)	5255
July	28	477 (4)	1840(14)	4658(35)	0 (0)	6975(53)	2829(21)	3365(26)	20(<1)	6214(47)	13189
August	24	383 (4)	2239(25)	1192(13)	0 (0)	3814(42)	2315(25)	2852(32)	19(<1)	5186(58)	9000
Year	95	258 (3)	1182(14)	1793(22)		3232(40)	2351(29)	2565(31)	13(<1)	4929(60)	8161
						Weight					
May	19	0.5(<1)	0.9 (1)	0.7(<1)	0 (0)	2.1 (2)	59.1(53)	50.9(45)	0.1(<1)	110.1(98)	112.2
June	24	6.5 (4)	8.7 (5)	3.9 (2)	0 (0)	19.1(11)	102.4(58)	52.7(30)	1.2(<1)	156.3(89)	175.4
July	28	57.0(11)	144.7(28)	65.1(13)	0 (0)	267.8(53)	125.4(25)	112.5(22)	3.4(<1)	241.3(47)	509.1
August	24	61.4(12)	259.8(51)	12.8 (3)	0 (0)	334 (66)	61.5(12)	71.9(14)	36.3 (7)	169.7(33)	503.7
Year	95	34.1(10)	110.7(32)	23.8 (7)		168.6(49)	90.2(26)	74.8(22)	10.5 (3)	175.5(51)	344.1

Appendix B9. Length-frequency distributions and mean lengths(mm) of *Daphnia pulex* and *Daphnia sp.* collected in 30 m vertical tows from Hungry Horse Reservoir, 1984.

Month	Sample Size	*Daphnia species* 0.00-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	Mean	*Daphnia pulex* 0.00-0.49	0.50-0.99	1.00-1.49	1.50-1.99	2.00-2.49	Mean
						Emery Area							
April	2	0.0	80.0	5.0	15.0	0.0	(0.88)	0.0	4.0	2.0	66.0	28.0	(1.85)
May	4	0.0	89.0	11.0	0.0	0.0	(0.75)	0.0	13.5	40.0	42.0	4.5	(1.37)
June	4	0.0	77.5	18.0	4.5	0.0	(0.87)	0.0	6.5	73.0	20.5	0.0	(1.25)
July	6	0.0	62.0	38.0	0.0	0.0	(0.93)	0.0	3.0	55.0	42.0	0.0	(1.42)
August	6	0.0	80.0	20.0	0.0	0.0	(0.84)	0.0	31.0	46.0	22.0	1.0	(1.24)
September	5	0.0	52.8	41.2	6.0	0.0	(0.95)	0.0	4.4	29.2	50.8	15.6	(1.59)
October	3	0.0	45.0	45.0	10.0	0.0	(1.08)	0.0	12.0	28.0	24.0	36.0	(1.18)
November	2	0.0	30.0	60.0	10.0	0.0	(1.18)	0.0	10.0	54.0	18.0	18.0	(1.37)
December	2	0.0	100.0	0.0	0.0	0.0	(0.87)	0.0	0.0	20.0	20.0	60.0	(1.90)
						Murray Area							
April	2	0.0	90.0	10.0	0.0	0.0	(0.79)	0.0	18.0	18.0	62.0	2.0	(1.58)
May	3	0.0	79.3	20.7	0.0	0.0	(0.81)	0.0	5.3	38.7	55.3	0.7	(1.45)
June	4	2.0	70.5	27.5	0.0	0.0	(0.85)	0.0	0.0	64.5	35.5	0.0	(1.35)
July	6	0.0	70.0	30.0	0.0	0.0	(0.92)	0.0	29.0	38.0	28.5	4.5	(1.29)
August	6	0.0	87.5	12.5	0.0	0.0	(0.87)	0.0	27.0	31.0	41.0	1.0	(1.34)
September	6	0.0	62.5	30.0	7.5	0.0	(0.94)	0.0	9.0	18.0	38.0	35.0	(1.73)
October	3	4.0	69.0	23.0	0.0	4.0	(0.93)	0.0	73.0	23.0	0.0	4.0	(0.89)
November	4	0.0	55.0	30.0	15.0	0.0	(1.02)	0.0	8.0	46.0	24.0	22.0	(1.51)
December	4	0.0	45.0	22.0	33.0	0.0	(1.26)	0.0	0.0	0.0	43.0	57.0	(2.05)
						Sullivan Area							
April	2	0.0	60.0	40.0	0.0	0.0	(0.91)	0.0	0.0	11.0	89.0	0.0	(0.81)
May	4	0.0	83.0	11.0	6.0	0.0	(0.65)	0.0	0.0	18.0	82.0	0.0	(1.58)
June	2	0.0	61.0	39.0	0.0	0.0	(0.92)	0.0	38.0	25.0	37.0	0.0	(1.24)
July	6	0.0	87.5	12.5	0.0	0.0	(0.82)	0.0	21.0	45.0	34.0	0.0	(1.28)
August	6	0.0	52.5	42.5	5.0	0.0	(0.91)	0.0	20.0	48.0	27.0	5.0	(1.32)
September	6	0.0	31.5	49.0	13.2	6.3	(1.20)	0.0	9.5	30.5	30.0	30.0	(1.58)
October	3	0.0	65.0	35.0	0.0	0.0	(0.86)	0.0	22.0	32.0	26.0	20.0	(1.46)
November	4	0.0	35.0	55.0	10.0	0.0	(1.13)	0.0	0.0	34.0	62.0	4.0	(1.57)
December		No Data											
						All Areas Combined							
April	6	0.0	76.7	18.3	5.0	0.0	(0.86)	0.0	8.8	10.2	69.0	12.0	(1.41)
May	10	0.0	84.2	14.0	1.8	0.0	(0.73)	0.0	6.4	31.6	60.2	1.8	(1.47)
June	10	0.8	71.4	26.0	1.8	0.0	(0.87)	0.0	10.2	60.0	29.8	0.0	(1.29)
July	18	0.0	73.2	26.8	0.0	0.0	(0.89)	0.0	17.7	46.0	34.8	1.5	(1.33)
August	18	0.0	73.3	25.0	1.7	0.0	(0.87)	0.0	26.0	41.7	30.0	2.3	(1.30)
September	17	0.0	48.7	40.0	9.1	2.2	(1.03)	0.0	7.8	25.7	38.9	27.6	(1.63)
October	9	1.3	59.7	34.4	3.3	1.3	(0.96)	0.0	35.6	27.7	16.7	20.0	(1.18)
November	10	0.0	42.0	46.0	12.0	0.0	(1.10)	0.0	5.2	42.8	38.0	14.0	(1.51)
December	6	0.0	63.3	14.7	22.0	0.0	(1.13)	0.0	0.0	6.7	35.3	58.0	(2.00)
						All Areas Combined (Yearly Average)							
	105	0.3	63.8	30.4	5.1	0.4	(0.93)	0.0	14.6	35.5	37.8	12.1	(1.43)

Appendix B10. Length-frequency distributions and mean lengths (mm) of *Diaptomus* and *Cyclops* collected in 30 M vertical tows from Hungry Horse Reservoir, 1984. Mean lengths of *Leptodora* and *Epischura* are also included.

		Length Groups									
		Diaptomus				Cyclops					
Month	Sample Size	0.00-0.49	0.50-0.99	1.00-1.49	Mean	0.00-0.49	0.50-0.99	1.00-1.49	Mean	Leptodora Mean	Epischura Mean
					Emery Area						
April	2	5.0	85.0	10.0	(0.84)	5.0	90.0	5.0	(0.70)	0.0	0.00
May	4	33.5	50.0	16.5	(0.68)	22.5	75.5	2.0	(0.67)	0.0	0.00
June	4	40.0	60.0	0.0	(0.58)	41.0	59.0	0.0	(0.51)	0.0	2.05
July	6	67.5	32.5	0.0	(0.44)	50.0	50.0	0.0	(0.54)	0.0	0.00
August	6	67.5	30.0	2.5	(0.51)	62.5	32.5	5.0	(0.54)	0.0	1.93
September	5	18.0	78.0	4.0	(0.70)	27.0	73.0	0.0	(0.55)	0.0	1.71
October	3	30.0	70.0	0.0	(0.66)	30.0	70.0	0.0	(0.60)	0.0	1.82
November	2	20.0	60.0	20.0	(0.74)	35.0	55.0	10.0	(0.61)	0.0	2.00
December	2	25.0	75.0	0.0	(0.61)	20.0	80.0	0.0	(0.60)	0.0	1.94
					Murray Area						
April	2	5.0	80.0	15.0	(0.91)	5.0	95.0	0.0	(0.78)	0.0	0.00
May	3	25.0	60.0	15.0	(0.72)	36.7	61.7	1.6	(0.56)	0.0	0.00
June	4	35.0	62.5	2.5	(0.58)	32.5	67.5	0.0	(0.57)	0.0	2.19
July	6	65.0	35.0	0.0	(0.43)	47.5	50.0	2.5	(0.54)	0.0	0.00
August	6	47.5	50.0	2.5	(0.54)	47.5	50.0	2.5	(0.51)	0.0	1.93
September	6	22.5	72.5	5.0	(0.69)	30.0	70.0	0.0	(0.54)	5.0	1.88
October	3	30.0	70.0	0.0	(0.66)	30.0	70.0	0.0	(0.60)	5.0	1.40
November	4	20.0	60.0	20.0	(0.74)	35.0	55.0	10.0	(0.61)	0.0	1.88
December	4	25.0	75.0	0.0	(0.61)	20.0	80.0	0.0	(0.60)	0.0	1.87
					Sullivan Area						
April	2	5.0	80.0	15.0	(0.91)	5.0	95.0	0.0	(0.78)	0.0	0.00
May	4	17.5	77.5	5.0	(0.69)	27.5	72.5	0.0	(0.56)	0.0	0.00
June	2	25.0	75.0	0.0	(0.61)	35.0	65.0	0.0	(0.55)	0.0	1.95
July	6	40.0	57.5	2.5	(0.59)	32.5	67.5	0.0	(0.58)	0.0	1.22
August	6	60.0	37.5	2.5	(0.51)	35.0	57.5	7.5	(0.60)	0.0	1.57
September	6	22.5	72.5	5.0	(0.69)	30.0	70.0	0.0	(0.54)	0.0	1.75
October	3	30.0	70.0	0.0	(0.66)	30.0	70.0	0.0	(0.60)	0.0	1.69
November	4	20.0	60.0	20.0	(0.74)	35.0	55.0	10.0	(0.61)	0.0	1.63
					All Areas Combined						
April	6	5.0	81.7	13.3	(0.89)	5.0	93.3	16.7	(0.75)	0.0	0.00
May	11	25.4	62.7	11.9	(0.69)	28.2	70.6	11.8	(0.60)	0.0	0.00
June	10	35.0	64.0	1.0	(0.59)	36.4	63.6	0.0	(0.54)	0.0	2.09
July	18	57.5	41.7	0.8	(0.48)	43.3	55.8	0.9	(0.55)	0.0	1.22
August	18	58.3	39.2	2.5	(0.52)	48.3	46.7	5.0	(0.55)	0.0	1.81
September	17	21.2	74.1	4.7	(0.69)	29.1	70.9	0.0	(0.54)	5.0	1.78
October	9	30.0	70.0	0.0	(0.66)	30.0	70.0	0.0	(0.60)	5.0	1.64
November	10	20.0	60.0	20.0	(0.74)	35.0	55.0	10.0	(0.61)	0.0	1.80
December	6	25.0	75.0	0.0	(0.61)	20.0	80.0	0.0	(0.60)	0.0	1.89
					All Areas Combined (Yearly Average)						
	105	35.5	59.2	5.3	(0.62)	34.2	63.7	2.1	(0.58)	5.0	1.82

Appendix B11. Zooplankton densities ($N \cdot M^{-3}$) estimated from Schindler Trap samples taken from Emery Area of Hungry Horse Reservoir, 1983.

TAXON	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Standard deviation
			One Meter				
Daphnia	0	0	0	0	0	0	0
Bosmina	0	0	0	0	0	0	0
Diaptomus	0	0	0	0	0	0	0
Cyclops	0	0	0	0	0	0	0
Epischura	0	0	0	0	0	0	0
			Three Meters				
Daphnia	1,510	110	430	1,170	90	662	644.8
Bosmina	280	210	1,850	1,370	280	798	760.9
Diaptomus	370	1,280	320	1,030	230	646	475.6
Cyclops	2,440	7,060	1,710	1,730	440	2,676	2,554.6
Epischura	40	0	50	40	0	26	24.1
			Six Meters				
Daphnia	1,050	1,190	1,320	1,740	230	1,106	553.5
Bosmina	430	780	1,500	2,120	180	1,002	798.4
Diaptomus	200	590	1,010	1,740	140	736	660.9
Cyclops	1,550	2,830	5,090	3,830	800	2,820	1,722.4
Epischura	160	0	90	0	0	50	72.8
			Nine Meters				
Daphnia	1,170	920	1,900	800	360	1,030	568.0
Bosmina	180	600	2,690	980	230	936	1,032.2
Diaptomus	50	920	1,640	910	280	760	623.9
Cyclops	1,960	6,140	6,080	2,600	800	3,516	2,454.4
Epischura	90	0	20	0	0	22	39.0
			Twelve Meters				
Daphnia	1,460	480	2,050	1,620	210	1,164	784.0
Bosmina	160	300	2,460	1,100	180	840	985.1
Diaptomus	120	390	1,490	1,010	160	634	596.3
Cyclops	2,080	3,520	5,870	4,660	640	3,354	2,064.7
Epischura	0	0	0	0	0	0	0
			Fifteen Meters				
Daphnia	2,170	460	1,000	1,300	360	1,058	732.0
Bosmina	160	430	1,810	660	340	680	656.9
Diaptomus	510	270	1,390	640	230	608	468.9
Cyclops	2,220	3,130	5,600	3,260	870	3,016	1,731.2
Epischura	40	20	0	0	0	12	17.9
			Twenty Meters				
Daphnia	270	120	250	730	530	380	245.8
Bosmina	90	200	920	730	280	444	360.6
Diaptomus	160	110	360	690	690	402	279.1
Cyclops	890	1,050	1,870	2,170	1,780	1,552	553.5
Epischura	20	0	0	0	0	4	8.9
			Twenty-Five Meters				
Daphnia	370	210	370	1,280	280	502	440.1
Bosmina	40	90	440	1,050	300	384	405.7
Diaptomus	250	440	420	620	230	392	159.3
Cyclops	850	3,110	1,570	3,010	960	1,900	1,094.4
Epischura	0	0	0	0	0	0	0
			Thirty Meters				
Daphnia	270	340	90	850	280	366	286.2
Bosmina	70	300	340	680	500	378	228.3
Diaptomus	140	300	360	710	690	440	250.7
Cyclops	850	2,100	960	2,350	940	1,440	723.2
Epischura	0	20	0	0	0	4	8.9

Appendix B11. Continued, Murray Area.

TAXON	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Standard deviation
			One Meter				
Daphnia	0	0	0	0	0	0	0
Bosmina	0	0	0	0	0	0	0
Diaptomus	0	0	0	0	0	0	0
Cyclops	0	0	0	0	0	0	0
Epischura	0	0	0	0	0	0	0
			Three Meters				
Daphnia	940	840	2,420	1,440	1,760	1,420	663.5
Bosmina	390	360	3,260	1,740	1,230	1,396	1,194.3
Diaptomus	1,030	940	1,190	910	1,710	1,156	328.3
Cyclops	3,720	3,200	5,210	2,120	1,740	3,198	1,379.2
Epischura	20	50	0	0	0	14	21.9
			Six Meters				
Daphnia	1,660	590	2,380	1,190	1,370	1,438	656.1
Bosmina	340	430	1,550	1,210	710	848	518.6
Diaptomus	430	460	360	430	1,500	636	484.4
Cyclops	3,950	3,080	5,300	1,190	1,800	3,064	1,650.4
Epischura	50	0	0	0	0	10	22.4
			Nine Meters				
Daphnia	780	570	1,600	730	760	888	406.5
Bosmina	90	500	1,090	1,050	840	714	419.9
Diaptomus	430	440	120	570	1,050	522	338.3
Cyclops	3,040	5,140	4,950	1,320	1,500	3,190	1,821.8
Epischura	120	20	20	0	0	32	50.2
			Twelve Meters				
Daphnia	1,000	320	360	620	870	634	301.5
Bosmina	160	340	320	1,160	500	496	390.2
Diaptomus	520	110	70	430	1,480	522	570.2
Cyclops	2,740	3,080	2,310	1,490	2,050	233	615.4
Epischura	70	0	0	0	0	14	31.3
			Fifteen Meters				
Daphnia	960	270	710	370	1,170	696	381.6
Bosmina	90	160	320	690	530	358	251.1
Diaptomus	570	180	70	200	1,350	474	524.7
Cyclops	2,860	3,970	2,470	780	1,670	2,350	1,206.9
Epischura	0	0	0	0	0	0	0
			Twenty Meters				
Daphnia	680	550	340	300	940	562	262.1
Bosmina	40	120	270	550	430	282	211.4
Diaptomus	690	480	110	140	1,330	550	498.7
Cyclops	1,690	2,880	1,730	550	1,710	1,712	823.9
Epischura	20	0	0	0	0	4	8.9
			Twenty-Five Meters				
Daphnia	280	160	270	410	1,330	490	477.9
Bosmina	0	40	440	1,030	750	450	446.4
Diaptomus	530	140	110	270	1,360	470	492.7
Cyclops	960	910	1,280	550	1,820	1,104	476.7
Epischura	20	0	0	0	0	4	8.9
			Thirty Meters				
Daphnia	280	90	210	270	960	362	342.7
Bosmina	50	90	70	940	1,000	430	493.6
Diaptomus	140	70	50	200	750	242	290.1
Cyclops	620	870	570	550	1,050	732	219.1
Epischura	0	0	0	0	0	0	0

Appendix B 11. Continued, Sullivan Area

TAXON	Aug.	Sept.	Year	Standard deviation
		One Meter		
Daphnia	0	0	0	0
Bosmina	0	0	0	0
Diaptomus	0	0	0	0
Cyclops	0	0	0	0
Epischura	0	0	0	0
		Three Meters		
Daphnia	410	160	285	176.8
Bosmina	230	530	380	212.1
Diaptomus	870	110	490	537.4
Cyclops	2,720	910	1,815	1,279.9
Epischura	20	0	10	14.1
		Six Meters		
Daphnia	820	1,300	1,060	339.4
Bosmina	40	660	350	438.4
Diaptomus	620	1,600	1,110	692.9
Cyclops	1,900	4,560	3,230	1,880.9
Epischura	40	0	20	28.3
		Nine Meters		
Daphnia	480	280	380	141.4
Bosmina	140	550	345	289.9
Diaptomus	410	360	385	35.4
Cyclops	1,140	2,470	1,805	940.5
Epischura	20	0	10	14.1
		Twelve Meters		
Daphnia	620	590	605	21.2
Bosmina	180	660	420	339.4
Diaptomus	760	360	560	282.8
Cyclops	1,980	3,220	2,600	876.8
Epischura	0	0	0	0
		Fifteen Meters		
Daphnia	390	320	355	49.5
Bosmina	40	480	260	311.1
Diaptomus	590	70	330	367.7
Cyclops	780	1,070	925	205.1
Epischura	20	20	20	0.02
		Twenty Meters		
Daphnia	300	410	355	77.8
Bosmina	20	410	215	275.8
Diaptomus	210	20	115	134.4
Cyclops	620	840	730	155.6
Epischura	40	0	20	28.3
		Twenty-Five Meters		
Daphnia	120	230	175	77.8
Bosmina	0	110	55	77.8
Diaptomus	230	40	135	134.4
Cyclops	430	340	385	63.6
Epischura	20	0	10	14.1
		Thirty Meters		
Daphnia	70	140	105	49.5
Bosmina	90	160	125	49.5
Diaptomus	390	120	255	190.9
Cyclops	590	870	730	198.0
Epischura	0	0	0	0

Appendix B12. Zooplankton densities ($N \cdot M^{-3}$) estimated from Schindler Trap samples taken from Emery Area of Hungry Horse Reservoir, 1984.

TAXON	May	June	July	Aug.	Sept.	Oct.	Nov.	Year	Standard deviation
				One Meter					
Daphnia	2,790	213	178	3,020	196	249	498	1,021	1,293.5
Bosmina	0	0	0	1,530	1,890	142	231	542	809.5
Diaptomus	11,500	765	1,370	1,850	409	178	1,740	2,545	4,000.8
Cyclops	2,210	480	36	3,820	2,470	2,150	2,510	1,954	1,291.8
Epischura	0	0	18	18	53	18	0	15	18.9
				Three Meters					
Daphnia	1,920	249	2,490	9,980	1,620	836	1,210	2,615	3,328.4
Bosmina	18	36	285	6,080	1,690	1,030	712	1,407	2,145.2
Diaptomus	4,390	1,330	15,800	6,400	2,920	783	1,510	4,733	5,263.6
Cyclops	1,370	1,490	1,570	8,330	5,250	5,660	3,740	3,916	2,652.3
Epischura	0	0	0	53	36	36	0	18	23.0
				Six Meters					
Daphnia	1,920	659	9,110	4,450	1,740	819	694	4,348	4,382.6
Bosmina	0	0	213	4,540	1,230	925	445	1,050	1,607.3
Diaptomus	2,170	465	15,200	2,130	2,510	872	1,070	4,603	5,300.4
Cyclops	1,100	147	5,050	4,870	4,930	6,000	2,790	3,909	1,753.3
Epischura	0	0	0	36	71	71	0	25	33.8
				Nine Meters					
Daphnia	569	9,060	13,700	6,550	1,100	1,100	765	4,692	5,194.6
Bosmina	0	0	178	5,620	1,580	1,010	463	1,264	2,006.5
Diaptomus	925	5,910	10,400	1,280	1,230	925	1,140	3,116	3,681.0
Cyclops	979	2,350	4,980	6,120	3,670	8,590	2,950	4,234	2,556.1
Epischura	0	0	0	142	18	36	0	26	52.1
				Twelve Meters					
Daphnia	552	6,780	7,850	8,110	890	1,210	1,350	3,820	3,549.3
Bosmina	0	0	53	3,130	2,240	1,670	854	896	1,226.9
Diaptomus	1,300	6,190	5,020	1,280	872	1,280	1,550	2,499	2,157.8
Cyclops	979	1,870	2,240	4,340	3,650	7,150	5,500	3,676	2,176.9
Epischura	0	0	0	18	36	18	0	10	14.2
				Fifteen Meters					
Daphnia	249	3,220	7,260	7,050	1,410	2,060	534	3,112	2,931.8
Bosmina	0	0	0	925	3,340	1,670	338	896	1,244.5
Diaptomus	516	3,720	14,600	2,210	605	1,740	1,260	3,522	5,005.3
Cyclops	338	694	2,560	3,420	3,330	11,900	5,040	3,897	3,886.2
Epischura	0	0	0	18	36	36	0	13	17.1
				Twenty Meters					
Daphnia	231	3,260	3,580	5,500	1,190	676	463	2,129	2,004.9
Bosmina	18	18	0	747	1,190	587	498	437	453.0
Diaptomus	409	4,340	4,090	1,440	534	1,010	1,030	1,836	1,661.9
Cyclops	285	1,070	1,160	2,130	1,760	5,800	3,200	2,201	1,834.1
Epischura	0	0	0	0	0	36	0	5	13.6
				Twenty-Five Meters					
Daphnia	178	3,470	2,290	4,390	552	445	498	1,689	1,701.5
Bosmina	0	18	36	480	641	480	409	295	268.3
Diaptomus	480	4,270	2,920	1,120	338	641	996	1,538	1,483.6
Cyclops	338	1,070	979	1,390	1,160	4,960	3,450	1,907	1,660.9
Epischura	0	0	0	0	0	0	0	0	0
				Thirty Meters					
Daphnia	142	3,970	2,260	1,550	285	267	516	1,284	1,423.9
Bosmina	0	0	36	231	516	338	463	226	220.3
Diaptomus	321	4,450	2,650	747	160	676	979	1,426	1,564.7
Cyclops	178	1,070	1,030	1,030	801	2,900	3,910	1,560	1,329.5
Epischura	0	0	0	18	18	0	0	5	8.8

Appendix B12. Continued, Murray area.

TAXON	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Standard deviation
					One Meter					
Daphnia	1,560	427	231	979	285	391	2,600	89	820	865.8
Bosmina	18	71	0	925	1,070	445	1,050	0	447	493.6
Diaptomus	712	22,800	0	1,920	1,120	2,420	2,650	142	3,971	7,672.5
Cyclops	1,390	2,350	160	7,060	2,530	5,390	4,430	196	2,938	2,489.2
Epischura	0	0	0	53	0	18	18	0	11	18.8
					Three Meters					
Daphnia	1,670	391	800	4,130	1,250	1,740	1,920	374	1,534	1,208.3
Bosmina	36	36	53	1,210	783	1,740	979	196	629	648.1
Diaptomus	3,080	6,670	3,040	2,420	1,300	1,580	1,510	836	2,555	1,853.0
Cyclops	1,190	1,190	1,730	7,830	3,560	6,030	3,270	1,600	3,300	2,458.3
Epischura	0	36	0	89	0	53	0	18	22	33.9
					Six Meters					
Daphnia	783	1,670	4,230	4,070	694	2,190	2,460	498	2,074	1,464.5
Bosmina	71	36	18	1,780	836	2,300	872	356	784	856.8
Diaptomus	1,120	5,360	3,060	1,280	818	1,760	2,120	907	2,053	1,528.2
Cyclops	712	1,480	2,290	5,250	2,670	12,200	4,070	1,690	3,795	3,696.8
Epischura	0	0	0	107	0	18	0	0	16	37.5
					Nine Meters					
Daphnia	907	3,270	9,070	15,200	605	1,250	1,960	694	4,120	5,282.2
Bosmina	124	89	142	2,490	1,120	925	578	462	741	802.3
Diaptomus	2,150	3,810	4,450	1,640	801	765	1,765	1,410	2,099	1,347.9
Cyclops	1,570	1,530	5,140	8,610	2,690	3,150	3,905	1,900	3,562	2,386.9
Epischura	0	0	0	35	0	53	0	0	11	21.0
					Twelve Meters					
Daphnia	427	1,050	2,670	14,900	623	231	1,460	462	2,728	4,981.1
Bosmina	53	36	71	1,350	783	409	285	125	389	462.6
Diaptomus	1,600	1,210	1,140	1,920	445	338	1,410	1,120	1,185	547.5
Cyclops	1,280	818	1,460	6,550	1,800	2,940	3,740	2,030	2,577	1,859.2
Epischura	0	0	0	18	0	18	0	0	5	8.3
					Fifteen Meters					
Daphnia	196	996	3,430	5,940	3,770	285	1,230	605	2,057	2,084.6
Bosmina	36	36	53	356	694	587	320	231	690	1,186.6
Diaptomus	1,100	2,620	1,810	729	676	463	1,390	907	1,212	713.0
Cyclops	480	729	1,870	2,380	2,760	5,370	3,010	1,800	2,300	1,528.9
Epischura	0	0	0	0	53	18	0	18	11	18.8
					Twenty Meters					
Daphnia	231	729	1,810	4,520	2,120	445	1,960	480	1,537	1,422.3
Bosmina	0	36	18	160	142	196	498	338	174	172.1
Diaptomus	516	1,640	1,370	356	160	498	2,170	1,480	1,024	731.7
Cyclops	213	498	1,800	1,560	1,120	2,140	5,070	2,170	1,821	1,496.5
Epischura	0	0	0	0	0	53	0	0	7	18.7
					Twenty-Five Meters					
Daphnia	53	872	2,420	2,330	587	231	783	534	976	903.9
Bosmina	0	18	36	53	552	214	267	320	183	193.5
Diaptomus	231	1,650	2,010	445	338	125	534	1,710	880	770.2
Cyclops	89	552	1,390	1,080	623	890	1,230	3,240	1,137	945.9
Epischura	0	0	0	0	8	0	0	0	2	6.4
					Thirty Meters					
Daphnia	552	1,210	1,620	2,120	267	142	480	498	861	709.6
Bosmina	0	36	36	71	107	320	302	249	140	129.6
Diaptomus	1,530	2,130	1,260	302	178	178	605	1,490	959	741.3
Cyclops	658	854	1,300	1,210	356	587	2,150	819	992	562.2
Epischura	0	0	0	0	0	0	0	0	0	0

Appendix B12. Continued, Sullivan Area.

TAXON	May	July	Aug.	Sept.	Oct.	Nov.	Year	Standard deviation
			One Meter					
Daphnia	1,330	320	230	2,540	0	2,490	1,152	1,150.5
Bosmina	160	35	20	480	18	783	249	315.6
Diaptomus	7,310	89	230	3,310	36	5,050	2,665	3,077.3
Cyclops	9,950	142	820	4,800	925	8,040	4,113	4,165.1
Epischura	0	0	40	18	0	71	22	29.0
			Three Meters					
Daphnia	516	800	520	1,960	196	2,280	1,045	860.1
Bosmina	71	35	1,140	658	160	658	454	438.8
Diaptomus	2,140	2,400	2,600	2,470	1,510	3,810	2,588	738.6
Cyclops	3,330	1,230	2,940	4,380	4,750	5,660	3,715	1,563.4
Epischura	0	0	0	53	0	36	6	14.7
			Six Meters					
Daphnia	267	5,320	3,670	2,150	516	4,110	2,672	2,038.7
Bosmina	89	231	2,310	231	107	1,010	663	876.9
Diaptomus	694	3,310	1,090	1,510	1,490	6,510	2,434	2,189.1
Cyclops	1,030	2,420	4,470	3,310	4,150	7,530	3,818	2,204.5
Epischura	0	0	0	18	36	18	12	14.7
			Nine Meters					
Daphnia	36	978	11,320	1,580	747	4,820	3,247	4,292.7
Bosmina	0	36	3,630	196	409	1,190	910	1,402.1
Diaptomus	71	801	960	1,760	890	5,500	1,664	1,954.5
Cyclops	125	445	4,380	3,150	4,950	10,900	3,992	3,925.1
Epischura	0	0	20	0	0	36	9	15.3
			Twelve Meters					
Daphnia	231	409	10,180	1,030	498	3,260	2,601	3,877.8
Bosmina	18	89	4,840	569	142	516	1,029	1,881.0
Diaptomus	1,390	356	1,280	1,190	1,600	3,130	1,491	909.0
Cyclops	1,490	231	3,350	2,860	4,360	7,600	3,315	2,549.6
Epischura	0	00	0	0	36	0	6	14.7
			Fifteen Meters					
Daphnia	36	302	11,100	3,290	302	2,810	2,973	4,220.7
Bosmina	0	62	930	1,170	231	1,100	582	541.8
Diaptomus	36	516	1,280	1,120	641	3,810	1,234	1,338.2
Cyclops	0	373	1,280	3,310	4,020	10,100	3,181	3,747.3
Epischura	0	0	0	71	0	0	12	29.0
			Twenty Meters					
Daphnia	b/	196	5,320	2,970	196	1,650	2,066	2,154.8
Bosmina		36	480	872	178	765	466	361.3
Diaptomus		676	780	961	338	2,300	1,011	755.4
Cyclops		516	910	1,600	3,130	7,700	2,771	2,930.2
Epischura		0	0	18	0	0	4	8.0
			Twenty-Five Meters					
Daphnia		534	2,970	1,390	391	1,160	1,289	1,028.2
Bosmina		36	250	285	196	498	253	166.9
Diaptomus		961	480	516	178	1,090	645	374.1
Cyclops		391	800	1,410	1,250	4,720	1,714	1,726.9
Epischura		0	0	0	0	0	0	0
			Thirty Meters					
Daphnia		338	1,440	1,250	338	1,530	979	594.0
Bosmina		0	460	213	71	231	195	177.0
Diaptomus		391	340	409	427	836	481	201.3
Cyclops		356	500	854	1,090	4,230	1,406	1,604.9
Epischura		0	0	0	0	0	0	0

b/ = no samples below 20 m for May.

Appendix B13. Zooplankton densities ($N \cdot M^{-3}$) estimated from Schindler Trap samples taken from Emery Area of Hungry Horse Reservoir, 1985.

TAXON	June	July	Year
	One Meter		
Daphnia	667	2,000	1,334
Bosmina	0	1,500	750
Diaptomus	4,333	6,600	5,467
Cyclops	8,667	4,700	6,684
Epischura	0	0	0
	Three Meters		
Daphnia	2,333	3,917	3,125
Bosmina	1,000	12,167	6,584
Diaptomus	5,667	25,833	15,750
Cyclops	16,333	10,583	13,458
Epischura	0	0	0
	Six Meters		
Daphnia	2,083	7,583	4,833
Bosmina	0	42,350	21,175
Diaptomus	7,917	23,567	15,742
Cyclops	16,250	17,967	17,108
Epischura	0	0	0
	Nine Meters		
Daphnia	3,750	9,867	6,808
Bosmina	417	26,800	13,608
Diaptomus	4,167	11,467	7,817
Cyclops	13,750	18,133	15,942
Epischura	0	0	0
	Twelve Meters		
Daphnia	417	8,392	4,404
Bosmina	417	19,233	9,825
Diaptomus	4,167	9,317	6,742
Cyclops	12,917	19,108	16,012
Epischura	0	0	0
	Fifteen Meters		
Daphnia	467	6,917	3,692
Bosmina	267	11,667	5,967
Diaptomus	2,133	7,167	4,650
Cyclops	3,000	20,083	11,542
Epischura	0	0	0
	Twenty Meters		
Daphnia	0	2,333	1,166
Bosmina	0	6,800	3,400
Diaptomus	2,333	5,800	4,066
Cyclops	4,333	8,133	6,233
Epischura	0	0	0
	Twenty-Five Meters		
Daphnia	583	1,600	1,092
Bosmina	150	5,667	2,908
Diaptomus	533	3,867	2,200
Cyclops	2,583	4,400	3,492
Epischura	0	0	0
	Thirty Meters		
Daphnia	133	1,150	642
Bosmina	50	4,050	2,050
Diaptomus	1,433	3,350	2,392
Cyclops	1,983	4,200	3,092
Epischura	0	0	0

Appendix B13. Continued, Murray Area.

TAXON	June	July	Year
	One Meter		
Daphnia	1,917	550	1,234
Bosmina	500	50	275
Diaptomus	18,416	750	9,583
Cyclops	12,833	1,700	7,266
Epischura	0	0	0
	Three Meters		
Daphnia	2,417	3,033	2,725
Bosmina	1,167	2,383	1,775
Diaptomus	19,333	2,933	11,133
Cyclops	16,417	5,150	10,784
Epischura	0	50	25
	Six Meters		
Daphnia	916	6,500	3,708
Bosmina	1,417	12,500	6,958
Diaptomus	5,167	9,000	7,084
Cyclops	11,250	12,000	11,625
Epischura	0	0	0
	Nine Meters		
Daphnia	1,250	12,500	6,875
Bosmina	0	15,417	7,708
Diaptomus	13,250	6,667	9,958
Cyclops	8,917	13,333	11,125
Epischura	0	0	0
	Twelve Meters		
Daphnia	17	7,416	3,716
Bosmina	150	9,375	4,762
Diaptomus	2,267	6,167	4,217
Cyclops	1,383	8,333	4,858
Epischura	0	0	0
	Fifteen Meters		
Daphnia	917	2,333	1,625
Bosmina	750	3,333	2,042
Diaptomus	8,333	5,667	7,000
Cyclops	8,167	3,333	5,750
Epischura	0	0	0
	Twenty Meters		
Daphnia	150	2,667	1,408
Bosmina	233	1,667	950
Diaptomus	1,750	2,667	2,208
Cyclops	1,800	5,000	3,400
Epischura	0	17	8
	Twenty-Five Meters		
Daphnia	1,000	1,750	1,375
Bosmina	233	2,000	1,116
Diaptomus	1,700	2,750	2,225
Cyclops	1,667	3,500	2,584
Epischura	0	0	0
	Thirty Meters		
Daphnia	383	2,000	1,192
Bosmina	317	2,250	1,284
Diaptomus	2,867	1,750	2,308
Cyclops	2,000	4,000	3,000
Epischura	0	17	8

Appendix B13. Continued, Sullivan Area.

TAXON	May	June	July	Year
One Meter				
Daphnia	0	383	1,000	461
Bosmina	0	17	1,000	339
Diaptomus	0	1,567	8,667	3,411
Cyclops	0	3,967	1,500	1,822
Epischura	0	0	650	217
Three Meters				
Daphnia	0	417	1,250	556
Bosmina	36	50	5,000	1,695
Diaptomus	36	5,850	6,500	4,129
Cyclops	391	2,333	1,250	1,325
Epischura	18	33	67	39
Six Meters				
Daphnia	0	267	5,500	1,922
Bosmina	0	33	5,750	1,928
Diaptomus	36	5,817	6,250	4,034
Cyclops	89	1,783	3,250	1,707
Epischura	18	17	67	34
Nine Meters				
Daphnia	18	150	4,000	1,389
Bosmina	0	33	8,333	2,789
Diaptomus	36	2,867	4,000	2,301
Cyclops	125	1,517	3,000	1,547
Epischura	0	0	50	17
Twelve Meters				
Daphnia	0		500	250
Bosmina	0		2,250	1,125
Diaptomus	0		2,250	1,125
Cyclops	302		1,000	651
Epischura	36		33	
Fifteen Meters				
Daphnia	0		750	375
Bosmina	0		1,500	750
Diaptomus	0		1,500	750
Cyclops	125		750	438
Epischura	36		0	18
Twenty Meters				
Daphnia			250	
Bosmina			967	
Diaptomus			433	
Cyclops			433	
Epischura			0	
Twenty-Five Meters				
Daphnia			133	
Bosmina			233	
Diaptomus			250	
Cyclops			267	
Epischura			0	
Thirty Meters				
Daphnia			167	
Bosmina			733	
Diaptomus			550	
Cyclops			367	
Epischura			0	

Appendix B14. The number and weight (g) of aquatic macroinvertebrates$\cdot m^{-2}$ in benthos samples from Emery, Murray and Sullivan areas of Hungry Horse Reservoir June through November, 1984.

Date	Mean Depth(m)	Larvae No.	Larvae Wt.	Pupae No.	Pupae Wt.	Total No.	Total Wt.	Oligochaeta No.	Oligochaeta Wt.	Other No.	Other Wt.
						Emery Area 1984					
June 6	11.7	-----	-----	----	-----	-----	-----	-----	-----	---	-----
	27.3	46.6	0.147	----	-----	46.6	0.147	7.2	0.002	---	-----
	48.3	10.8	0.047	----	-----	10.8	0.047	14.3	0.005	---	-----
August 10	8.3	43.0	0.079	3.6	0.037	46.6	0.116	107.5	0.043	---	-----
	28.0	663.1	1.078	----	-----	663.1	1.078	308.3	0.242	---	-----
	53.0	236.5	0.575	----	-----	236.5	0.575	186.4	0.223	---	-----
November 7	14.8	57.3	0.075	----	-----	57.3	0.075	-----	-----	---	-----
	31.8	50.2	0.120	----	-----	50.2	0.120	3.6	<0.001	---	-----
	51.5	186.4	0.967	----	-----	186.4	0.967	7.2	0.013	---	-----
Summary	11.6	33.4	0.052	1.2	0.012	34.6	0.064	35.8	0.014	---	-----
	29.1	253.3	0.448	----	-----	253.3	0.448	106.4	0.081	---	-----
	50.9	144.6	0.530	----	-----	144.6	0.530	69.3	0.081	---	-----
						Murray Area 1984					
June 20	19.3	8.1	0.006	2.7	0.002	10.8	0.008	5.4	0.002	---	-----
	28.3	83.3	0.135	----	-----	83.3	0.135	51.1	0.033	---	-----
	60.3	430.1	0.315	14.3	0.104	444.4	0.419	28.7	0.007		
August 9	3.0	154.1	0.171	----	-----	154.1	0.171	17.9	0.012	3.6	0.005
	25.8	559.1	1.960	----	-----	559.1	1.960	207.9	0.173	---	-----
	50.5	455.2	0.351	----	-----	455.2	0.351	147.0	0.459	---	-----
November 8	10.8	14.4	<0.001	----	-----	14.4	<.001	-----	-----	---	-----
	30.2	211.5	0.839	----	-----	211.5	0.839	14.3	0.14	---	-----
	50.8	75.3	0.505	----	-----	75.3	0.505	-----	-----	---	-----
Summary	11.9	53.8	0.054	1.1	0.001	54.9	0.055	7.5	0.004	3.2	0.007
	28.1	264.5	0.894	----	-----	264.5	0.894	87.1	0.069	---	-----
	53.9	320.2	0.391	4.8	0.035	325.0	0.426	58.5	0.155	---	-----
						Sullivan Area 1984					
June 21	8.3	28.7	0.068	----	-----	28.7	0.068	17.9	0.071	---	-----
	37.7	172.1	0.423	3.6	0.005	175.6	0.428	89.6	0.047	---	-----
August 8	3.8	168.4	0.125	----	-----	168.4	0.125	35.9	0.043	7.2	0.057
	34.2	440.9	0.545	----	-----	440.9	0.545	240.1	0.312	---	-----
November 8	10.2	333.4	0.305	----	-----	333.4	0.305	28.7	0.133	---	-----
	33.5	50.2	0.136	----	-----	50.2	0.136	-----	-----	---	-----
	44.5	125.5	0.701	----	-----	125.5	0.701	14.4	0.008	---	-----
Summary	7.4	176.8	0.166	----	-----	176.8	0.166	27.5	0.082	2.4	0.019
	35.1	221.0	0.368	1.2	0.002	222.2	0.370	109.9	0.370	---	-----
	44.5	125.5	0.701	----	-----	125.5	0.701	14.4	0.008	---	-----
						Areas Combined 1984					
	10.4	86.8	0.089	0.8	0.004	87.6	0.093	23.1	0.033	1.9	0.008
						[144.4][a]		[42.3]			
	30.7	246.9	0.582	0.4	0.001	247.3	0.583	100.6	0.089	---	-----
						[296.1]		[154.9]			
	51.3	217.1	0.495	2.1	0.015	219.1	0.510	41.6	0.102	---	-----
						[218.1]		[60.7]			

[a] Standard deviation in brackets.

Appendix B15. The number and weight(g) of aquatic macroinvertebrates·m^{-2} in benthos samples from Emery, Murray and Sullivan areas of Hungry Horse Reservoir May through November, 1985.

Date	Mean Depth (m)	Aquatic Dipteran: Larvae No.	Larvae Wt.	Pupae No.	Pupae Wt.	Total No.	Total Wt.	Oligochaeta No.	Oligochaeta Wt.	Other No.	Other Wt.
					Emery Area 1985						
May	15.1	----	-----	---	-----	----	-----	82.4	0.009	-	-
	32.4	71.7	0.072	---	-----	71.7	0.072	179.2	0.673	-	-
	48.1	25.1	0.037	---	-----	25.1	0.037	28.7	0.026	-	-
June	4.0	10.8	0.004	---	-----	10.8	0.004	60.9	0.001	-	-
	33.0	25.1	0.012	3.6	0.003	28.7	0.015	53.8	0.059	-	-
	43.0	96.8	0.072	---	-----	96.8	0.072	57.3	0.006	-	-
August	10.0	3.6	0.001	---	-----	3.6	0.001	93.2	0.047	-	-
	28.3	265.2	0.760	3.6	0.005	268.8	0.765	168.5	0.073	-	-
	91.0	7.2	0.001	3.6	0.010	10.8	0.011	129.0	0.053	-	-
September	14.0	53.8	0.043	3.6	0.028	57.4	0.076	344.1	0.098	-	-
	33.0	483.9	0.962	---	-----	483.9	0.962	924.7	0.630	-	-
	80.3	78.9	0.252	---	-----	78.9	0.252	537.6	0.467	-	-
October	14.0	7.2	0.023	---	-----	7.2	0.023	233.0	0.091	-	-
	33.0	93.2	0.506	---	-----	93.2	0.506	595.0	0.874	-	-
	49.3	75.3	1.068	---	-----	75.3	1.068	519.7	0.250	-	-
November	8.0	43.0	0.121	---	-----	43.0	0.121	293.9	0.086	-	-
	35.0	315.4	1.247	---	-----	315.4	1.247	379.9	0.280	-	-
	44.3	60.9	0.262	---	-----	60.9	0.262	157.7	0.230	-	-
					Murray Area 1985						
May	15.2	21.5	0.007	---	-----	21.5	0.007	14.3	0.001	-	-
	33.5	134.4	0.336	---	-----	134.4	0.336	59.2	0.013	-	-
	49.0	177.4	0.504	5.4	0.005	182.8	0.508	172.1	0.108	-	-
June	4.0	-----	-----	---	-----	-----	-----	14.3	0.004	-	-
	35.0	211.5	0.024	3.6	0.019	215.1	0.043	32.3	0.002	-	-
	85.0	752.7	0.311	---	-----	752.7	0.311	505.4	0.109	-	-
July	13.0	25.1	0.020	----	-----	25.1	0.020	17.9	0.017	-	-
	30.3	186.4	0.499	21.5	0.030	207.9	0.529	347.7	0.435	-	-
August	8.0	3.6	0.005	----	-----	3.6	0.005	----	-----	-	-
	31.3	68.1	0.281	----	-----	68.1	0.281	89.6	0.451	-	-
	81.0	96.8	0.315	----	-----	96.8	0.315	111.1	0.277	-	-
September	14.0	----	-----	----	-----	----	-----	146.9	0.293	-	-
	37.0	46.6	0.127	----	-----	45.6	0.127	336.9	0.269	-	-
	44.0	60.9	0.053	----	-----	60.9	0.053	200.7	0.075	-	-
October	14.0	7.2	0.015	----	-----	7.2	0.015	204.3	0.181	-	-
	33.3	46.6	0.180	----	-----	46.6	0.180	233.0	0.181	-	-
	78.0	25.1	0.074	----	-----	25.1	0.074	286.7	0.244	-	-
November	9.0	----	-----	----	-----	-----	-----	32.3	0.015	-	-
	37.0	96.8	0.243	----	-----	96.8	0.243	175.6	0.129	-	-
	65.0	129.0	0.342	----	-----	129.0	0.342	189.9	0.164	-	-
					Sullivan Area 1985						
May	15.2	14.4	0.012	---	-----	14.4	0.012	10.8	0.001	-	-
	30.8	103.9	0.276	7.2	0.025	111.1	0.301	197.1	0.056	-	-
June	5.0	32.3	0.048	---	-----	32.3	0.048	21.5	0.021	-	-
	37.7	118.3	0.163	---	-----	118.3	0.163	17.9	0.008	-	-
July	----	-----	-----	--	--	-----	-----	----	-----	-	-
	38.0	132.6	0.898	--	--	132.6	0.898	430.3	0.356	-	-
August	8.5	17.9	0.002	--	--	17.9	0.002	150.5	0.091	-	-
	28.0	43.0	0.116	--	--	43.0	0.116	530.5	0.530	-	-
September	12.5	----	-----	--	--	----	-----	112.9	0.046	5.4	0.015
	35.0	48.4	0.235	--	--	48.4	0.235	564.5	0.683	-	-
October	12.3	17.9	0.110	3.6	0.007	21.5	0.117	132.6	0.068	0	0
	38.0	50.2	0.249	---	-----	50.2	0.249	433.7	0.252	-	-
November	8.5	21.5	0.052	---	-----	21.5	0.052	182.8	0.096	-	-
	31.0	64.5	0.363	---	-----	64.5	0.363	175.5	0.178	3.6	0.001

Appendix B16. The number and weight (g) of aquatic macroinvertebrates m^{-2} in benthos samples from Emery, Murray and Sullivan areas of Hungry Horse Reservoir, 1985. Monthly samples are combined.

Mean Depth (m)	Aquatic Dipteran: Larvae No.	Larvae Wt.	Pupae No.	Pupae Wt.	Total No.	Total Wt.	Oligochaeta No.	Oligochaeta Wt.	Other No.	Other Wt.
Emery Area										
10.8	19.7	0.033	0.6	0.005	20.3	0.037	184.6	0.055	---	-----
32.5	209.1	0.593	1.2	0.001	210.3	0.595	383.5	0.431	---	-----
59.4	57.4	0.282	0.6	0.002	58.0	0.284	238.3	0.172	---	-----
Murray Area										
11.0	8.2	0.007	---	-----	8.2	0.007	61.4	0.073	---	-----
34.0	111.8	0.237	3.8	0.007	115.6	0.244	188.2	0.211	---	-----
67.0	174.7	0.249	6.7	0.001	175.4	0.250	232.5	0.170	---	-----
Sullivan Area										
10.1	22.7	0.045	0.6	0.001	23.3	0.046	96.8	0.052	0.6	0.002
34.5	81.7	0.333	1.1	0.004	82.8	0.337	331.7	0.350	0.5	0.001
Areas Combined										
10.7	16.4	0.027	0.4	0.002	16.8	0.029	111.5	0.061	0.2	0.001
					[22.2][a]		[119.2]			
33.7	131.6	0.381	2.0	0.004	133.7	0.385	298.3	0.331	0.2	0.001
					[131.1]		[277.4]			
63.0	112.6	0.267	0.6	0.001	113.2	0.268	235.6	0.171	---	-----
					[176.2]		[215.3]			

a/ Standard deviation in brackets

Appendix B17. The mean number and weight (g) of surface insects captured per hectare from Hungry Horse Reservoir in the Emery, Murray and Sullivan areas April-November, 1984. Samples were taken nearshore (<100 m) and offshore (>100 m).

		Areas												Areas Combined			
		Emery				Murray				Sullivan							
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
April (12)	Coleopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.0	0.0	0.00	0.0	0.00
	Hemipterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	8.5	0.02	0.0	0.00	2.8	0.01
	Homopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Hymenopterans	8.5	0.02	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	2.8	0.01	0.0	0.00
	Other	0.0	0.00	8.5	0.08	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	2.8	0.03
	Total																
	Terrestrials	8.5	0.02	8.5	0.08	0.0	0.00	0.0	0.00	0.0	0.00	8.5	0.02	2.8	0.01	5.6	0.03
	Aquatic																
	Dipterans	17.0	0.14	8.5	0.14	8.5	0.04	33.5	0.16	42.0	0.04	33.5	0.10	22.5	0.07	25.2	0.13
	Other Aquatics	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Total Aquatics	17.0	0.14	8.5	0.14	8.5	0.04	33.5	0.16	42.0	0.04	33.5	0.10	22.5	0.07	25.2	0.13
	TOTAL INSECTS	25.0	0.15	17.0	0.22	8.5	0.04	33.5	0.16	42.0	0.04	42.0	0.11	25.2	0.08	30.8	0.16

		Areas												Areas Combined			
		Emery				Murray				Sullivan							
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
May (20)	Coleopterans	108.5	2.34	79.0	1.30	37.5	0.68	29.2	0.54	8.5	0.06	8.5	0.06	60.0	1.22	45.0	0.75
	Hemipterans	8.2	0.18	4.2	0.01	0.0	0.00	0.0	0.00	0.0	0.00	8.5	0.08	3.3	0.07	3.4	0.02
	Homopterans	0.0	0.00	4.2	<0.01	0.0	0.00	4.2	0.02	8.5	0.01	0.0	0.00	1.7	<0.01	3.4	<0.01
	Hymenopterans	129.2	1.60	58.2	0.62	25.0	0.83	4.2	0.04	0.0	0.00	0.0	0.00	61.7	0.97	25.0	0.26
	Other	4.2	0.03	4.2	0.04	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.7	0.01	1.7	0.01
	Total																
	Terrestrials	250.0	4.14	150.0	1.94	62.5	1.51	37.5	0.59	17.0	0.08	17.0	0.14	128.4	2.28	78.4	1.05
	Aquatic																
	Dipterans	137.5	1.50	121.0	0.62	133.2	0.50	141.8	0.47	141.5	0.52	183.0	0.99	136.6	0.90	141.7	0.63
	Other Aquatics	4.2	0.15	4.2	0.02	16.8	0.02	4.2	0.02	0.0	0.00	0.0	0.00	8.4	0.07	3.4	0.02
	Total Aquatics	141.8	1.64	125.0	0.64	150.0	0.52	146.0	0.48	141.5	0.52	183.0	0.99	145.0	0.97	145.0	0.65
	TOTAL INSECTS	391.8	5.79	275.0	2.61	212.5	2.03	183.2	1.07	158.5	0.60	200.0	1.12	273.4	3.25	223.3	1.70

Appendix B17. (continued)

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
June (23)	Coleopterans	175.0	1.81	62.5	2.80	96.0	3.07	25.0	0.34	4.2	0.07	5.7	0.04	9.3	1.65	33.4	1.15
	Hemipterans	16.8	0.67	12.5	0.11	12.5	0.12	4.2	0.02	0.0	0.00	0.0	0.00	9.7	0.26	6.1	0.05
	Homopterans	0.0	0.00	0.0	0.00	4.2	0.01	0.0	0.00	0.0	0.00	5.6	0.02	1.4	<0.01	1.5	0.01
	Hymenopterans	25.0	1.18	58.2	1.20	95.8	2.61	54.2	2.40	8.5	0.50	5.6	0.12	43.1	1.43	42.5	1.34
	Other	4.2	0.04	8.5	0.11	4.2	0.06	0.0	0.00	0.0	0.00	0.0	0.00	2.8	0.03	3.1	0.04
	Total Terrestrials	221.0	3.69	141.8	4.21	212.5	5.86	83.2	2.8	12.8	0.56	16.7	0.18	148.3	3.37	86.4	2.58
	Aquatic Dipterans	75.0	0.66	12.7	0.14	33.2	0.59	12.8	0.07	100.0	0.51	155.7	0.56	69.4	0.59	51.7	0.23
	Other Aquatics	20.8	0.09	0.0	0.00	41.8	0.24	12.8	0.14	8.5	0.13	0.0	0.00	23.7	0.15	4.6	0.05
	Total Aquatics	95.8	0.76	12.7	0.14	75.0	0.83	24.9	0.22	108.2	0.64	155.7	0.56	93.0	0.74	56.1	0.23
	TOTAL INSECTS	316.5	4.44	154.0	4.34	287.5	6.69	108.5	2.98	120.8	1.20	172.0	0.74	241.6	4.11	142.3	2.35

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
July (36)	Coleopterans	16.7	0.16	5.5	0.03	8.5	0.25	2.8	0.01	11.2	0.11	19.3	0.18	12.1	0.17	9.2	0.27
	Hemipterans	19.5	0.14	8.5	0.40	2.8	0.01	0.0	0.00	2.8	<0.01	2.8	0.33	8.4	0.05	3.3	0.24
	Homopterans	11.2	0.01	2.8	0.02	16.7	0.02	8.5	0.01	2.8	<0.01	2.8	0.09	10.2	0.01	4.7	0.24
	Hymenopterans	11.2	0.03	5.7	0.05	8.3	0.06	11.2	0.02	5.5	0.04	13.8	0.10	8.3	0.04	10.2	0.25
	Other	11.0	0.14	2.8	0.26	13.8	0.04	19.5	0.01	2.8	0.09	8.3	0.19	9.2	0.09	10.2	0.15
	Total Terrestrials	69.5	0.48	25.2	0.75	50.0	0.38	41.8	0.04	25.2	0.24	47.0	0.88	48.2	0.37	38.0	0.55
	Aquatic Dipterans	36.2	0.09	5.7	0.10	36.2	0.14	5.7	0.01	58.3	0.09	55.5	0.34	43.6	0.11	22.2	0.15
	Other Aquatics	114.0	0.23	2.8	0.50	2.8	0.02	2.8	0.01	0.0	0.00	11.2	0.05	38.9	0.08	5.6	0.19
	Total Aquatics	150.2	0.32	8.3	0.58	38.8	0.16	8.5	0.02	58.3	0.09	66.7	0.40	82.4	0.19	27.8	0.33
	TOTAL INSECTS	219.5	0.81	33.3	1.34	89.2	0.53	50.2	0.07	83.5	0.33	113.8	1.28	130.7	0.56	65.7	0.90

Appendix B17. (continued)

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Aug. (35)	Coleopterans	3.4	0.14	2.8	0.02	0.0	0.00	0.0	0.00	8.5	0.04	0.0	0.00	4.0	0.06	0.9	0.01
	Hemipterans	0.0	0.00	5.7	0.20	11.2	0.05	0.0	0.00	2.8	0.02	2.8	0.01	4.9	0.02	2.8	0.07
	Homopterans	3.4	<0.01	5.7	<0.01	102.8	0.09	30.5	0.04	89.0	0.06	22.2	0.05	68.7	0.06	19.4	0.03
	Hymenopterans	6.8	0.02	2.8	0.01	50.0	0.11	72.2	0.18	1,708.3	9.71	599.8	1.82	622.6	3.47	224.9	0.67
	Other	3.4	0.01	11.2	0.10	11.3	0.03	2.8	0.04	0.0	0.00	8.5	1.20	5.0	0.01	7.5	0.45
	Total																
	Terrestrials	16.8	0.16	27.7	0.34	175.2	0.29	105.5	0.27	1,808.3	9.83	633.2	3.08	705.0	3.62	255.4	1.23
	Aquatic																
	Dipterans	19.8	0.03	13.8	0.11	125.2	0.27	16.7	0.08	80.7	0.16	39.0	0.11	78.5	0.16	23.2	0.10
	Other Aquatics	0.0	0.00	2.8	0.01	5.7	0.01	0.0	0.00	2.8	<0.01	0.0	0.00	3.0	<0.01	0.9	<0.01
	Total Aquatics	19.8	0.33	16.7	0.12	130.5	0.28	16.7	0.08	83.5	0.16	39.0	0.11	81.4	0.17	24.1	0.10
	TOTAL INSECTS	36.6	0.19	44.3	0.46	305.5	0.57	122.3	0.34	1,891.7	10.0	672.2	3.20	786.2	3.79	279.6	1.34

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Sept. (36)	Coleopterans	93.0	0.50	2.8	<0.01	13.8	0.03	2.8	0.01	19.5	0.02	11.2	0.03	42.1	0.19	5.6	0.02
	Hemipterans	38.2	0.08	0.0	0.00	33.2	0.18	2.8	<0.01	36.2	0.10	19.5	0.07	35.8	0.12	7.4	0.02
	Homopterans	171.7	0.66	283.3	0.19	47.3	0.04	36.2	0.02	58.3	0.19	44.5	0.04	92.4	0.30	121.3	0.08
	Hymenopterans	12,381.2	52.52	9,519.3	50.22	766.7	4.09	483.2	2.75	288.8	2.02	227.7	0.80	4,478.9	19.54	3,410.1	17.92
	Other	15.7	0.03	25.0	0.16	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	5.2	0.01	8.3	0.05
	Total																
	Terrestrials	12,699.7	53.79	9,830.5	50.57	861.2	4.34	525.0	2.78	402.8	2.34	302.8	0.94	4,654.6	20.15	3,552.3	18.10
	Aquatic																
	Dipterans	111.3	0.10	33.3	0.02	61.2	0.18	28.0	0.04	86.0	0.27	119.5	0.55	86.2	0.18	60.3	0.20
	Other Aquatics	2.8	0.02	0.0	0.00	2.8	0.02	2.8	0.02	2.8	0.02	0.0	0.00	2.8	0.02	0.9	0.01
	Total Aquatics	114.0	0.12	33.3	0.02	64.0	0.19	30.7	0.06	88.8	0.29	119.5	0.55	88.9	0.20	61.2	0.21
	TOTAL INSECTS	12,813.5	53.90	9,863.8	50.60	924.8	4.53	555.5	2.8	491.7	2.63	422.3	1.49	4,743.3	20.36	3,613.9	18.31

Appendix B17. (continued)

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Oct. (18)	Coleopterans	0.0	0.00	0.0	0.00	0.0	0.00	11.0	0.01	0.0	0.00	0.0	0.00	0.0	0.00	3.7	<0.01
	Hemipterans	0.0	0.00	0.0	0.00	16.7	0.07	0.0	0.00	11.3	0.02	16.7	0.08	9.3	0.03	5.6	0.03
	Homopterans	5.7	<0.01	5.7	<0.01	211.0	0.06	455.7	0.33	200.0	0.15	489.0	0.34	138.9	0.07	316.8	0.23
	Hymenopterans	0.0	0.00	0.0	0.00	16.7	28.87	11.0	<0.01	27.7	0.13	114.3	0.34	14.8	0.07	51.8	0.11
	Other	0.0	0.00	0.0	0.00	16.7	0.06	11.0	0.12	5.7	0.10	5.7	0.01	7.4	0.05	5.6	0.04
	Total Terrestrials	5.7	<0.01	5.7	<0.01	261.3	0.28	489.0	0.46	244.3	0.40	655.7	0.78	170.4	0.23	383.4	0.42
	Aquatic Dipterans	28.0	0.01	105.7	0.05	89.0	0.04	283.3	0.10	66.7	0.18	94.3	0.18	61.2	0.07	161.1	0.11
	Other Aquatics	0.0	0.00	0.0	0.00	5.7	0.01	0.0	0.0	11.3	0.05	5.7	<0.01	5.7	0.02	1.9	<0.01
	Total Aquatics	28.0	0.01	105.7	0.05	94.7	0.05	283.3	0.10	77.7	0.23	100.0	0.18	66.8	0.09	163.0	0.11
	TOTAL INSECTS	33.3	0.01	111.3	0.06	355.7	0.33	772.3	0.56	322.0	0.63	755.7	0.95	237.0	0.32	546.4	0.52

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
November (18)	Coleopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Hemipterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Homopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Hymenopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Other	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Total Terrestrials	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Aquatic Dipterans	5.7	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.9	<0.01	0.0	0.00
	Other Aquatics	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Total Aquatics	5.7	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.00	1.9	<0.01	0.0	0.00
	TOTAL INSECTS	5.7	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.9	<0.01	0.0	0.00

Appendix B17. (continued)

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Grand Mean	Coleopterans	58.8	0.64	18.6	0.49	19.6	0.49	8.4	0.11	8.4	0.05	7.0	0.05	27.7	0.40	11.5	0.22
(198)	Hemipterans	13.5	0.14	4.5	0.12	11.3	0.06	1.0	<0.01	8.9	0.03	7.6	0.09	11.2	0.08	4.2	0.07
	Homopterans	34.3	0.12	52.5	0.04	48.6	0.03	54.0	0.04	47.4	0.06	61.3	0.07	43.4	0.07	55.8	0.05
	Hymenopterans	2,273.4	9.89	1,695.1	9.09	161.3	1.17	107.3	0.31	379.2	2.23	177.4	0.57	935.7	4.44	674.7	3.58
	Other	6.4	0.04	8.9	0.11	6.4	0.02	4.9	0.02	1.1	0.03	3.8	0.27	4.7	0.03	5.9	0.13
	Total Terrestrials	2,382.3	10.84	1,779.4	9.35	247.1	1.77	176.0	0.98	444.9	2.44	257.0	1.05	1,022.3	5.01	752.0	4.05
														[4,792.6]	[21.31]	[3,530.0]	[19.60] a/
	Aquatic Dipterans	59.7	0.31	34.9	0.14	67.2	0.24	54.0	0.10	72.4	0.21	79.6	0.34	66.4	0.25	55.5	0.19
	Other Aquatics	24.3	0.08	1.5	0.09	9.4	0.04	3.0	0.02	3.2	0.02	2.7	0.01	12.3	0.05	2.4	0.04
	Total Aquatics	83.9	0.39	36.3	0.23	79.5	0.28	56.9	0.13	75.5	0.24	82.3	0.35	78.7	0.30	57.8	0.23
														[112.0]	[0.65]	[108.7]	[0.50]
	TOTAL INSECTS	2,466.1	11.23	1,815.7	10.08	323.6	2.05	232.9	1.11	520.3	2.68	339.3	1.40	1,101.3	5.31	809.3	4.28
														[4,823.3]	[21.36]	[3,537.4]	[19.57]

a/ Standard deviations are given in brackets.

Appendix B18. The mean number and weight (g) of surface insects captured per hectare from Hungry Horse Reservoir in the Emery, Murray and Sullivan areas May-November, 1985. Samples were taken nearshore (<100 m) and offshore (>100 m).

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
May (48)	Coleopterans	44.3	0.55	25.0	0.33	72.2	1.42	22.2	0.66	16.3	0.25	9.2	0.13	44.5	0.79	18.0	0.38
	Hemipterans	2.8	0.01	2.8	0.18	1.9	0.01	0.0	0.00	1.9	0.01	1.9	0.01	2.1	0.01	1.4	0.05
	Homopterans	0.01	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.9	0.15	0.0	0.00	0.7	0.06
	Hymenopterans	111.2	0.54	33.3	0.08	83.2	0.14	55.5	0.24	31.6	0.40	3.8	0.06	70.8	0.34	30.6	0.13
	Other	2.8	0.02	22.2	0.03	66.7	0.58	20.4	0.16	13.0	0.04	5.7	0.07	30.6	0.24	15.3	0.10
	Total Terrestrials	161.0	1.23	83.3	0.61	224.0	2.15	98.1	1.06	63.1	0.71	22.2	0.44	147.9	1.38	66.0	0.71
	Aquatic Dipterans	55.7	0.14	11.3	0.01	872.1	1.60	163.0	0.62	92.8	0.29	83.3	0.33	375.8	0.75	95.2	0.36
	Other Aquatics	5.5	0.03	2.8	<0.01	3.8	0.14	3.7	0.08	16.8	0.10	16.8	0.08	9.1	0.10	8.4	0.06
	Total Aquatics	61.2	0.18	14.0	0.02	875.9	1.74	166.8	0.70	109.2	0.39	100.1	0.40	384.7	0.34	103.5	0.42
	TOTAL INSECTS	222.3	1.41	97.3	0.63	1,099.9	3.90	264.9	1.75	172.2	1.09	122.2	0.84	532.6	2.22	169.5	1.13

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
June (48)	Coleopterans	5.7	0.06	14.0	0.15	27.8	0.62	22.3	0.31	50.0	0.29	16.7	0.16	27.8	0.39	18.8	0.23
	Hemipterans	0.0	0.00	0.0	0.00	5.6	0.10	7.0	0.14	0.0	0.00	0.0	0.00	2.8	0.05	3.5	0.07
	Homopterans	0.0	0.00	2.8	0.01	1.4	<0.01	1.4	<0.01	2.8	0.72	19.5	0.04	1.4	0.18	6.3	0.01
	Hymenopterans	0.0	0.00	8.5	1.59	5.7	0.07	7.1	0.08	2.8	0.03	8.3	0.04	3.5	0.04	7.8	0.45
	Other	11.2	<0.01	0.0	0.00	4.2	0.04	2.3	0.02	2.8	<0.01	5.7	0.08	5.5	0.03	2.8	0.03
	Total Terrestrials	16.8	0.05	25.2	1.75	44.5	0.82	40.2	0.54	58.3	1.02	49.3	0.31	41.0	0.68	38.9	0.79
	Aquatic Dipterans	30.5	0.09	13.8	0.03	22.3	0.04	15.2	0.02	36.0	0.09	52.3	0.20	27.8	0.05	24.3	0.07
	Other Aquatics	0.0	0.00	2.8	<0.01	0.0	0.00	5.6	0.05	0.0	0.00	2.8	0.02	0.0	0.00	4.2	0.03
	Total Aquatics	30.5	0.09	16.7	0.03	22.3	0.04	20.9	0.07	36.0	0.09	55.7	0.23	27.8	0.05	28.5	0.10
	TOTAL INSECTS	47.2	0.15	41.9	1.79	66.7	0.86	61.1	0.61	94.5	1.10	105.8	0.53	68.8	0.74	67.5	0.89

Appendix B18. (continued)

		Areas												Areas Combined			
		Emery				Murray				Sullivan							
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
July (51)	Coleopterans	47.2	0.35	8.2	0.29	7.8	0.10	5.9	0.04	14.0	0.03	5.5	0.01	17.9	0.14	6.2	0.07
	Hemipterans	19.3	0.26	29.0	0.18	7.8	0.02	3.6	0.02	2.8	0.02	2.8	0.02	9.3	0.07	7.7	0.04
	Homopterans	14.0	0.02	8.5	0.11	16.7	1.49	11.9	0.03	0.0	0.00	5.5	0.01	12.4	0.83	9.8	0.04
	Hymenopterans	50.0	0.55	12.5	0.10	3.9	0.15	25.1	0.21	22.5	0.06	30.7	0.09	21.0	0.22	24.4	0.16
	Other	11.3	0.13	4.2	0.02	4.4	0.02	3.6	0.02	8.3	0.05	0.0	0.00	6.9	0.04	2.8	0.01
	Total																
	Terrestrials	141.7	1.29	62.5	0.70	45.6	1.78	50.0	0.32	47.0	0.15	44.5	0.12	67.3	1.31	50.7	0.33
	Aquatic																
	Dipterans	425.0	0.30	500.0	1.20	71.2	0.10	136.9	0.16	152.8	0.37	150.0	0.31	168.0	0.21	200.7	0.37
	Other Aquatics	16.7	0.04	0.0	0.00	3.4	<0.01	1.2	<0.01	0.0	0.00	0.0	0.00	5.6	0.01	0.7	<0.01
	Total Aquatics	441.8	0.34	500.0	1.20	74.5	0.10	138.1	0.15	152.8	0.37	150.0	0.31	173.6	0.22	201.4	0.37
	TOTAL INSECTS	583.2	1.64	562.5	1.89	120.1	1.88	188.1	0.47	200.0	0.52	194.5	0.43	240.8	1.52	252.1	0.70

		Areas												Areas Combined			
		Emery				Murray				Sullivan							
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
August (48)	Coleopterans	0.0	0.00	5.5	0.01	4.2	0.01	7.0	0.02	14.0	0.03	5.5	0.04	5.6	0.02	6.2	0.02
	Hemipterans	8.3	0.09	5.5	0.02	41.7	0.25	37.5	0.10	64.0	0.08	27.8	0.14	39.0	0.16	27.1	0.09
	Homopterans	119.3	0.04	133.3	0.04	22.2	0.01	18.2	0.01	94.3	0.04	16.7	<0.01	64.5	0.02	48.0	0.02
	Hymenopterans	58.5	0.26	39.0	0.17	1,223.7	4.38	1,758.3	4.76	5,255.5	12.06	1,241.6	3.10	1,940.0	5.27	1,199.0	3.20
	Other	2.8	0.01	0.0	0.00	8.3	0.05	4.2	0.03	2.8	<0.01	0.0	0.00	5.6	0.03	2.1	0.01
	Total																
	Terrestrials	189.0	0.39	138.3	0.24	1,300.0	4.71	1,825.1	4.91	5,430.5	12.21	1,291.7	3.29	2,055.0	5.51	1,283.00	3.34
	Aquatic																
	Dipterans	27.8	0.04	27.8	0.01	41.8	0.13	33.2	0.06	238.8	0.64	111.1	0.24	87.5	0.23	51.4	0.10
	Other Aquatics	11.2	0.01	19.5	0.02	2.8	0.01	4.2	0.03	15.8	0.18	2.8	<0.01	8.4	0.05	7.7	0.02
	Total Aquatics	39.0	0.05	47.2	0.04	44.5	0.14	37.3	0.09	255.5	0.81	114.0	0.24	95.9	0.28	59.0	0.11
	TOTAL INSECTS	227.7	0.44	235.0	0.23	1,344.4	4.85	1,862.6	5.00	5,636.0	13.03	1,405.5	3.53	2,151.0	5.79	1,342.0	3.45

Appendix B18. (continued)

Month (N)	Insect Group	Areas: Emery Nearshore Number	Emery Nearshore Weight	Emery Offshore Number	Emery Offshore Weight	Murray Nearshore Number	Murray Nearshore Weight	Murray Offshore Number	Murray Offshore Weight	Sullivan Nearshore Number	Sullivan Nearshore Weight	Sullivan Offshore Number	Sullivan Offshore Weight	Areas Combined Nearshore Number	Areas Combined Nearshore Weight	Areas Combined Offshore Number	Areas Combined Offshore Weight
Sept. (45)	Coleopterans	2.8	0.03	0.0	0.00	1.4	0.01	1.4	<0.01	5.5	0.05	0.0	0.00	2.3	0.02	0.7	<0.01
	Hemipterans	63.3	0.66	0.0	0.00	4.2	0.11	4.2	0.02	2.3	0.01	0.0	0.00	13.3	0.22	2.1	0.01
	Homopterans	52.8	0.10	0.0	0.00	8.4	0.01	4.2	0.02	0.0	0.00	11.2	0.01	17.4	.03	7.0	0.01
	Hymenopterans	766.7	2.20	1,647.2	3.84	20.9	0.08	8.3	0.02	22.2	0.40	5.7	0.04	207.7	0.69	417.4	0.98
	Other	2.3	<0.01	0.0	0.00	0.0	0.00	1.4	<0.01	2.8	<0.01	0.0	0.00	1.4	0.01	0.7	<0.01
	Total Terrestrials	883.7	2.96	1,647.2	3.84	34.9	0.20	23.7	0.06	33.5	0.46	16.7	0.05	247.9	0.96	427.3	1.00
	Aquatic Dipterans	1,449.8	0.60	675.0	0.30	50.1	0.08	57.0	0.16	33.3	0.12	30.5	0.03	395.8	0.22	204.9	0.17
	Other Aquatics	5.5	0.01	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	1.4	<0.01	0.0	0.00
	Total Aquatics	1,455.5	0.62	675.0	0.30	50.1	0.08	57.0	0.16	33.3	0.12	30.5	0.03	397.2	0.22	204.9	0.17
	TOTAL INSECTS	2,344.3	3.58	2,322.2	4.14	84.8	0.28	80.7	0.22	66.8	0.59	47.2	0.13	645.2	1.18	632.7	1.18

Month (N)	Insect Group	Areas: Emery Nearshore Number	Emery Nearshore Weight	Emery Offshore Number	Emery Offshore Weight	Murray Nearshore Number	Murray Nearshore Weight	Murray Offshore Number	Murray Offshore Weight	Sullivan Nearshore Number	Sullivan Nearshore Weight	Sullivan Offshore Number	Sullivan Offshore Weight	Areas Combined Nearshore Number	Areas Combined Nearshore Weight	Areas Combined Offshore Number	Areas Combined Offshore Weight
Oct. (54)	Coleopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Hemipterans	8.3	0.18	22.3	0.04	4.5	0.02	3.3	0.01	0.0	0.00	0.0	0.00	4.3	0.06	5.8	0.01
	Homopterans	69.5	0.05	414.0	0.46	35.5	0.01	25.5	0.02	11.2	<0.01	2.8	<0.01	37.7	0.02	106.8	0.11
	Hymenopterans	8.3	0.02	0.0	0.00	3.3	<0.01	2.3	0.01	2.8	0.03	0.0	0.00	4.3	0.01	1.3	<0.01
	Other	8.5	0.07	2.8	<0.01	2.3	0.02	6.7	0.03	5.5	<0.01	0.0	0.00	4.4	0.03	4.4	0.02
	Total Terrestrials	94.5	0.32	438.8	0.50	45.7	0.06	37.9	0.06	19.5	0.03	2.8	<0.01	50.7	0.11	119.2	0.15
	Aquatic Dipterans	219.3	0.06	464.0	0.26	18.9	0.02	45.5	0.04	8.5	0.01	16.7	0.02	61.1	0.02	132.1	0.08
	Other Aquatics	14.0	0.06	8.3	0.02	0.0	0.00	3.4	0.01	0.0	0.00	0.0	0.00	3.1	0.01	3.7	0.01
	Total Aquatics	233.3	0.12	472.3	0.28	18.9	0.02	49.0	0.05	8.5	0.01	16.7	0.02	64.3	0.04	135.9	0.09
	TOTAL INSECTS	327.8	0.44	911.2	0.78	64.5	0.08	86.7	0.13	27.7	0.04	19.5	0.02	114.9	0.15	255.0	0.24

Appendix B18. (continued)

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Nov. (24)	Coleopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Hemipterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	Homopterans	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	94.7	0.21	0.0	0.00	0.0	0.00
	Hymenopterans	0.0	0.00	0.0	0.00	2.3	0.01	2.3	<0.01	0.0	0.00	0.0	0.00	1.4	<0.01	1.4	<0.01
	Other	0.0	0.00	5.7	0.01	8.3	0.02	5.6	0.25	0.0	0.00	0.0	0.00	4.2	0.01	27.9	0.19
	Total Terrestrials	0.0	0.00	5.7	0.01	11.2	0.03	8.3	0.27	0.0	0.00	94.7	0.21	5.6	0.01	29.2	0.19
	Aquatic Dipterans	11.0	<0.01	0.0	0.00	8.5	0.01	2.8	<0.01	5.7	0.02	5.7	<0.01	8.4	0.01	2.3	<0.01
	Other Aquatics	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	5.7	0.04	0.0	0.00	1.4	0.01
	Total Aquatics	11.0	<0.01	0.0	0.00	8.5	0.01	2.8	<0.01	5.7	0.02	11.0	0.04	8.4	0.01	4.2	0.01
	TOTAL INSECTS	11.0	<0.01	5.7	0.01	19.5	0.03	11.2	0.27	5.7	0.02	105.7	0.25	13.9	0.02	33.4	0.20

		Areas															
		Emery				Murray				Sullivan				Areas Combined			
		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore		Nearshore		Offshore	
Month (N)	Insect Group	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight
Grand Mean (321)	Coleopterans	15.4	0.16	8.1	0.11	14.4	0.27	8.2	0.13	15.5	0.11	5.9	0.06	14.9	0.20	7.5	0.11
	Hemipterans	15.8	0.19	8.1	0.05	10.1	0.08	8.5	0.04	10.4	0.02	4.8	0.02	11.5	0.09	7.5	0.04
	Homopterans	39.3	0.03	91.0	0.10	14.4	0.28	11.1	0.01	15.5	0.11	8.4	0.04	20.7	0.13	29.0	0.04
	Hymenopterans	153.0	0.55	281.6	0.93	195.9	0.72	277.3	0.79	764.7	1.88	134.6	0.48	333.6	0.93	285.3	0.74
	Other	6.1	0.03	5.0	0.01	11.1	0.08	5.9	0.05	6.0	0.02	8.8	0.05	9.9	0.05	6.4	0.04
	Total Terrestrials	229.5	1.0	393.7	1.20	247.0	1.43	310.9	1.04	811.9	2.13	212.3	0.55	389.2	1.50	304.1	0.97
														[1,471.9]	[4.02]	[1,283.2]	[3.26] [1]
	Aquatic Dipterans	340.6	0.19	247.4	0.23	131.1	0.24	66.9	0.14	87.4	0.24	69.9	0.19	170.2	0.23	109.7	0.18
	Other Aquatics	8.1	0.02	5.4	0.01	1.5	0.02	2.7	0.02	6.0	0.05	4.3	0.02	4.2	0.03	3.9	0.02
	Total Aquatics	348.7	0.21	252.7	0.24	132.6	0.25	69.6	0.16	93.3	0.28	74.6	0.21	174.4	0.25	113.6	0.19
														[885.4]	[1.00]	[312.1]	[0.46]
	TOTAL INSECTS	578.1	1.18	646.4	1.44	379.5	1.69	380.5	1.20	905.2	2.42	237.0	0.86	563.6	1.75	417.6	1.17
														[1,735.4]	[4.30]	[1,315.1]	[3.31]

[1] Standard deviations are given in brackets.

Appendix C1. Number of fish stomachs collected in Hungry Horse Reservoir during 1983, 84 and 85

Date	Westslope cutthroat trout	Bull trout	Mountain whitefish	Northern squawfish	Longnose sucker	Largescale sucker	Total
			Emery Area				
8/23/83	3	5	5	7	5	4	29
9/27/83	21	17	11	6	--	--	55
11/29/83	11	6	10	2	--	--	29
6/26/84	16	20	8	21	--	--	65
8/14/84	2	16	7	16	--	--	41
5/16/85	14	14	6	14	--	--	48
8/14/85	19	20	6	11	--	--	56
10/31/85	20	24	5	6	--	--	55
			Murray Area				
8/24/83	3	2	4	8	6	5	28
9/28/83	23	9	5	6	--	--	43
11/30/83	14	4	11	--	--	--	29
6/27/84	21	21	6	23	--	--	71
8/16/84	5	14	6	20	--	--	45
10/12/84	12	20	7	7	--	--	46
12/22/84	48	--	--	--	--	--	48
5/16/85	20	20	5	7	--	--	52
8/14/85	1	11	7	6	--	--	25
11/6/85	19	21	6	14	--	--	60
			Sullivan Area				
8/25/83	12	2	2	7	5	4	32
9/29/83	21	6	5	6	--	--	38
12/15/83	11	7	15	--	--	--	33
6/28/84	23	17	6	14	--	--	60
8/22/84	16	6	8	19	--	--	49
10/10/84	20	21	11	13	--	--	65
5/16/85	21	20	6	14	--	--	61
8/11/85	18	18	6	19	--	--	61
11/5/85	20	20	5	6	--	--	51
Totals	434	361	179	272	16	13	1,275

Appendix C2. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 13 juvenile westslope cutthroat collected August 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	48	2.564	0.3739	10.203	61.538	24.769
Coleoptera	15	0.801	0.0600	1.637	53.846	18.76%
Hemiptera	1	0.053	0.0003	0.008	7.692	2.585
Homoptera	43	2.297	0.0750	2.047	61.538	21.961
Other Terrestrial	2	0.107	0.0180	0.491	15.385	5.328
Total Terrestrial	109	5.823	0.5272	14.386	76.923	32.377
Diptera Larvae	22	1.175	0.0221	0.603	30.769	10.849
Diptera Pupae	3	0.160	0.0071	0.194	15.385	5.246
Diptera Adult	1734	92.628	3.1052	84.735	92.308	89.890
Total Diptera	1759	93.964	3.1344	85.532	100.000	93.165
Other Aquatics	4	0.214	0.0030	0.082	15.385	5.227
Total Aquatics	1763	94.177	3.1374	95.614	100,000	93.264
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C3. Composition by number. weigh!., and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 28 juvenile westslope cutthroat collected September 1983

Item	Numbre	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	345	5.354	0.0584	0.073	17.857	7.763
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	21	0.326	0.0058	0.005	10.714	3.682
Leptodora	1	0.016	0.0014	0.001	3.571	1.196
Total Zooplankton	367	5.695	0.0956	0.084	17.857	7.879
Hymenoptera	5069	78.647	107.2961	94.180	96.429	89.75%
Coleoptera	130	2.017	0.9511	0.835	53.571	18.808
Hemiptera	95	1.474	0.5300	0.465	39.286	13.742
Homoptera	173	2.685	2.0247	1.777	78.571	27.678
Other Terrestrial	86	1.335	1.3228	1.161	64.236	22.260
Total Terrestrial	5552	86.158	112.1247	98.418	96.429	93.668
Diptera Larvae	5	0.078	0.0310	0.027	10.714	3.606
Diptera Pupae	17	0.254	0.0340	0.030	21.429	7.241
Diptera Adult	489	7.588	1.5779	1.385	64.286	24.420
Total Diptera	5J.1	7.930	1.6429	1.442	67.857	25.743
Other Aquatics	14	0.217	0.0640	0.056	7.143	2.472
Total Aquatics	525	8.147	1.7069	1.498	67.857	25.834
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C4. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 12 juvenile westslope cutthroat collected November 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	1620	98.540	0.4379	87.353	91.667	92.520
Cpepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	1	0.061	0.0004	0.080	8.333	2.825
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	1621	98.601	0.4383	87.433	91.667	92.567
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	12	0.730	0.0220	4.389	33.333	12.817
Diptera Adult	9	0.547	0.0390	7.780	16.667	8.331
Total Diptera	21	1.277	0.0610	12.168	41.667	18.371
Other Aquatics	2	0.122	0.0020	0.399	8.333	2.951
Total Aquatics	23	1.399	0.0630	12.567	50.000	21.322
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C5. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 53 juvenile westslope cutthroat collected seasonally 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	1965	19.729	0.5263	0.446	30.189	16.788
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	22	0.221	0.006%	0.005	7.547	2.591
Leptodora	1	0.010	0.0014	0.001	1.887	0.633
Total Zooplankton	1988	19.960	0.5339	0.452	30.189	16.867
Hymenoptera	5116	51.365	107.6700	91.174	66.038	69.526
Coleoptera	145	1.456	1.0111	0.856	41.509	14.607
Hemiptera	96	0.964	0.5303	0.449	22.642	8.018
Homoptera	216	2.169	2.0997	1.778	56.604	20.183
Other Terrestrial	88	0.884	1.3408	1.135	37.736	13.252
Total Terrestrial	5661	56.837	112.6519	95.392	69.811	74.014
Diptera Larvae	27	0.271	0.0531	0.045	13.208	4.508
Diptera Pupae	32	0.321	0.0631	0.053	22.642	7.672
Diptera Adult	2232	22.410	4.7221	3.999	60.377	28.929
Total Diptera	2291	23.002	4.8383	4.097	69.811	32.303
Other Aquatics	20	0.201	0.0690	0.058	9.434	3.231
Total Aquatics	2311	23.203	4.9073	4.155	71.698	33.019
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C6. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 4 adult westslope cutthroat collected August 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	1	0.079	0.0004	0.001	25.000	8.360
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	1	0.079	0.0004	0.001	25.000	8.360
Hymenoptera	1072	85.079	20.2710	75.010	100.000	86.697
Coleoptera	12	0.952	1.5500	5.736	25.000	10.563
Hemiptera	8	0.635	0.0010	0.004	25.000	8.546
Homoptera	74	5.873	0.7090	2.624	75.000	27.832
Other Terrestrial	20	1.587	0.4250	1.573	50.000	17.720
Total Terrestrial	1186	94.127	22.9560	84.946	100.000	93.024
Diptera Larvae	3	0.238	0.0009	0.003	25.000	8.414
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	64	5.079	0.2440	0.903	75.000	26.994
Total Diptera	67	5.317	0.2449	0.906	75.000	27.075
Other Aquatics	3	0.238	0.0120	0.044	25.000	8.428
Total Aquatics	70	5.556	0.2569	0.951	75.000	27.169
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	2	0.159	2.3800	8.807	50.000	19.655
Sucker	1	0.079	1.2800	4.736	25.000	9.939
Unidentified	0	0.000	0.1510	0.559	0.000	0.186
Total Fish	3	0.238	3.8110	14.102	50.000	21.447

Appendix C7. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 29 adult westslope cutthroat collected September 1983

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	194	0.727	0.0466	0.011	13.793	4.844
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	321	1.204	0.1235	0.030	13.793	5.009
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	515	1.931	0.1702	0.042	17.241	6.405
Hymenoptera	24187	90.6983	385.5200	94.032	100.000	94.905
Coleoptera	231	1.091	2.4980	0.609	68.966	23.55.5
Hemiptera	234	0.877	3.2228	0.786	62.069	21.244
Homopter3	275	1.031	1.9014	0.464	72.414	24.636
Other Terrestrial	189	0.709	10.7100	2.612	68.966	24.095
Total Terrestrial	25176	34.391	403.8522	98.504	100.000	97.632
Diptera Larvae	18	0.067	0.0290	0.007	6.897	2.324
Diptera Pupae	113	0.424	0.2850	0.070	31.034	10.509
Diptera Adult	763	2.861	4.4890	1.095	62.069	22.008
Total Diptera	894	3.352	4.8030	1.171	65.517	23.347
Other Aquatics	87	0.326	1.1620	0.293	31.034	10.548
Total Aquatics	981	3.678	5.9650	1.455	68.966	24.699
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	3.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	3	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C8. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food iteins in the stomachs of 18 adult westslope cutthroat collected November 1933

1tem	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	2539	95.571	0.7251	93.045	53.333	91.7517
Copepods	2	0.073	9.0002	0.026	5.556	1.886
Epischura	1	0.039	0.0004	0.051	5.556	1.882
Leptodora	6	0.000	0.3000	0.000	0.900	0.000
Total Zooplankton	2542	98.983	0.7257	93.122	83.333	91.914
Hymenoptera	0	0.909	0.0000	9.009	9.900	0.900
Coleoptera	0	0.000	0.0009	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.090	0.000	0.030
Other Terrestrial	0	0.009	0.9000	0.000	9.090	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	19	0.740	0.0410	5.251	33.333	13.111
Diptera Adult	5	0.135	0.0120	1.540	5.556	2.430
Total Diptera	24	0.935	0.0530	6.801	38.889	15.541
Other Aquatics	3	0.078	0.0306	0.077	11.111	3.755
Total Aquatics	25	1.012	0.0536	6.878	50.000	19.297
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0090	0.000	0.000	0.000
Mountain Whitefish	0	9.000	0.3000	0.000	0.030	0.000
Northern Squawfish	0	0.000	0.0990	0.000	0.000	0.000
Sucker	0	0.000	9.0300	0.003	0.000	0.000
Unidentified	0	0.030	0.9003	0.000	0.000	0.000
Total Fish	0	0.099	0.0000	0.000	0.090	0.000

Appendix C9. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 51 adult westslope cutthroat collected seasonally 1983

Item	Number	Percent ---me----	Weight(g)	Percent	Frequency	IRI
Daphnis	2733	8,961	0.7717	0.176	37.255	15.464
Copepods	2	0.007	0.0002	0.000	1.961	0.656
Epischura	323	1.059	0.1244	0.028	11.765	4.284
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	3058	10.026	0.8963	0.205	41.176	17.136
Hymenoptera	25259	82.816	405.7910	92.691	64.706	80.071
Coleoptera	303	0.993	4.0480	0.925	41.176	14.365
Hemiptera	242	0.793	3.2238	0.736	37.255	12.928
Homoptera	349	1.144	2.6104	0.596	47.059	16.266
Other Terrestrial	209	0.685	11.1350	2.543	43.137	15.455
Total Terrestrial	26362	86.433	426.8082	97.491	64.706	82.877
Diptera Larvae	21	0.069	0.0299	0.007	5.882	1.986
Diptera Pupae	132	0.433	0.3260	0.074	29.412	9.973
Diptera Adult	832	2.728	4.7450	1.084	43.137	15.650
Total Diptera	985	3.230	5.1009	1.165	56.863	20.419
Other Aquatics	92	0.302	1.1746	0.268	23.529	8.033
Total Aquatics	1077	3.531	6.2755	1.433	62.745	22.570
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	2	0.007	2.3800	0.544	3.922	1.491
Sucker	1	0.003	1.2800	0.292	1.961	0.752
Unidentified	0	0.000	0.1510	0.034	0.000	0.011
Total Fish	3	0.010	3.8110	0.871	3.922	1.601

Appendix C10. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 29 juvenile westslope cutthroat collected June 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	1451	42.390	0.3323	0.548	13.793	18.910
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	12	0.351	0.0058	0.010	6.897	2.419
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	1463	42.740	0.3381	0.557	13.793	19.030
Hymenoptera	1069	31.230	49.9840	82.415	89 555	67.757
Coleoptera	398	11.627	8.9898	14.823	86.207	37.552
Hemiptera	10	0.292	0.1136	0.187	13.793	4.758
Homoptera	2	0.058	0.0001	0.000	3.448	1.169
Other Terrestrial	25	0.730	0.1190	0.196	34.483	11.803
Total Terrestrial	1504	43.938	59.2065	97.622	93.103	78.221
Diptera Larvae	264	7.713	0.0954	0.157	27.586	11.819
Diptera Pupae	76	2.220	0.0704	0.115	20.690	7.675
Diptera Adult	86	2.512	0.3849	0.635	34.483	12.543
Total Diptera	426	12.445	0.5507	0.908	65.517	26.290
Other Aquatics	29	0.847	0.5521	0.910	31.034	10.931
Total Aquatics	455	13.292	1.1028	1.813	75.862	38.324
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.003
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	1	0.029	0.0011	0.002	3.448	1.160
Total Fish	1	0.029	0.0811	0.003	3.448	1.160

Appendix C11. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 8 juvenile westslope cutthroat collected August 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Cojjpods	0	0.000	0.0900	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	5407	99.797	20.5807	99.245	87.500	95.514
Coleoptera	2	0.037	0.0030	0.014	12.500	4.184
Hemiptera	2	0.037	0.0073	0.035	25.000	a.357
Homoptera	3	0.055	0.0034	0.016	25.000	8.357
Other Terrestrial	3	0.055	0.1424	0.687	12.500	4.414
Total Terrestrial	5417	99.982	20.7368	99.998	87.500	95.826
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	1	0.018	0.0005	0.002	12.500	4.174
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	1	0.018	0.0005	0.002	12.509	4.174
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	1	0.013	0.005	3.002	12.500	4.174
Westslope Cutthroat	0	0.009	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.9000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C12. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 18 juvenile westslope cutthroat collected October 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	235	13.284	0.0667	0.978	5.556	6.606
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	235	13.284	0.0667	0.978	5.556	6.606
Hymenoptera	835	47.202	3.8804	56.894	94.444	66.180
Coleoptera	138	7.801	0.6083	8.919	88.889	35.203
Hemiptera	118	6.670	1.1659	17.094	88.889	37.551
Homoptera	86	4.862	0.1072	1.572	72.222	26.218
Other Terrestrial	130	7.349	0.1944	2.850	50.000	20.066
Total Terrestrial	1307	73.884	5.9562	87.329	100.000	87.071
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	1	0.057	0.0005	0.007	5.556	1.873
Diptera Adult	224	12.663	0.7968	11.683	38.889	21.078
Total Diptera	225	12.719	0.7973	11.690	44.444	22.951
Other Aquatics	2	0.113	0.0002	0.003	5.556	1.891
Total Aquatics	227	12.832	0.7975	11.693	50.000	24.842
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Dull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C13. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 6 juvenile westslope cutthroat collected December 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	1786	99.832	0.5072	18.493	100.000	72.775
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	1786	99.832	0.5072	18.493	100.000	72.775
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	1	0.056	0.0002	0.007	16.667	5.577
Diptera Pupae	1	0.056	0.0001	0.004	16.667	5.575
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	2	0.112	0.0003	0.011	33.333	11.152
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	2	0.112	0.0903	0.011	33.333	11.152
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	1	0.056	2.2352	81.496	16.667	32.740
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	1	0.056	2.2352	81.496	16.667	32.740

Appendix C14. Composition by numbre, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 61 juvenile westslope cutthroat collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	3472	28.002	0.9062	0.996	18.033	15.677
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	12	0.097	0.0058	0.006	3.279	1.127
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	3484	23.099	0.9120	1.003	18.033	15.712
Hymenoptera	7311	58.964	74.4451	81.854	81.967	74.262
Coleoptera	538	4.33s	9.6011	10.557	68.852	27.916
Hemiptera	130	1.048	1.2868	1.415	36.066	12.843
Homoptera	91	0.734	0.1107	0.122	26.230	9.028
Other Terrestrial	158	1.274	0.4558	0.501	32.787	11.521
Total Terrestrial	8228	66.360	85.8995	94.448	85.246	82.018
Diptera Larvae	265	2.137	0.0956	0.105	14.754	5.665
Diptera Pupae	79	0.637	0.0715	0.079	14.754	5.157
Diptera Adult	310	2.500	1.1817	1.299	27.869	10.556
Total Diptera	654	5.275	1.3488	1.483	49.180	18.646
Other Aquatics	31	0.250	0.5523	0.607	16.393	5.750
Total Aquatics	685	5.525	0.9011	2.390	55.738	21.118
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	1	0.008	2.2352	2.458	1.639	1.368
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	1	0.008	0.0011	0.001	1.639	0.550
Total Fish	2	0.016	2.2363	2.459	3.279	1.918

Appendix C15. Composition by number, weight, and frequency of occurance (percent: and calculated index of relative importance (IRI) for major food items in the stomachs of 29 adult westslope cutthroat collected June 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	855	17.474	0.2215	0.176	6.897	8.182
Copepods	0	0.000	0.0000	0.000	0.000	0 .000
Epischura	699	14.286	0.3377	0.269	24.138	12.897
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	1554	31.760	0.5592	0.445	24.138	18.781
Hymenoptera	1794	36.665	89.9232	71.498	86.207	64.790
Coleoptera	1084	22.154	30.7232	24.428	96.552	47.711
Hemiptera	21	0.429	0.5067	0.403	27.586	9.473
Homoptera	9	0.184	1.2973	1.031	17.241	6.152
Other Terrestrial	30	0.613	0.4559	0.362	37.931	12.969
Total Terrestrial	2938	60.045	122.9063	97.722	100.000	85.922
Diptera Larvae	206	4.210	0.3502	0.278	34.483	12.990
Diptera Pupae	97	1.982	0.6169	0.490	34.483	12.319
Diptera Adult	38	0.777	0.2777	0.221	31.034	10.677
Total Diptera	341	6.969	1.2448	0.990	65.517	24.492
Other Aquatics	60	1.226	1.0607	0.843	31.034	11.035
Total Aquatics	401	8.195	2.3055	1.833	72.414	27.481
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C16. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 7 adult westslope cutthroat collected August 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	5279	98.342	36.5217	84.676	100.000	94.339
Coleoptera	38	0.708	0.2018	0.468	42.857	14.678
Hemiptera	11	0.205	0.0897	0.208	57.143	19.185
Homoptera	20	0.373	0.0757	0.176	28.571	9.707
Other Terrestrial	10	0.186	0.9313	2.159	28.571	10.306
Total Terrestrial	5358	99.814	37.8202	87.687	100.000	95.833
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	8	0.149	0.0002	0.000	28.571	9.574
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	8	0.149	0.0002	0.000	28.571	9.574
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	8	0.149	0.0002	0.000	28.571	9.574
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	2	0.037	5.3107	12.313	14.286	8.879
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	2	0.037	5.3107	1'2.313	14.286	a.979

Appendix C17. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 13 adult westslope cutthroat collected October 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	1053	60.727	4.6673	57.566	92.308	70.200
Coleoptera	117	6.747	0.4676	5.767	84.615	32.377
Hemiptera	177	10.208	1.0179	12.555	92.308	38.357
Homoptera	203	11.707	0.1690	2.084	53.846	22.546
Other Terrestrial	131	7.555	1.7417	21.482	69.231	32.756
Total Terrestrial	1681	96.943	8.0635	99.454	100.000	98.799
Diptera Larvae	2	0.115	0.0028	0.035	7.692	2.614
Diptera Pupae	21	1.211	0.0102	0.126	23.077	8.138
Diptera Adult	30	1.730	0.0313	0.386	38.462	13.526
Total Diptera	53	3.057	0.0443	0.546	53.846	19.150
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	53	3.057	0.0443	0.546	53.846	19.150
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C18. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance for major food items in the stomachs of 19 adult westslope cutthroat collected December 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	21149	97.268	5.8161	91.992	68.421	85.894
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	21149	97.268	5.8161	91.992	68.421	85.894
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	103	0.474	0.0159	0.251	26.316	9.014
Diptera Pupae	5	0.023	0.0003	0.005	21.053	7.027
Diptera Adult	18	0.083	0.0019	0.030	15.789	5.301
Total Diptera	126	0.579	0.0181	0.286	47.368	16.078
Other Aquatics	468	2.152	0.4882	7,722	47,368	19.081
Total Aquatics	594	2.732	0.5063	8.008	57.895	22.878
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C19. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 68 adult westslope cutthroat collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	22004	65.220	6.0376	3.293	22.059	30.191
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	699	2.072	0.3377	0.184	10.294	4.183
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	22703	67.292	6.3753	3.477	29.412	33.394
Hymenoptera	8126	24.086	131.1122	71.516	64.706	53.436
Coleoptera	1239	3.672	31.3926	17.123	61.765	27.520
Hemiptera	209	0.619	1.6143	0.881	35.294	12.265
Homoptera	232	0.688	1.5420	0.841	20.588	7.372
Other Terrestrial	171	0.507	3.1289	1.707	32.353	11.522
Total Terrestrial	9977	29.572	168.7900	92.068	72.059	64.566
Diptera Larvae	311	0.922	0.3689	0.201	23.529	8.217
Diptera Pupae	131	0.388	0.6276	0.342	27.941	9.557
Diptera Adult	86	0.255	0.3109	0.170	25.000	8.475
Total Diptera	528	1.565	1.3074	0.713	54.412	18.897
Other Aquatics	528	1.565	1.5489	0.845	26.471	9.627
Total Aquatics	1056	3.130	2.8563	1.558	60.294	21.661
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	2	0.006	5.3107	2.897	1.471	1.458
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	2	0.006	5.3107	2.897	1.471	1.458

Appendix C20. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 4 juvenile bull trout collected August 1983

Item	Number	Percent	Weight(g)	Percent	Frequency[a]	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	1	25.000	0.0004	0.004	25.000	16.668
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	1	25.000	0.0004	0.004	25.000	16.668
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	1	25.000	0.0014	0.013	25.000	16.671
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	1	25.000	0.0014	0.013	25.000	16.671
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	1	25.000	0.0014	0.013	25.000	16.671
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	1	25.000	7.7600	70.495	25.000	40.165
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	1	25.000	2.9300	26.617	25.000	25.539
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.3160	2.871	0.000	0.957
Total Fish	2	50.000	11.0060	99.984	50.000	66.661

Appendix C21. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 11 juvenile bull trout collected September 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	1	6.667	0.0004	0.002	9.091	5.253
Coleoptera	1	6.667	0.0020	0.011	9.091	5.256
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	2	13.333	0.0024	0.013	9.091	7.479
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000 .
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	1	6.667	0.0007	0.004	9.091	5.254
Total Diptera	1	6.667	0.0007	0.004	9.091	5.254
Other Aquatics	1	6.667	0.0130	0.068	9.091	5.275
Total Aquatics	2	13.333	0.0137	0.072	18.182	10.529
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	2	13.333	13.2030	69.554	18.182	33.690
Northern Squawfish	3	20.000	4.8060	25.318	27.273	24.197
Sucker	O	0.000	0.0000	0.000	0.000	0.000
Unidentified	6	40.000	0.9573	5.043	27,273	24.105
Total Fish	11	73.333	18.9663	99.915	72.727	81.992

AppendixC22. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 3 juvenile bull trout collected Novmeber 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	1	10.000	0.0003	0.398	33.333	14.577
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total zooplankton	1	10.000	0.0003	0.398	33.333	14.577
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	1	10.000	0.0020	2.656	33.333	15.330
Diptera Pupae	8	80.000	0.0060	7.968	66.667	51.545
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	9	90.000	0.0080	10.624	66.667	55.764
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	9	90.000	0.0080	10.624	66.667	55.764
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0670	88.977	0.000	29.659
Total Fish	0	0.000	0.0670	88.977	0.000	29.659

Appendix C23. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 18 juvenile bull trout collected seasonally 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	1	3.448	0.0003	0.001	5.556	3.002
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	1	3.448	0.0004	0.001	5.556	3.002
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	2	6.897	0.0007	0.002	11.111	6.003
Hymenoptera	1	3.448	0.0004	0.001	5.556	3.002
Coleoptera	1	3.448	0.0020	0.007	5.556	3.003
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	2	6.897	0.0024	0.008	5.556	4.153
Diptera Larvae	1	3.448	0.0020	0.007	5.556	3.003
Diptera Pupas	9	31.034	0.0074	0.025	16.667	15.909
Diptera Adult	1	3.448	0.0007	0.002	5.556	3.002
Total Diptera	11	37.931	0.0101	0.034	22.222	20.062
Other Aquatics	1	3.448	0.0130	0.043	5.556	3.016
Total Aquatics	12	41.379	0.0231	0.077	27,778	23.078
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	1	3.448	7.7500	25.810	5.556	11.605
Mountain Whitefish	2	5.897	13.2030	43.914	11.111	20.641
Northern Squawfish	4	13.793	7.7360	25.730	22.222	20.582
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	6	20.690	1.3403	4.458	16.667	13.938
Total Fish	13	44.828	30.0393	99.913	55.556	66.765

Appendis C24. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 3 adult bull trout collected August 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepcds	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	2	28.571	0.0030	0.026	33.333	20.643
Total Diptera	2	28.571	0.0030	0.026	33.333	20.643
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	2	28.571	0.0030	0.026	33.333	20.643
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	1	14.286	0.5500	4.695	33.333	17.438
Northern Squawfish	4	57.143	9.5780	81.765	33.333	57.414
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	1.5830	13.514	0.000	4.505
Total Fish	5	71.429	11.7110	99.974	66.667	79.357

Appendix C25. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 7 adult bull trout collected September 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	1	7.692	0.0020	0.001	14.286	7.326
Coleoptera	2	15.385	0.0020	0.001	14.286	9.890
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	3	23.077	0.0040	0.001	14.286	12.455
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	2	15.385	0.0004	0.000	14.286	9.890
Total Diptera	2	15.385	0.0004	0.000	14.286	9.890
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	2	15.385	0.0004	0.000	14.286	9.890
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	2	15.385	296.5000	94.765	28.571	46.241
Northern Squawfish	1	7.692	1.2532	0.401	14.286	7.460
Sucker	3	23.077	9.6927	3.098	42.857	23.011
Unidentified	2	15.385	5.4274	1.735	14.286	10.468
Total Fish	8	61.538	312.8733	99.999	85.714	82.417

Appendix C26. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 10 adult bull trout collected November 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	82	92.135	0.0235	0.009	50.000	47.381
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	82	92.135	0.0235	0.009	50.000	47.381
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	4	4.494	22.9100	8.858	20.000	11.118
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	3	3.371	232.6800	89.967	30.000	41.113
Unidentified	0	0.000	3.0150	1.166	0.000	0.389
Total Fish	7	7.865	258.6050	99.991	50.000	52.619

Appendix C27. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 20 adult bull trout collected seasonally 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	82	75.229	0.0235	0.004	25.000	33.411
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	82	75.229	0.0235	0.004	25.000	33.411
Hymenoptera	1	0.917	0.0020	0.000	5.000	1.973
Coleoptera	2	1.835	0.0020	0.000	5.000	2.278
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	3	2.752	0.0040	0.001	5.000	2.584
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	4	3.670	0.0034	0.001	10.000	4.557
Total Diptera	4	3.670	0.0034	0.001	10.000	4.557
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	4	3.670	0.0034	0.001	10.000	4.557
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	7	6.422	319.9500	54.861	25.000	28.761
Northern Squawfish	5	4.587	10.8312	1.857	10.000	5.481
Sucker	6	5.505	242.3727	41.558	30.000	25.687
Unidentified	2	1.835	10.0254	1.719	5.000	2.851
Total Fish	20	13.349	533.1893	99.995	65.000	61.114

Appendix C28. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 28 juvenile bull trout collected June 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	2	1.626	0.0004	0.001	3.571	1.733
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	30	24.390	0.0145	0.028	7.143	10.520
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	32	26.016	0.0149	0.029	10.714	12.253
Hymenoptera	1	0.813	0.0226	0.043	3.571	1.476
Coleoptera	1	0.813	0.0411	0.079	3.571	1.488
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	2	1.626	0.0637	0.122	7.143	2.964
Diptera Larvae	41	33.333	0.0543	0.104	14.286	15.908
Diptera Pupae	20	16.260	0.0351	0.067	21.429	12.585
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	61	49.593	0.0894	0.171	28.571	26.112
Other Aquatics	7	5.691	0.0624	0.120	17.857	7.889
Total Aquatics	68	55.285	0.1518	0.291	39.286	31.520
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	3	2.439	12.0824	23.161	10.714	12.105
Northern Squawfish	11	8.943	31.5448	60.468	25.000	31.470
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	7	5.691	8.3105	15.930	17.857	13.159
Total Fish	21	17.073	51.9377	99.558	46.429	54.353

Appendix C29. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major-food items in the stomachs of 15 juvenile bull trout collected **August 1981**

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	37	68.519	0.0079	0.045	13.333	27.299
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	2	3.704	0.0008	0.005	6.667	3.458
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	39	72.222	0.0087	0.049	13.333	28.535
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	7	12.963	0.4067	2.311	13.333	9.536
Diptera Pupae	4	7.407	0.0072	0.041	13.333	6.927
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	11	20.370	0.4139	2.352	26.667	16.463
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	11	20.370	0.4139	2.352	26.667	16.463
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	3	5.556	10.5987	60.216	13.333	26.368
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	1	1.852	6.5799	37.383	6.667	15.301
Total Fish	4	7.407	17.1786	97.599	20.000	41.669

Appendix C30. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 18 juvenile bull trout collected October 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	9	18.367	0.0021	0.015	16.667	11.683
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	9	18.367	0.0021	0.015	16.667	11.683
Hymenoptera	9	13.367	0.0505	0.360	16.667	11.798
Coleoptera	2	4.082	0.0343	0.244	5.556	3.294
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	4	8.163	0.0004	0.003	5.556	4.574
Other Terrestrial	3	6.122	0.0223	0.159	11.111	5.797
Total Terrestrial	18	36.735	0.1075	0.756	27.778	21.759
Diptera Larvae	6	12.245	0.0029	0.021	16.667	9.644
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	4	8.163	0.0025	0.018	11.111	6.431
Total Diptera	10	20.408	0.0054	0.038	22.222	14.223
Other Aquatics	2	4.082	0.0055	0.939	11.111	5.077
Total Aquatics	12	24.490	0.0109	0.078	27.778	17.448
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	3	6.122	8.5096	60.622	16.667	27.804
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	7	14.286	5.4071	38.520	22.222	25.009
Total Fish	10	20.408	13.9167	99.142	33.333	50.961

Appendix C31. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance for major food items in the stomachs of 61 juvenile bull trout collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	48	21.239	0.0104	0.012	9.836	10.362
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	32	14.159	0.0153	0.018	4.918	6.365
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	80	35.398	0.0257	0.031	13.115	16.181
Hymenoptera	10	4.425	0.0731	0.087	6.557	3.690
Coleoptera	3	1.327	0.0754	0.090	3.279	1.565
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	4	1.770	0.0004	0.000	1.639	1.137
Other Terrestrial	3	1.327	0.0223	0.027	3.279	1.544
Total Terrestrial	20	8.850	0.1712	0.204	11.475	6.843
Diptera Larvae	54	23.894	0.4639	0.554	14.754	13.067
Diptera Pupae	24	10.619	0.0423	0.050	13.115	7.928
Diptera Adult	4	1.770	0.0025	0.003	3.279	1.684
Total Diptera	82	36.283	0.5087	0.607	26.230	21.040
Other Aquatics	9	3.982	0.0679	0.081	11.475	5.180
Total Aquatics	91	40.265	0.5766	0.688	32.787	24.580
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	3	1.327	12.0824	14.417	4.918	6.887
Northern Squawfish	17	7.522	50.6531	60.441	19.672	29.212
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	15	6.637	20.2975	24.219	16.393	15.750
Total Fish	35	15.487	83.0330	99.077	36.066	50.210

Appendix C32. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 21 adult bull trout collected June 1984

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.0QO	0.0000	0.000	0.0000	0.000
Total Zooplankton	Q	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	1	5.000	0.0111	0.005	4.762	3.256
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.00Q	0.000
Other Terrestrial	0	0.000	0.0000	0.000	3.000	0.000
Total Terrestrial	1	5.000	0.0111	0.005	4.762	3.256
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	2	10.000	0.0022	0.Q01	9.524	6.508
Diptera Adult	0	0.000	0.0000	0.000	0.00Q	0.0Q0
Total Diptera	2	10.000	0.0022	0.001	9.524	6.508
Other Aquatics	5	25.000	0.0377	0.016	14.286	13.101
Total Aquatics	7	35.000	0.0399	0.017	23.810	19.509
Westslope Cutthroat	0	.0 000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	3	15.000	34.1100	14.880	14.286	14.722
Northern Squawfish	7	35.000	111.6341	48.699	28.571	37.423
Sucker	2	10.000	51.5300	22.595	9.524	14.010
Unidentified	0	0.000	31.8487	13.894	0.000	4.531
Total Fish	12	50.000	229.1828	99.978	47.619	59.139

Appendix C33. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 9 adult bull trout collected August 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	47	95.918	0.1108	0.277	11.111	35.769
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Aomoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	47	95.918	0.1108	0.277	11.111	35.769
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	1	2.041	0.0016	0.004	11.111	4.385
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	1	2.041	0.0016	0.004	11.111	4.385
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	1	2.041	0.0016	0.004	11.111	4.385
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Wnitefish	0	0.000	12.2520	30.606	0.000	10.202
Northern Squawfish	1	2.041	11.6872	29.196	11.111	14.116
Sucker	0	0.000	6.9301	17.312	0.000	5.771
Unidentified	0	0.000	9.0491	22.605	0.000	7.535
Total Fish	1	2.041	39.9184	99.719	11.111	37.624

Appendix C34. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 6 adult bull trout collected October 1984

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Eipischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	1	33.333	0.0006	0.000	16.667	16.667
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	1	33.333	0.0006	0.000	16.667	16.667
Diptera Larvae	0	0.000	3.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.~000	0.000	0.000	0.000
Total Diptera	9	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	1	33.333	26.6200	10.005	16.667	20.002
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	1	33.333	230.0000	86.448	16.667	45.483
Unidentified	0	0.000	9.4359	3.547	0.000	1.182
Total Fish	2	66.667	266.0559	100.000	33.333	66.667

Appendix C35. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 1 adult bull trout collected December 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.2318	100.000	0.000	33.333
Total Fish	0	0.000	0.2318	100.000	0.000	33.333

Appendix C36. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 37 adult bull trout collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	47	65.278	0.1108	0.021	2.703	22.667
Coleoptera	1	1.389	0.0111	0.002	2.703	1.365
Hemiptera	1	1.389	0.0006	0.000	2.703	1.364
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	49	68.056	0.1225	0.023	8.108	25.396
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	3	4.167	0.0038	0.001	8.108	4.092
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	3	4.167	0.0038	0.001	8.108	4.092
Other Aquatics	5	6.944	0.0377	0.007	8.108	5.020
Total Aquatics	8	11.111	0.0415	0.008	16.216	9.112
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	4	5.556	72.9820	13.627	10.811	9.998
Northern Squawfish	8	11.111	123.3213	23.027	18.919	17.686
Sucker	3	4.167	288.5201	53.873	8.108	22.049
Unidentified	0	0.000	50.5655	9.442	0.000	3.147
Total Fish	15	20.833	535.3889	99.969	35.135	51.979

Appendix C37. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 12 mountain whitefish collected August 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	11134	99.198	2.7306	98.212	100.000	99.137
Copepods	19	0.169	0.0020	0.072	25.000	8.414
Epischura	58	0.517	0.0224	0.806	33.333	11.552
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	11211	99.884	2.7550	99.090	100.000	99.658
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	3	0.027	0.0017	0.061	25.000	8.363
Diptera Pupae	10	0.089	0.0236	0.849	33.333	11.424
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	13	0.116	0.0253	0.910	41.667	14.231
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	13	0.116	0.0253	0.910	41.667	14.231
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C38. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 17 mountain whitefish collected September 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Da&r&	5393	95.355	1.2759	67.329	88.235	83.373
Copepods	0	0.000	0.0000	0.000	0.000	0.330
Epischura	4	0.071	0.0015	0.079	11.765	3.972
Leptordora	2	3.035	0.0027	0.142	5.882	2.020
Total Zooplankton	5399	96.462	1.2811	67.551	88.235	84.083
Hymenopters	160	2.553	0.4637	34.450	29.412	18.907
Coleoptera	0	0.000	0.00150	0.000	0.000	0.003
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	2	0.035	3.0430	2.257	5.382	3.723
Other Terrestrial	i	0.018	0.0049	3.211	5.332	2.037
Total Terrestrial	163	2.912	0.5107	25.929	29.412	19.751
Diptera Larvae	21	3.375	0.0556	2.924	29.412	10.924
Diptera Pupae	14	0.250	3.0431	2.535	29.412	13.733
Diptera Adult	0	0.000	0.0000	0.003	0.000	0.000
Total Diptera	35	0.625	0.1047	5.521	52.941	19.696
Other Aquatics	0	0.000	3.3000	0.000	0.009	3.000
Total Aquatics	35	0.625	0.1047	5.521	52.341	19.696
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.330	0.000	0.000
Mountain Whitefish	0	0.300	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.030	0.000
Unidentified	0	0.000	0.0000	0.000	0.009	0.000
Total Fish	0	0.000	cl.0000	0.000	0.000	0.000

Appendix C39. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 34 mountain whitefish collected November 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	52166	99.933	11.8302	99.358	100.000	99.763
Copepods	4	0.008	0.0000	0.000	2.941	0.983
Epischura	5	0.010	0.0020	0.017	14.706	4.911
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	52175	99.950	11.8322	99.374	100.000	99.775
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	9	0.017	0.0175	0.147	17.647	5.937
Diptera Pupae	17	0.033	0.0570	0.479	32.353	10.955
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	26	0.050	0.0745	0.626	41.176	13.951
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	26	0.050	0.0745	0.626	41.176	13.951
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C40-Composition by number , weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 63 mountain whitefish collected seasonally 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	68693	99.523	15.8377	95.503	96.825	97.284
Copepods	23	0.033	0.0020	0.012	5.349	2.132
Epischura	67	0.097	0.0259	0.156	17.460	5.905
Leptodora	2	0.003	0.0027	0.016	1.587	0.535
Total Zooplankton	68785	99.657	15.8683	95,687	96.825	97.390
Hymenoptera	160	0.232	0.4637	2.796	7.937	3.655
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	2	0.003	0.0430	0.259	1.587	0.616
Other Terrestrial	1	0.001	0.0040	0.024	1.587	0.538
Total Terrestrial	163	0.236	0.5107	3.080	7.937	3.751
Diptera Larvae	33	0.048	0.0758	0.457	22.222	7.576
Diptera Pupae	41	0.059	0.1287	0.776	31.746	10.861
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	74	0.107	0.2045	1.233	44.444	15.262
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	74	0.107	0.2045	2.233	44.444	15.262
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	9.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.003	0.000	0.000

AppendixC41. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 20 mountain whitefish collected June 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	17618	98.745	3.8588	84.239	100.000	94.328
Copepods	16	0.090	0.0000	0.000	15.000	5.030
Epischura	46	0.258	0.0221	0.482	30.000	10.247
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	17680	99.092	3.8809	84.721	100.000	94.604
Hymenoptera	17	0.095	0.5681	12.402	5.000	5.832
Coleoptera	1	0.006	0.0844	1.842	5.000	2.283
Hemiptera	1	0.006	0.0072	0.157	5.000	1.721
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	19	0.106	0.6597	14.401	5.000	6.503
Diptera Larvae	106	0.594	0.0130	0.284	25.000	8.626
Diptera Pupae	31	0.174	0.0225	0.491	45.000	15.222
Diptera Adult	6	0.034	0.0044	0.096	5.000	1.710
Total Diptera	143	0.801	0.0399	0.871	55.000	18.891
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	143	0.801	0.0399	0.871	55.000	18.891
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0003	0.007	0.000	0.002
Total Fish	0	0.000	0.0003	0.007	0.000	0.002

Appendix C42. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 13 mountain whitefish collected August 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	5079	99.141	1.2197	99.730	100.000	99.624
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	5	0.098	0.0019	0.155	15.385	5.213
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	5084	99.239	1.2216	99.886	100.000	99.708
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	35	0.683	0.0009	0.074	7.692	2.816
Diptera Pupae	4	0.078	0.0005	0.041	15.385	5.168
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	39	0.761	0.0014	0.114	15.385	5.420
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	39	0.761	0.0014	0.114	15.385	5.420
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C43. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 12 mountian whitefish collected October 1984

Item	Number	Percent	Weight(g)	Percent	Frequency se	IRI
Dapbnia	12458	99.984	3.7616	99.798	100.000	99.927
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	C	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	12458	99.984	3.7616	99.798	100.000	99.927
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coloeptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.3000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	3.000	0.000	0.000
Diptera Pupae	3	0.015	0.0076	0.202	8.333	2.850
Diptera Adult	n	0.000	0.0000	0.000	0.000	0.000
Total Diptera	2	0.016	0.0075	0.202	8.333	2.850
Other Aquatics	0	0.000	0.3000	0.000	3.700	0.000
Total Aquatics	2	0.016	0.0075	0.202	8.333	2.850
Westslope Cutthroat	0	0.000	0.3000	3.000	0.000	0.000
Bull Trout	0	0.003	0.0303	0.000	0.000	0.000
Mountain Whitefish	0	3.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	3	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	0	0.000	0.0000	0.000	0.000	0.000

Appendix C44. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 45 mountain whitefish collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	35155	99.238	8.8401	92.344	100.000	97.194
Copepods	16	0.045	0.0000	0.000	6.567	2.237
Epischura	51	0.144	0.0240	0.251	17.778	6.057
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	35222	99.427	8.8641	92.595	100.000	97.341
Hymenoptera	17	0.048	0.5681	5,934	2.222	2.735
Coleoptera	1	0.003	0.0844	0.882	2.222	1.036
Hemiptera	1	0.003	0.0072	0.075	2.222	0.767
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	19	0.054	0.6597	6.891	2.222	3.056
Diptera Larvae	141	0.398	0.0139	0.145	13.333	4.626
Diptera Pupae	37	0.104	0.0306	0.320	26.667	9.030
Diptera Adult	6	0.017	0.0044	0.046	2.222	0.762
Total Diptera	184	0.519	0.0489	0.511	31.111	10.714
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	184	0.519	0.0489	0.511	31.111	10.714
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0003	0.003	0.000	0.001
Total Fish	0	0.000	0.0003	0.003	0.000	0.001

Appendix C45. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 5 juvenile northern squawfish collected August 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	37	30.579	0.0108	3.216	20.000	17.932
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	37	30.579	0.0108	3.216	20.000	17.932
Hymenoptera	11	9.091	0.0120	3.574	20.000	10.888
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	11	9.091	0.0120	3.574	20.000	10.888
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	73	60.331	0.0710	21.144	40.000	40.491
Total Diptera	73	60.331	0.0710	21.144	40.000	40.491
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	73	60.331	0.0710	21.144	40.000	40.491
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.2420	72.067	0.000	24.022
Total Fish	0	0.000	0.2420	72.067	0.000	24.022

Appendix **C46.** Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 7 juvenile northern squawfish collected September 1983

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	10	76.923	0.3850	85.556	14.286	58.921
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	1	7.692	0.0020	0.444	14.286	7.474
Total Terrestrial	11	84.615	0.3870	86.000	28.571	66.396
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	1	7.692	0.0020	0.444	14.286	7.474
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	1	7.692	0.0020	0.444	14.286	7.474
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	1	7.692	0.0020	0.444	14.286	7.474
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	1	7.692	0.0610	13.556	14.286	11.845
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	1	7.692	0.0610	13.556	14.286	11.845

AgpendixC47. Compostion by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 1 juvenile northern squawfish collected November 1983

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	12	92.308	0.0032	75.190	100.000	89.499
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	12	92.303	0.0032	76.190	100.000	89.493
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.003	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total 'Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Iptera Pupae	1	7.692	0.0910	23.810	100.000	43.834
Diptera Adult	3	0.300	0.0000	0.000	0.000	0.000
Total Diptera	1	7.692	0.0010	23.510	100.000	43.834
Other Aquatics	0	0.000	0.3003	0.000	0.000	0.000
Tot31 Aquatics	1	7.692	0.0010	23.810	100.000	43.534
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.00013	3.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0003	0.003	0.000	0.000
Unidentified	0	0.000	0.0000	3,000	0.000	0.000
Total Fish	0	3.030	0.0000	0.003	0.000	0.000

Appendix C48. Composition by number , weight, and frequency of occurance (percent! and calculated index of relative importnace (IRI) for major food items in the stomachs of 13 juvenile northern squawfish collected seasonally 1983

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	49	33.333	9.0140	1.772	13.385	16.830
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	3.0000	3.000	3.030	0.000
Leptodora	0	0.800	0.0000	0.300	0.000	0.000
Tots1 Zooplankton	43	33.333	0.0140	1.772	15.385	15.830
Hymenoptera	21	14.286	0.3970	50.253	15.335	26.641
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.030	0.0000	0.000	0.000	0.003
Homoptera	0	0.030	0.0000	0.000	3.000	0.000
Other Terrestrial	1	0.680	0.0020	0.253	7.592	2.875
Total Terrestrial	22	14.366	0.3390	50.506	23,377	29.516
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	2	1.351	0.0030	3.380	15.385	5.708
Diptera Adult	73	49.660	0.0710	3.987	15.385	24.677
Total Diptera	75	51.020	0.0740	9.367	30.769	30.386
Other Aquatics	3	0.000	0.0000	0.000	0.000	0.300
Total Aquatics	75	51.020	0.0740	0.367	30.769	39.386
Westslope Cutthroat	0	0.303	3.3000	0.900	0.000	0.000
Bull Trout	0	3.030	0.0000	0.000	0.000	3.000
Mountian Whitefish	1	0.680	0.0613	7.722	7.692	5.355
Northern Squawfish	0	3.330	0.0000	0.0013	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.2420	30.633	0.000	10 211
Total Fish	1	0.680	0.3030	38.354A	7.592	15.576

Appendix C49. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 3 adult northern squawfish collected August 1983

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Keptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountian Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	1	100.000	3.9600	53.574	33.333	65.636
Sucker	0	0.000	0.0000	3.000	0.000	0.000
Unidentified	0	0.000	2.2690	36.426	0.000	12.142
Total Fish	1	100.000	5.2290	100.000	33.333	77.778

Appendix C50. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 1 adult northern squawfish collected September 1983

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	1	100.000	1.7400	100.000	100.000	100.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	1	100.000	1.7400	100.000	100.000	100.000

Appendix C51. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 4 adult northern squawfish collected seasonally 1983

Item	Number	Percent	Weight (g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	1	50.000	1.7400	21.835	25.000	32.278
Northern Squawfish	1	50.000	3.9600	49.693	25.000	41.564
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	2.2690	28.473	0.000	9.491
Total Fish	2	100.000	7.9690	100.000	50.000	83.333

Appendix C52. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 18 juvenile northern squawfish collected June 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	1	100.000	0.0007	0.419	5.556	35.325
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	1	100.000	0.0007	0.419	5.556	35.325
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.1665	99.581	0.000	33.194
Total Fish	0	0.000	0.1665	99.581	0.000	33.194

AppendixC53. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 13 juvenile northern squawfish collected August 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	2	5.556	0.0000	0.000	7.692	4.416
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	2	5.556	0.0000	0.000	7.692	4.416
Hymenoptera	28	77.778	0.2082	1.676	23.077	34.177
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Yemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	4	11.111	0.0002	0.002	15.385	8.832
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	32	88.889	0.2084	1.678	30.769	40.445
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000 .
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	3	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	1	2.778	0.0014	0.011	7.692	3.494
Total Aquatics	1	2.778	0.9014	0.011	7.692	3.494
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountian Whitefish	1	2.778	12.2100	98.311	7.692	36.260
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0000	0.000	0.000	0.000
Total Fish	1	2.778	12.2100	98.311	7.692	36.260

Appendix C54. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 6 juvenile northern squawfish collected October 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	289	100.000	0.0693	93.649	83.333	92.327
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	289	100.000	0.0693	93.649	83.333	92.327
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0047	6.351	0.000	2.1.17
Total Fish	0	0.000	0.0047	6.351	0.000	2.117

AppendixC55. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 37 juvenile northern squawfish collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	291	89.264	0.0693	0.547	16.216	35.342
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	291	89.264	0.0693	0.547	16.216	35.342
Hymenoptera	28	8.589	0.2082	1.644	8.108	6.114
Coleoptera	1	0.307	0.0007	0.006	2.703	1.005
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	4	1.227	0.0002	0.002	5.405	2.211
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	33	10.123	0.2091	1.652	13.514	8.429
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	1	0.307	0.0014	0.011	2.703	1.007
Total Aquatics	1	0.307	0.0014	0.011	2.703	1.007
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	1	0.307	12.2100	96.438	2.703	33.149
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.1712	1.352	0.000	0.451
Total Fish	1	0.307	12.3812	97.790	2.703	33.600

Appendix C56. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 17 adult northern squawfish collected June 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	6	37.500	0.5825	0.489	5.882	14.624
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	6	37.500	0.5825	0.489	5.882	14.624
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	5	31.250	0.0035	0.003	11.765	14.339
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	5	31.250	0.0035	0.003	11.765	14.339
Other Aquatics	1	6.250	0.0020	0.002	5.882	4.045
Total Aquatics	6	37.500	0.0055	0.005	17.647	18.384
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	1	6.250	40.1600	33.732	5.882	15.288
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	2	12.500	58.3745	49.031	11.765	24.432
Unidentified	1	6.250	19.9335	16.743	5.882	9.625
Total Fish	4	25.000	118.4680	99.506	17.647	47.384

Appendix C57. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 6 adult northern squawfish collected August 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	440	100.000	1.4792	99.382	16.667	72.016
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	440	100.000	1.4792	99.382	16.667	72.016
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	0.0092	0.618	0.000	0.206
Total Fish	0	0.000	0.0092	0.618	0.000	0.206

AppendixC58. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 1 adult northern squawfish collected October 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	0	0.000	0.0000	0.000	0.000	0.000
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	0	0.000	0.0000	0.000	0.000	0.000
Other Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Total Aquatics	0	0.000	0.0000	0.000	0.000	0.000
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	0	0.000	0.0000	0.000	0.000	0.000
Nountai Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Norther Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	0	0.000	0.0000	0.000	0.000	0.000
Unidentified	0	0.000	16.3000	100.000	0.000	33.333
Total Fish	0	0.000	16.3000	100.000	0.000	33.333

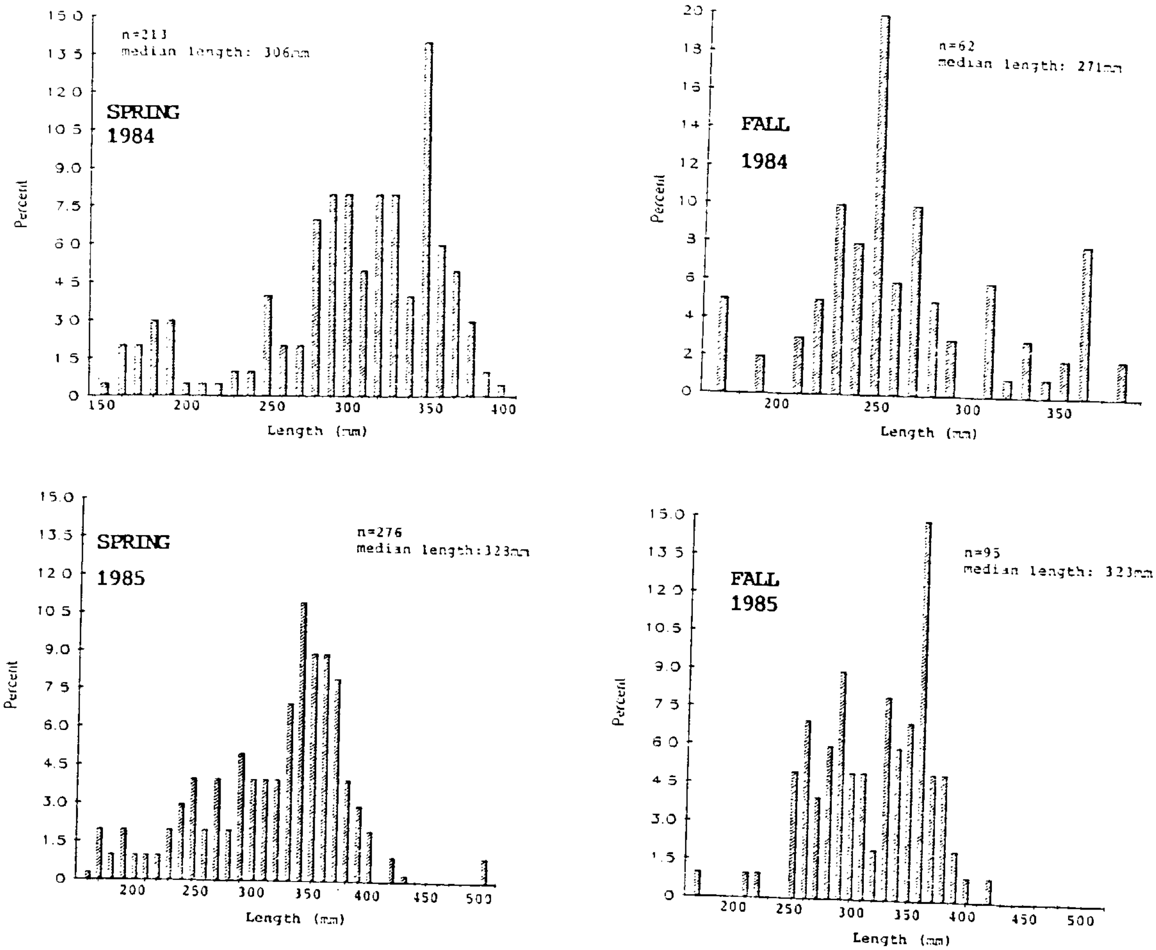
Appendix C59. Composition by number, weight, and frequency of occurance (percent) and calculated index of relative importance (IRI) for major food items in the stomachs of 24 adult northern squawfish collected seasonally 1984

Item	Number	Percent	Weight(g)	Percent	Frequency	IRI
Daphnia	0	0.000	0.0000	0.000	0.000	0.000
Copepods	0	0.000	0.0000	0.000	0.000	0.000
Epischura	0	0.000	0.0000	0.000	0.000	0.000
Leptodora	0	0.000	0.0000	0.000	0.000	0.000
Total Zooplankton	0	0.000	0.0000	0.000	0.000	0.000
Hymenoptera	446	97.807	2.0617	1.507	8.333	35.882
Coleoptera	0	0.000	0.0000	0.000	0.000	0.000
Hemiptera	0	0.000	0.0000	0.000	0.000	0.000
Homoptera	0	0.000	0.0000	0.000	0.000	0.000
Other Terrestrial	0	0.000	0.0000	0.000	0.000	0.000
Total Terrestrial	446	97.807	2.0617	1.507	8.333	35.882
Diptera Larvae	0	0.000	0.0000	0.000	0.000	0.000
Diptera Pupae	5	1.096	0.0035	0.003	8.333	3.144
Diptera Adult	0	0.000	0.0000	0.000	0.000	0.000
Total Diptera	5	1.096	0.0035	0.003	8.333	3.144
Other Aquatics	1	0.219	0.0020	0.001	4.167	1.462
Total Aquatics	6	1.316	0.0055	0.004	12.500	4.607
Westslope Cutthroat	0	0.000	0.0000	0.000	0.000	0.000
Bull Trout	1	0.219	40.1600	29.347	4.167	11.244
Mountain Whitefish	0	0.000	0.0000	0.000	0.000	0.000
Northern Squawfish	0	0.000	0.0000	0.000	0.000	0.000
Sucker	2	0.439	58.3745	42.658	8.333	17.143
Unidentified	1	0.219	36.2427	26.485	4.167	10.290
Total Fish	4	0.877	134.7772	98.489	12.500	37.289

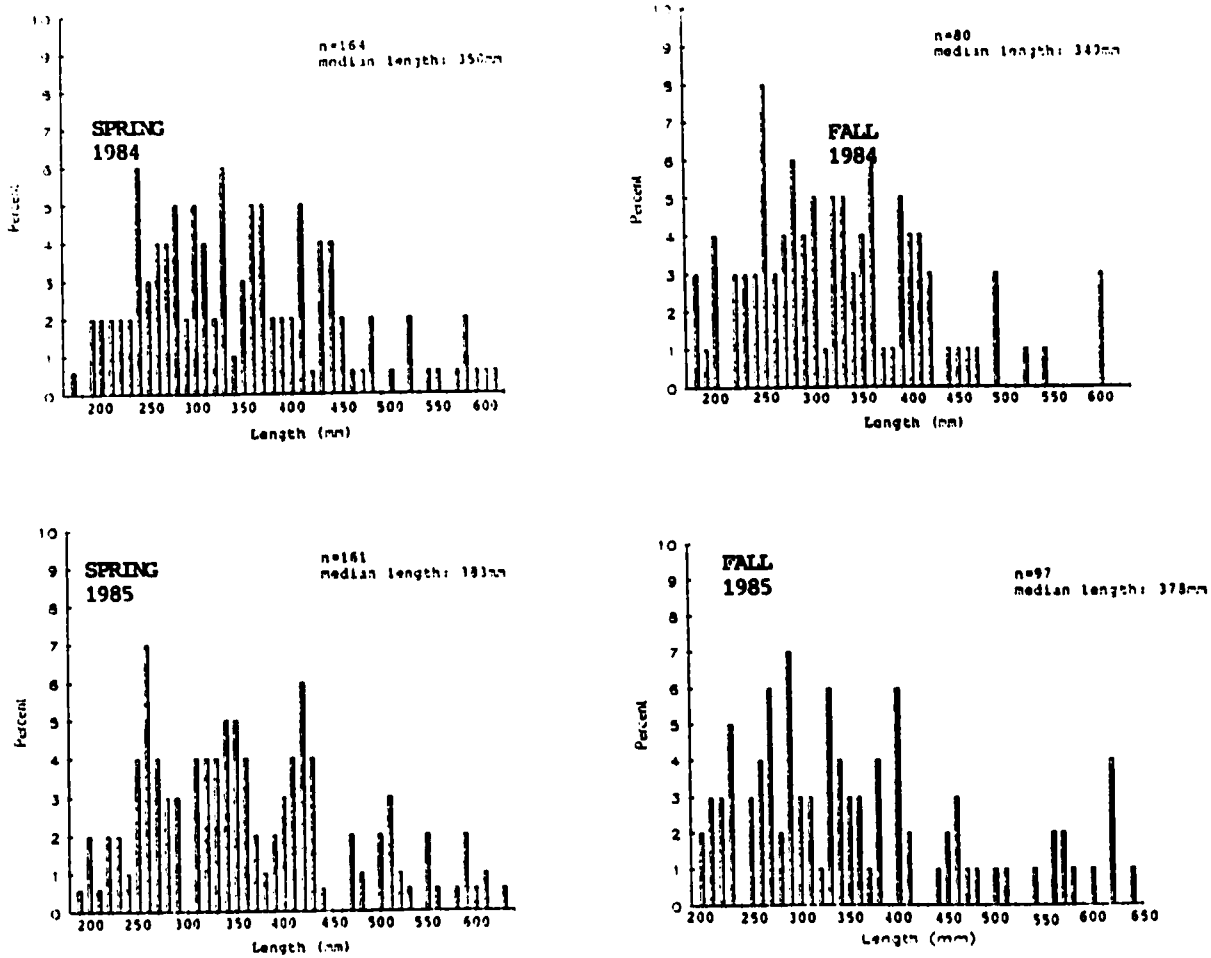
APPENDIX D1. Average catch in floating and sinking nets for fish species from Hungry Horse Reservoir, 1983-85.

DATE:	Number of nets/area[a] E	M	S	Emery WCT	DV	MVF	NSQ	CSU	LNSU	Murray WCT	DV	MWF	NSQ	CSU	LNSU	Sulli WCT	DV	MWF	NSQ	CSU	LNSU	areas WCT	DV	MWF	NSQ	CSU	LNSU
Floating Nets																											
07/26-28/83	14	14	14	1.2	0.1	0.1	2.9	0.0	0.0	0.7	0.1	0.0	1.7	0.0	0.0	1.4	0.1	0.0	0.6	0.1	0.0	1.1	0.1	0.0	1.7	0.1	0.0
08/23-25/83	14	14	14	0.2	0.1	0.0	2.7	0.0	0.0	0.2	0.1	0.0	1.9	0.1	0.1	0.9	0.0	0.0	1.5	0.1	0.1	0.4	0.1	0.0	2.0	0.1	0.0
09/27-29/83	14	14	14	2.0	0.2	1.7	4.4	0.0	0.0	3.0	0.3	1.9	3.3	0.3	0.0	3.5	0.1	0.3	1.1	0.0	0.0	2.8	0.2	1.3	2.9	0.1	0.1
11/01-03/83	14	14	14	2.6	0.2	0.5	0.1	0.0	0.0	1.2	0.1	0.4	0.0	0.0	0.0	3.3	0.1	0.9	0.1	0.1	0.0	2.4	0.2	0.6	0.1	0.0	0.0
11/29-12/03/83	14	14	14	0.5	0.1	0.1	0.0	0.0	0.0	0.8	0.0	0.1	0.0	0.0	0.0	0.7	0.1	0.0	0.0	0.0	0.0	0.7	0.1	0.1	0.0	0.0	0.0
04/24-27/84	14	14	14	2.2	0.0	0.1	0.1	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	9.1	1.2	0.1	0.1	0.0	0.0	4.8	0.4	0.0	0.0	0.0	0.1
05/30-31/84	14	14	12	1.6	1.4	0.5	0.9	0.4	0.1	3.4	0.6	0.3	0.4	0.1	0.1	2.1	1.0	0.3	0.8	0.1	0.0	2.4	0.6	0.4	0.7	0.2	0.1
06/26-28/84	14	14	14	1.1	0.7	0.2	5.0	0.3	0.0	2.3	0.2	0.2	2.2	3.2	0.1	4.3	0.6	0.1	1.3	0.2	0.0	2.6	0.5	0.2	2.9	0.2	0.1
08/13-22/84	28	23	28	0.1	0.1	0.1	5.3	0.0	0.0	0.2	0.0	0.1	5.4	0.1	0.0	0.5	0.0	0.1	1.7	0.0	0.0	0.2	0.1	0.1	4.1	0.1	0.0
10/11-15/84	--	28	26	---	---	---	---	---	- -	0.4	0.1	0.6	0.8	0.2	0.0	1.8	0.1	0.0	0.2	0.0	0.0	1.1	0.1	0.3	0.5	0.1	0.0
05/14-21/85	14	28	23	4.8	0.5	0.1	1.9	0.2	0.0	2.5	0.4	0.2	0.2	0.1	0.0	3.7	0.9	0.2	0.7	0.0	0.0	3.5	0.5	0.2	0.7	0.1	0.0
08/14-20/85	28	25	30	0.7	0.1	0.7	1.7	0.0	0.1	0.1	0.1	0.4	1.3	0.1	0.0	1.1	0.0	0.1	1.6	0.1	0.0	0.6	0.1	0.4	1.5	0.1	0.1
10/31-11/06/85	28	26	14	0.8	0.4	0.1	0.2	0.1	0.0	1.2	0.1	0.3	0.0	0.1	0.0	2.5	0.1	0.2	0.1	0.0	0.0	1.3	0.2	0.2	0.1	0.1	0.0
Sinking Nets																											
07/26-28/83	2	2	2	0.0	1.0	1.0	13.5	3.5	10.5	4.0	1.5	7.5	4.0	7.5	0.0	2.0	2.0	3.0	4.0	10.0	0.0	2.3	1.5	7.0	3.8	12.0
08/23-25/83	3	3	3	0.3	1.3	2.0	8.7	3.3	11.3	0.0	0.3	1.3	10.3	6.3	6.0	0.0	0.7	0.7	6.0	5.7	6.0	0.1	0.8	1.3	8.3	4.1	7.8
09/27-29/83	3	3	3	0.0	4.7	15.0	14.7	4.7	0.3	1.5	3.3	38.0	5.3	1.3	0.0	2.3	3.7	22.0	3.3	0.3	0.0	1.1	3.9	25.0	7.8	2.1	0.1
11/01-03/83	3	3	3	0.3	1.3	9.0	2.3	1.0	0.3	0.0	3.0	7.3	0.7	1.0	0.0	0.3	2.3	13.7	3.7	0.7	0.3	0.3	2.2	10.0	2.2	0.9	0.1
11/29-12/03/83	3	3	3	1.3	1.7	3.0	0.7	0.3	0.0	1.3	1.3	7.7	1.3	0.0	0.0	0.3	2.0	6.7	0.3	0.0	0.0	1.0	1.7	5.9	0.8	0.7	0.0
04/24-27/84	4	4	4	1.5	4.3	11.5	1.3	1.0	0.3	1.5	2.5	11.0	0.3	0.3	0.3	0.0	8.0	16.8	2.0	1.5	2.5	1.0	4.9	13.1	1.2	0.9	1.0
05/30-31/84	4	4	4	0.0	6.5	7.3	3.5	1.0	6.8	1.0	7.3	7.5	4.0	1.5	2.8	0.3	2.3	4.5	4.3	0.8	1.9	0.4	5.3	6.4	3.9	1.1	3.0
06/26-28/84	4	4	4	0.8	3.5	7.0	7.5	4.8	6.8	0.3	5.0	3.0	5.5	2.5	7.0	0.3	5.8	7.5	4.0	3.8	9.0	0.4	4.9	5.8	5.7	3.7	7.6
08/13-22/84	10	10	10	0.0	1.7	3.5	12.8	2.8	8.0	0.1	1.8	1.9	13.3	4.6	5.9	0.2	0.7	3.7	3.9	3.7	4.3	0.1	1.4	3.1	9.1	3.7	6.1
10/11-15/84	--	10	,	__	---	---	---	---	---	0.0	3.6	21.6	3.8	0.5	0.3	0.7	5.5	23.3	5.9	1.1	0.3	0.3	3.4	22.3	4.6	0.8	0.3
05/14-21/85	6	10	10	0.0	4.5	11.2	2.4	1.2	4.0	0.0	3.8	13.8	1.4	1.8	3.8	0.2	5.6	13.3	2.5	1.9	1.9	0.1	4.7	13.1	2.0	1.7	3.1
08/14-20/85	10	10	10	0.6	3.3	9.5	11.2	1.7	4.7	0.0	1.4	4.0	10.8	2.7	2.8	0.2	3.3	4.7	8.1	4.3	6.2	0.3	2.7	5.1	10.0	2.9	4.6
10/31-11/05/85	10	10	5	0.0	3.9	6.8	2.8	1.0	0.4	0.1	2.2	4.3	2.3	1.0	0.1	0.6	4.2	ii.8	1.2	1.2	0.4	0.2	3.8	6.8	2.3	1.0	0.3

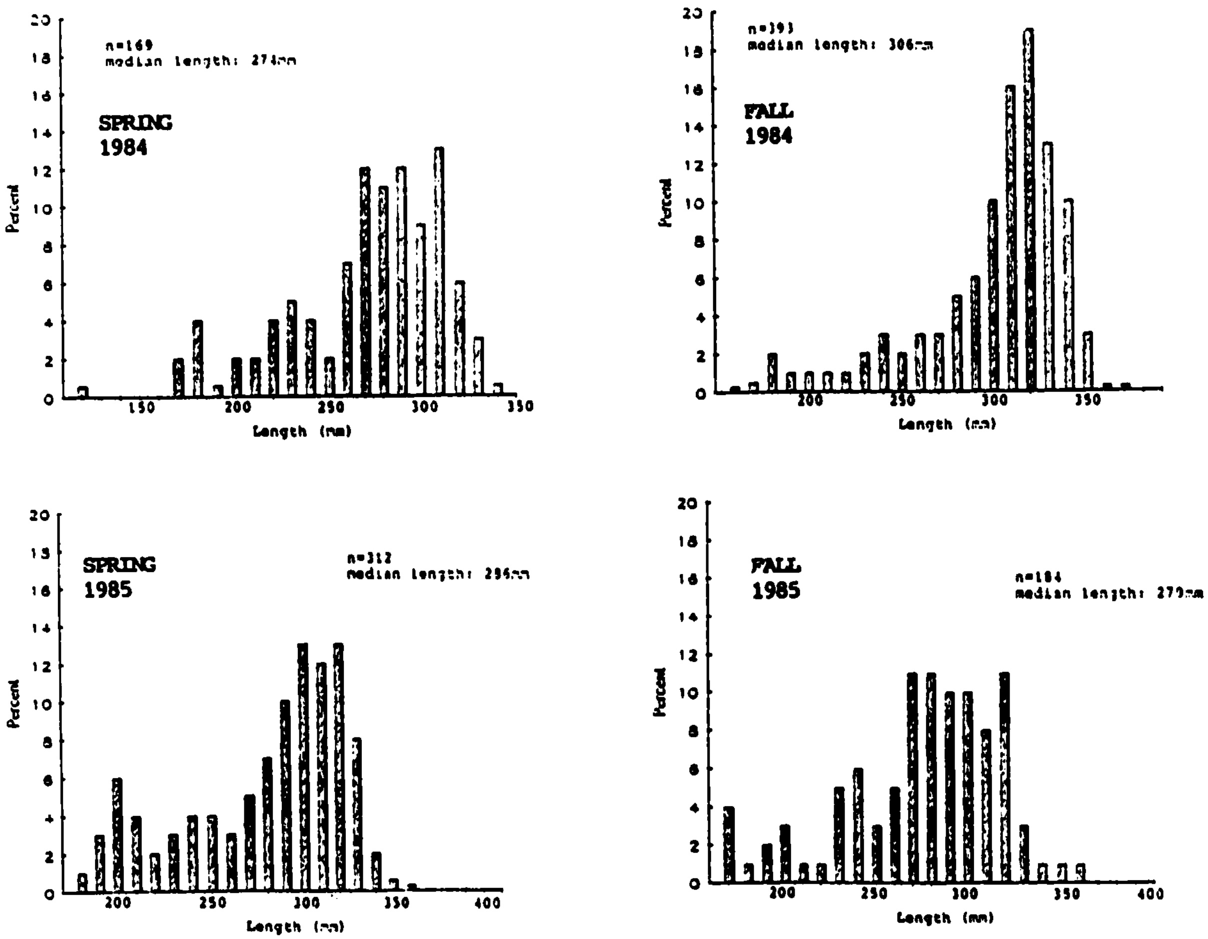
a/ E = Emery area, M = Murray area, S = Sullivan area



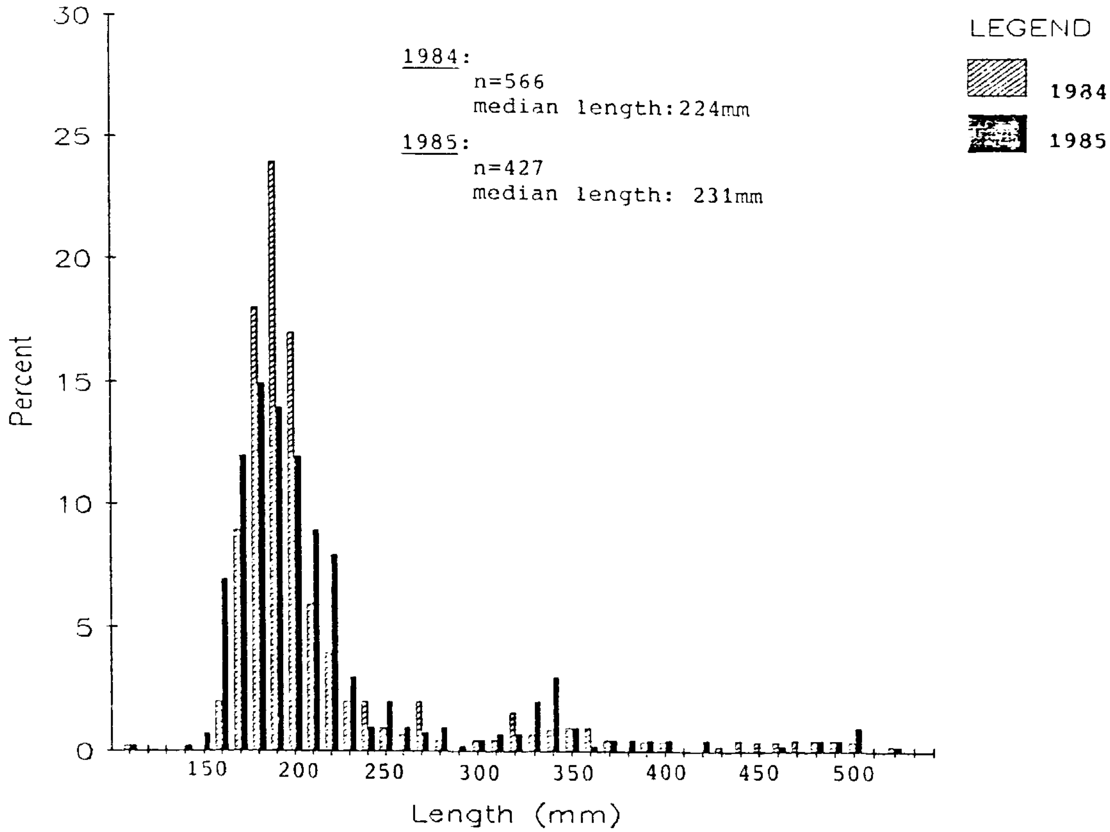
Appendix E1. Length frequency diagrams for westslope cutthroat captured in floating and sinking gill nets in Hungry Horse Reservoir in the spring and fall, 1984 and 1985.



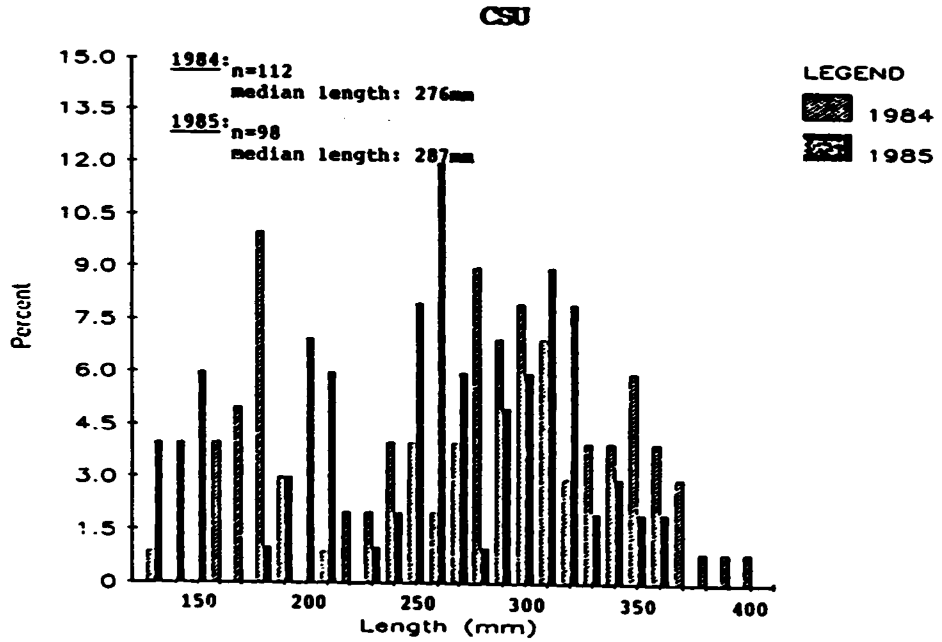
Appendix E2. Length frequency diagrams for bull trout captured in floating and sinking gill nets in Hungry Horse Reservoir in the spring and fall, 1984 and 1985.

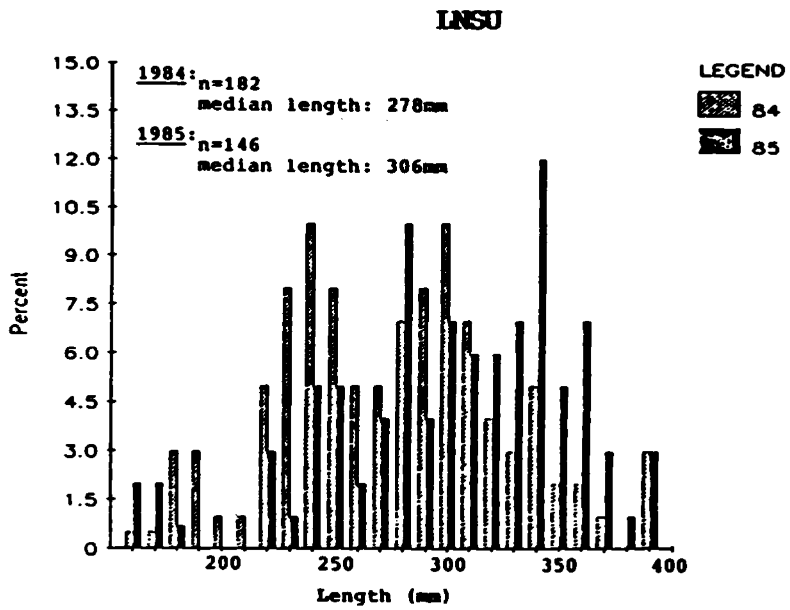


Appendix E3. Length frequency diagrams for mountian whitefish captured in floating and sinking gill nets in Hungry Horse Reservoir in the spring and fall, 1984 and 1985.

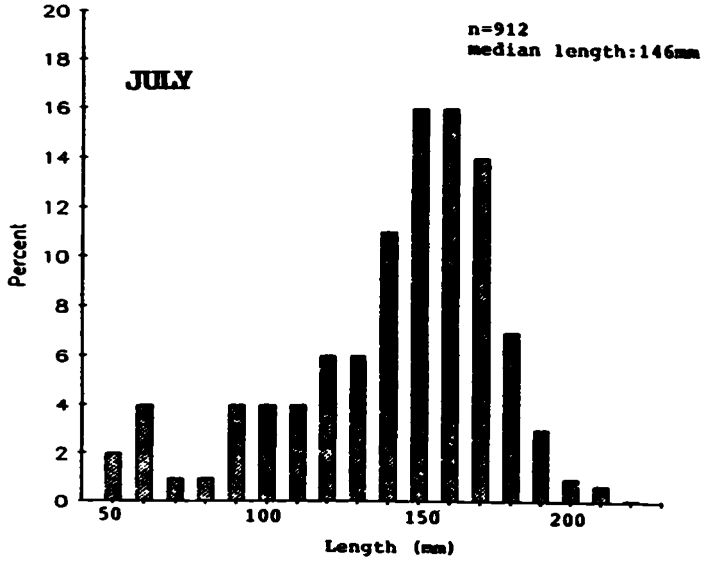


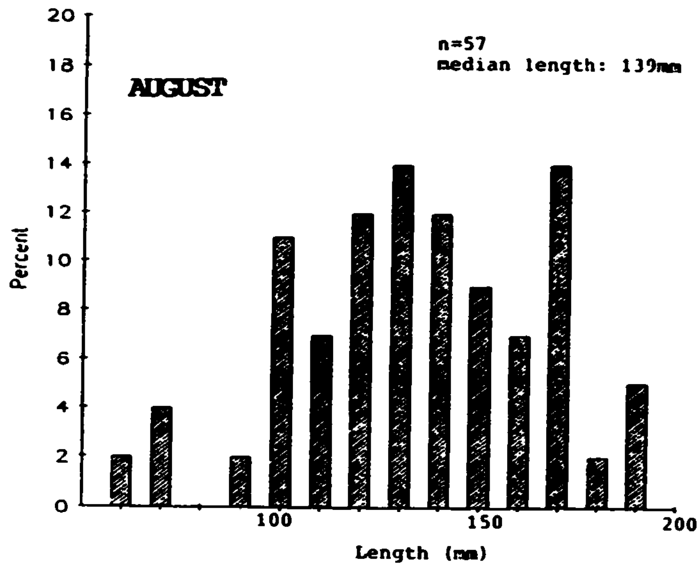
Appendix E4. Length frequency diagram for northern squawfish captured in floating and sinking gill nets in Hungry Horse Reservoir in 1984 and 1985.



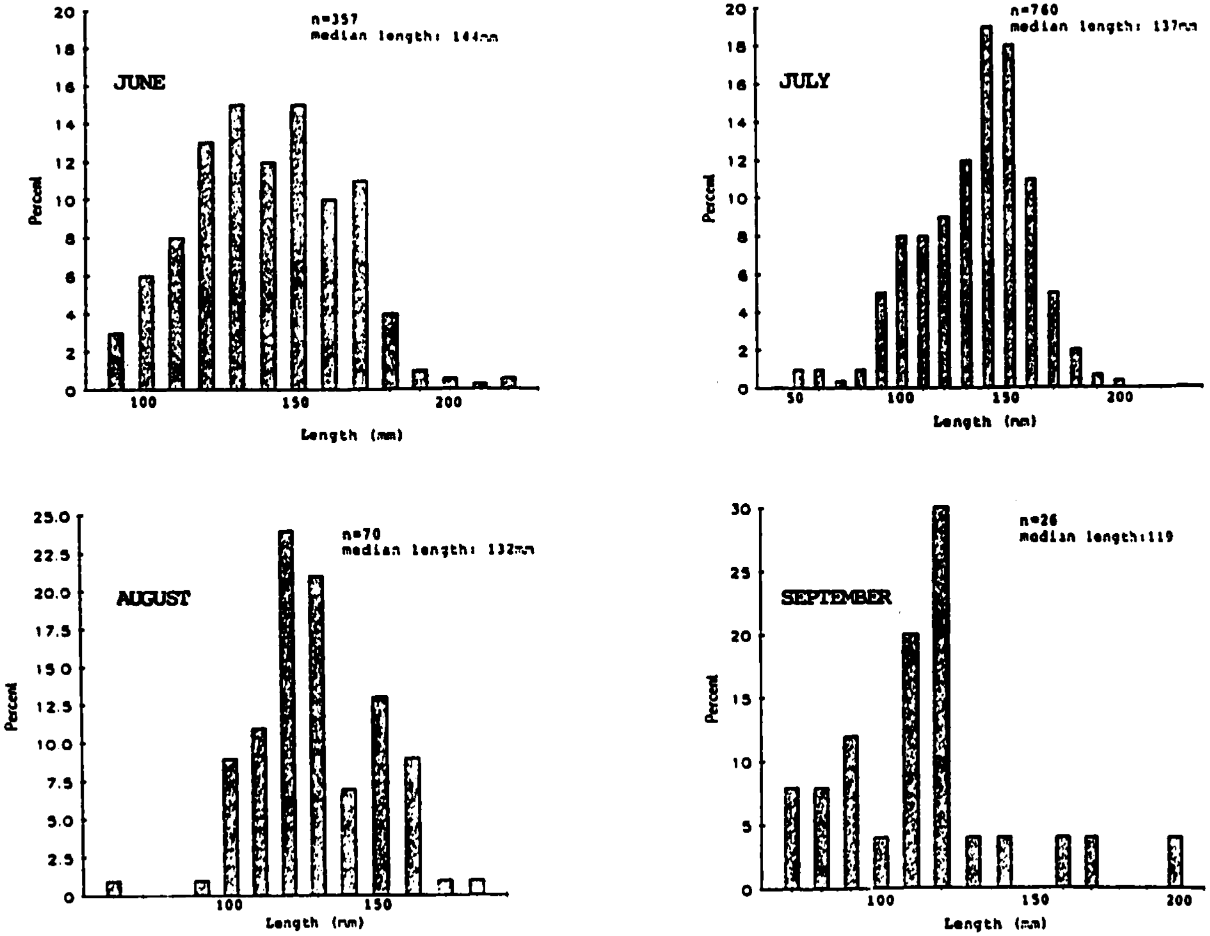


Appendix E5. Length frequency diagram for large scaled suckers and longnose suckers captured in floating and sinking gill nets in Hungry Horse Reservoir, 1984 and 1985.

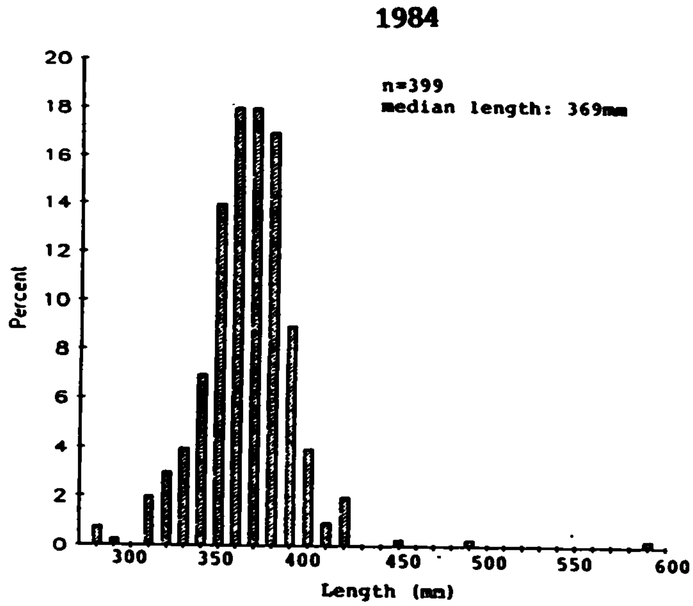


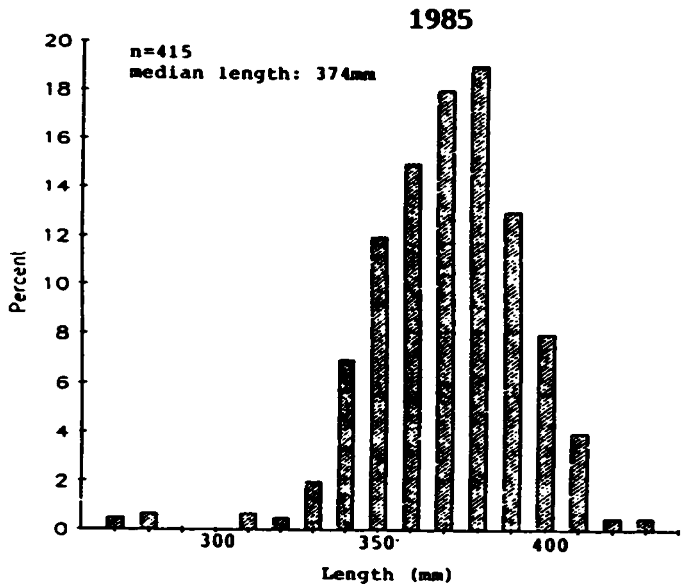


Appendix F1. Length frequency diagram of juvenile cutthroat trout caught in downstream trap in Hungry Horse Creek, July and August 1984.



Appendix F2. Length frequency diagram of juvenile cutthroat trout caught in downstream trap in Hungry Horse Creek, June through September 1985.





Appendix F3. Length frequency diagram of adult cutthroat trout caught in downstream trap in Hungry Horse Creek, 1984 and 1985.

Appendix G1. Tagging and return information for westslope cutthroat and bull trout tagged in tributaries to Hungry Horse Reservoir and South Fork River, 1983.

Tagging Data				Return Data				
Date	Location	Length (mm)		Date	Location	Length (mm)	Method of Recapture	Distance Moved (km)
				Westslope Cutthroat				
6-16-83	Emery Cr.	170	J[a]	6-?-83	Emery Cr.	~150	Angling	—
6-24-83	Emery Cr.	135	J	7-20-83	Hungry Horse Res.--Emery Bay	169	Gill Net	—
6-28-83	Emery Cr.	146	J	11-29-83	Hungry Horse Res.--Emery Bay	266	Gill Net	—
7-3-83	Emery Cr.	142	J	9-3-83	Emery Cr.	~178	Angling	—
6-28-83	Hungry Horse Cr.	348	A	12-15-83	Mouth of Clark Cr.	~368	Gill Net	+49.9[b]
7-4-83	Hungry Horse Cr.	368	A	7-23-83	Hungry Horse Res.	—	Angling	—
7-19-83	Lower Twin Cr.	380	A	7-26-83	Mouth of Lower Twin Cr.	~368	Angling	0.5
7-19-83	Lower Twin Cr.	200	J	8-31-83	Inlet of S. Fork River	~203	Angling	-8.4
7-24-83	Lower Twin Cr.	255	J	7-26-83	Mouth of Lower Twin Cr.	~252	Angling	0.5
7-28-83	Lower Twin Cr.	234	J	8-2-83	Mouth of Lower Twin Cr.	~229	Angling	0.5
8-2-83	Lower Twin Cr.	232	J	9-21-83	Inlet of S. Fork River	~254	Angling	-8.4
6-15-83	Murray Cr.	106	J	6-29-83	Mouth of Hungry Horse Cr.	—	Angling	-18.8
6-16-83	Murray Cr.	340	A	6-29-83	Mouth of Lost Johnny Cr.	—	Angling	+14.5
6-23-83	North Fork Logan Cr.	172	J	8-30-83	Mouth of Sullivan Cr.	203-229	Angling	-9.3
6-24-83	North Fork Logan Cr.	145	J	8-24-83	Mouth of Lid Cr.	~178	Angling	-28.2
7-28-83	Sullivan Cr.	200	J	8-21-83	Sullivan Cr.	—	Angling	—
7-30-83	Sullivan Cr.	163	J	9-29-83	Hungry Horse Res.--Devils Corkscrew Area	208	Gill Net	—
6-16-83	Tent Cr.	333	A	6-25-83	Riverside Boat Landing	—	Angling	+3.7
6-21-83	Tent Cr.	367	A	—	Hungry Horse Res.--Devils Corkscrew Area	~373	Gill Net	+28.5
				Bull Trout				
8-1-83	Sullivan Cr.	194	J	—	Hungry Horse Res.--Devils Corkscrew Area	~203	Gill Net	+5.2

a/ J--Juvenile fish; A--Adult fish

b/ + is up-reservoir movement; - is down-reservoir movement

Appendix G2. Tagging and return information of juvenile westslope cutthroat tagged in tributaries to Hungry Horse Reservoir (HHR) and South Fork River, 1984.

Tagging Data			Return Data				
Date	Location	Length (mm)	Date	Location	Length (mm)	Method of Recapture	Distance Moved (km)
7-9-84	Emery Cr.	135	8-?-84	HHR—Mouth of Lost Johnny	---	Angling	+2.2 a/
7-25-84	Emery Cr.	170	8-30-84	Wounded Buck Cr.	---	Angling	+4.9
7-20-84	Forest Cr.	165	8-27-84	Sullivan Cr.	~190	Angling	+4.0
7-23-84	Forest Cr.	170	8-8-84	HHR--Mouth of Graves Cr.	---	Angling	-4.8
9-7-83	Hungry Horse Cr.	148	7-21-84	Huhgry Horse Cr. Trap	206	Trap	---
7-5-84	Hungry Horse Cr.	152	7-21-84	HHR--Mouth of Lost Johnny Cr.	~153	Angling	+2.3
7-11-84	Hungry Horse Cr.	175	7-15-84	HHR—Mouth of Hungry Horse Cr.	---	Angling	0.5
7-12-84	Hungry Horse Cr.	182	7-15-84	HHR—Mouth of Hungry Horse Cr.	---	Angling	0.5
7-31-83	Lower Twin Cr.	210	6-28-84	HHR—Sullivan Area	283	Gill Net	-5.2
8-1-83	Lower Twin Cr.	181	4-26-84	HHR--Sullivan Area	239	Gill Net	-12.9
7-14-84	Lower Twin Cr.	227	7-14-84	Lower Twin Cr.	227	Angling	---
7-31-83	Sullivan Cr.	180	6-28-84	HHR—Sullivan Area	262	Gill Net	4.0
8-8-83	Sullivan Cr.	202	5-31-84	HHR--Murray Area	290	Gill Net	-24.1
7-23-84	Wheeler Cr.	155	9-5-84	Sullivan Cr.	---	Angling	+4.0
7-23-84	Wheeler Cr.	152	9-5-84	Sullivan Cr.	---	Angling	+4.0

a/ + is up-reservoir movement, - is down-river reservoir movement

Appendix G3. Tagging and return information of adult westslope cutthroat and bull trout tagged in tributaries to Hungry Horse Reservoir (HHR) and South Fork River, 1984.

Tagging Data			Return Data				
Date	Location	Length (mm)	Date	Location	Length (mm)	Method of Recapture	Distance Moved (km)
7-11-84	Forest Cr.	388	9-2-84	Murray Bay	---	Angling	-22.7 a/
6-24-83	Hungry Horse Cr.	378	5-28-84	Hungry Horse Cr. Trap	390	Trap	—
7-3-83	Hungry Horse Cr.	386	5-23-84	Hungry Horse Day	—	Angling	0.5
6-28-84	Hungry Horse Cr.	390	10-23-84	Hungry Horse Day	-430	Angling	0.5
7-7-84	Hungry Horse Cr.	397	7-18-84	Hungry Horse Day	- -	Angling	0.5
7-2-84	Hungry Horse Cr.	368	7-5-84	Hungry Horse Bay		Angling	0.5
7-3-84	Hungry Horse Cr.	369	7-8-84	Hungry Horse Bay	--	Angling	0.5
7-7-84	Hungry Horse Cr.	319	7-15-84	Hungry Horse Bay	--	Angling	0.5
7-4-84	Hungry Horse Cr.	391	J-15-84	Hungry Horse Bay	—	Angling	0.5
7-4-84	Hungry Horse Cr.	284	7-27-84	Hungry Horse Cr. Trap	204	Trap	—
7-6-84	Hungry Horse Cr.	371	7-12-84	Hungry Horse Bay	- -	Angling	0.5
7-11-84	Hungry Horse Cr.	357	7-15-84	Hungry Horse Bay	--	Angling	0.5
7-13-84	Hungry Horse Cr.	355	7-21-84	Hungry Horse Day	—	Angling	0.5
7-13-84	Hungry Horse Cr.	351	7-15-84	Hungry Horse Day		Angling	0.5
7-17-84	Hungry Horse Cr.	373	7-21-84	Hungry Horse Bay		Angling	0.5
8-9-83	Lower Twin Cr.	297	7-l-84	H.H.R.-Lid Cr. Area	—	Angling	-52.3
6-15-83	Murray Cr.	351	7-9-84	Hungry Horse Cr. Trap	367	Trap	-18.8
6-17-83	North Fork Logan Cr.	340	5-19-84	North Fork Logan Cr.	- -	Angling	—
7-12-84	Quintonkon Cr.	378	7-15-84	Sullivan Cr.	-390	Angling	-1.0
5-9-84	Rwervoir--Mouth of Sullivan Cr.	370	5-31-84	H.H.R.--Emery Area	-365	Gill Net	-48.0
5-2-84	Reservoir--Upper end	255	7-?-84	S.Fork River--Log Landing	-340	Angling	+3.0
8-8-83	Sullivan Cr.	387	6-16-84		-390	Angling	
6-18-83	Tent Cr.	360	6-25-84	Hungry Horse Cr. Trap	380	Trap	-14.8
6-22-83	Tent Cr.	392	7-8-84	H.H.R.--Mouth of Deep Cr.	-415	Angling	-5.6
5-9-84	Reservoir--Mouth of Sullivan Cc.	559	*W* 8-29-84	Quintonkon Cr.	—	Angling	-6.0

a/ + is up-reservoir movement; - is down-reservoir movement

Appendix G4. Tagging and return information for westslope cutthroat tagged in tributaries to Hungry Horse Reservoir and South Fork River, 1985.

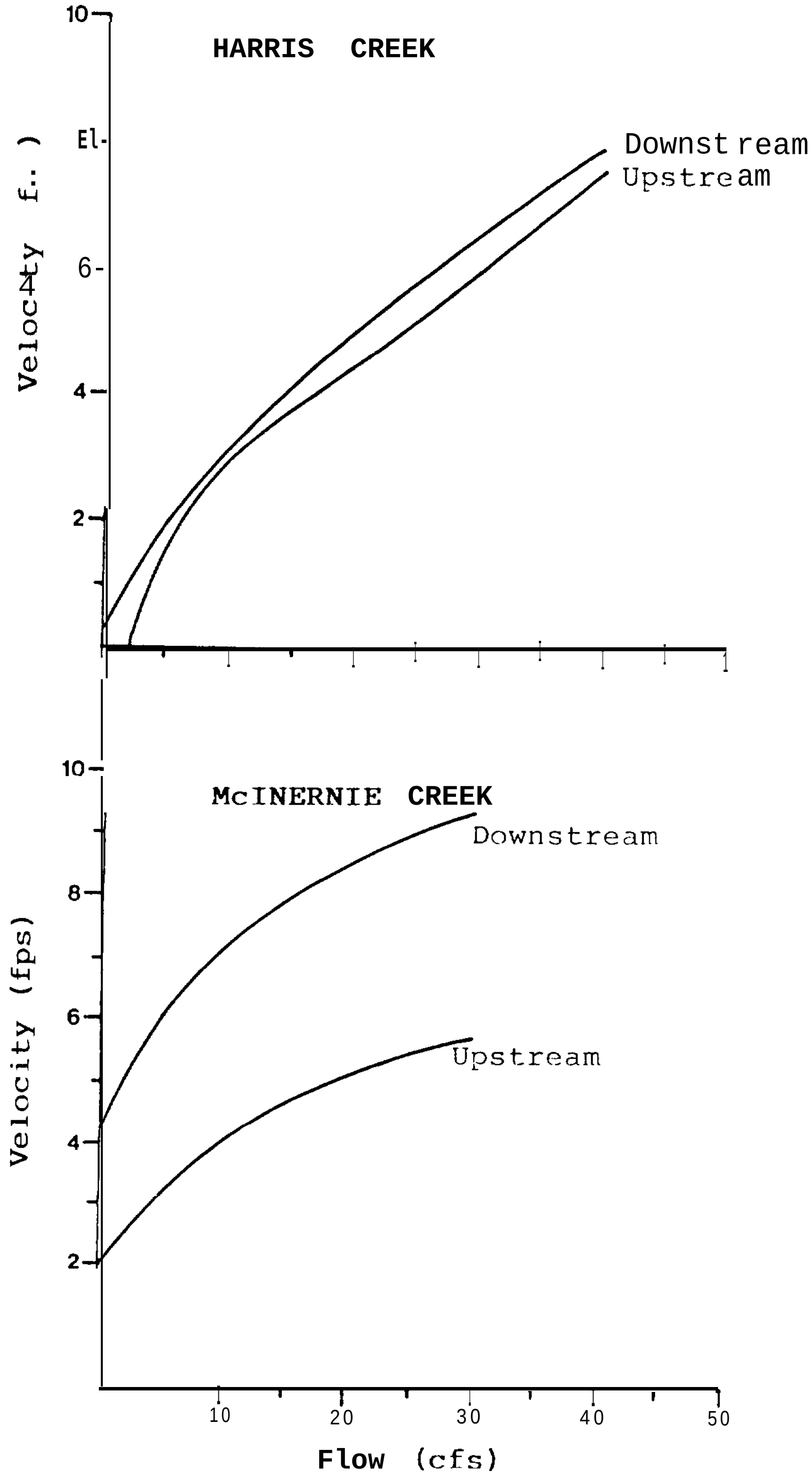
TAGGING DATA			RETURN DATA				
Date	Location	Length mm	Date	Location	Length mm	Method Of recapture	Distance Moved km
6/22/83	Murrav Creek	357	5/27/85	Mouth of Clayton Creek	-356	Angler	+1
7/02/83	Hungry Horse Creek	322	7/05/85	Hungry Horse-Creek	374	'Trap	--
6/30/84	Hungry Horse Creek	336	6/13/85	Hungry Horse Creek	364	Trap	--
6/30/84	Hungry Horse Creek	392	7/01/85	Hungry Horse Creek	398	Trap	--
6/30/84	Hungry Horse Creek	366	6/28/85	Hungry Horse Creek	374	Trap	--
7/07/84	Hungry Horse Creek	367	7/04/85	Hungry Horse Creek	375	Trap	--
7/01/84	Hungry Horse Creek	382	6/28/85	Hungry Horse Creek	373	Trap	--
7/01/84	Hungry Horse Creek	370	6/18/85	Hungry Horse Creek	373	Trap	--
7/01/84	Hungry Horse Creek	380	6/26/85	Hungry Horse Creek	393	Trap	--
7/07/84	Hungry Horse Creek	372	5/27/85	Hungry Horse Creek	-380	Angler	--
7/04/84	Hungry Horse Creek	370	6/28/85	Hungry Horse Creek	377	Trap	--
7/04/84	Hungry Horse Creek	290	7/01/85	Hungry Horse Creek	324	Trap	--
7/05/84	Hungry Horse Creek	350	7/01/85	Hungry Horse Creek	360	Trap	--
7/07/84	Hungry Horse Creek	403	7/07/85	Hungry Horse Creek	-381	Angler	--
7/06/84	Hungry Horse Creek	369	6/25/85	Hugnry Horse Creek	370	Trap	--
7/06/84	Hunqiv Horse Creek	387	6/19/85	Hungry Horse Creek	396	Trap	-
7/08/84	Hungry Horse Creek	376	7/02/85	Hungry Horse Creek	377	Trap	--
7/08/84	Hungry Horse Creek	323	6/29/85	Hungry Horse Creek	343	Trap	--
7/09/04	Hungry Horse Creek	365	6/23/85	Hungry Horse Creek	-368	Angler	--
7/10/84	Hungry Horse Creek	399	5/27/85	Hungry Horse Bay	-393	Angler	0.5
7/11/84	Hungry Horse Creek	332	7/03/85	Hungry Horse Creek	3.15	Trap	--
7/11/84	Hungry Horse Creek	376	6/30/85	Hungry Horse Creek	380	Trap	--
7/11/84	Hungry Horse Creek	382	?/??/85	-- ? ---	400	Angler	--
7/12/84	Hungry Horse Creek	350	5/22/85	Hungry Horse Bay	-330	Angler	0.5
7/13/84	Hungry Horse Creek	359	5/27/85	Hungry Horse Creek	-360	Angler	--
7/14/84	Hungry Horse Creek	379	6/27/85	Hungry Horse Creek	386	Traip	-
7/16/84	Hungry Horse Creek	375	6/25/85	Hungry Horse Creek	381	Trap	--
7/16/84	Hungry Horse Creek	410	6/26/85	Hungry Horse Creek	411	Trap	--
7/17/84	Hungy Horse Creek	380	5/22/85	Hungry Horse Bay	-356	Angler	0.5
7/20/84	Hungry Horse Creek	344	7/05/85	Hungry Horse Creek	353	Trap	--
7/20/84	Hungry Horse Creek	399	6/23/85	Hungry Horse Creek	---	Angler	--
7/23/84	Hungry Horse Creek	403	5/27/85	Hungry Horse Bay	-397	Angler	--
7/23/84	Hungry Horse Creek	373	7/13/85	Hungry Horse Creek	37 5	Trap	--
7/24/84	Hungry Horse Creek	420	7/12/85	Hungry Horse Creek	375	Trap	--
6/28/85	Hungry Horse Creek	393	7/20/85	HHR - Elk Island	---	Angler	+18.8
7/11/85	Hungry Horse Creek	378	8/17/85	HHR - Murray Arae	-305	Angler	+18.8
5/02/84	HHR-Sullivan Area	255	7/04/85	HHR - log landing	-356	Angler	0.5
9/25/84	HHR-Sullivan Area	362	8/18/85	HHR - Sull. Area	370	Angler	-2.9
9/25/84	HHR-Sullivan Area	261	6/14/85	S.Fk.R., between Sp.Bear & Twin Cr.	-305	Angler	+22 .7

Appendix G4. (continued)

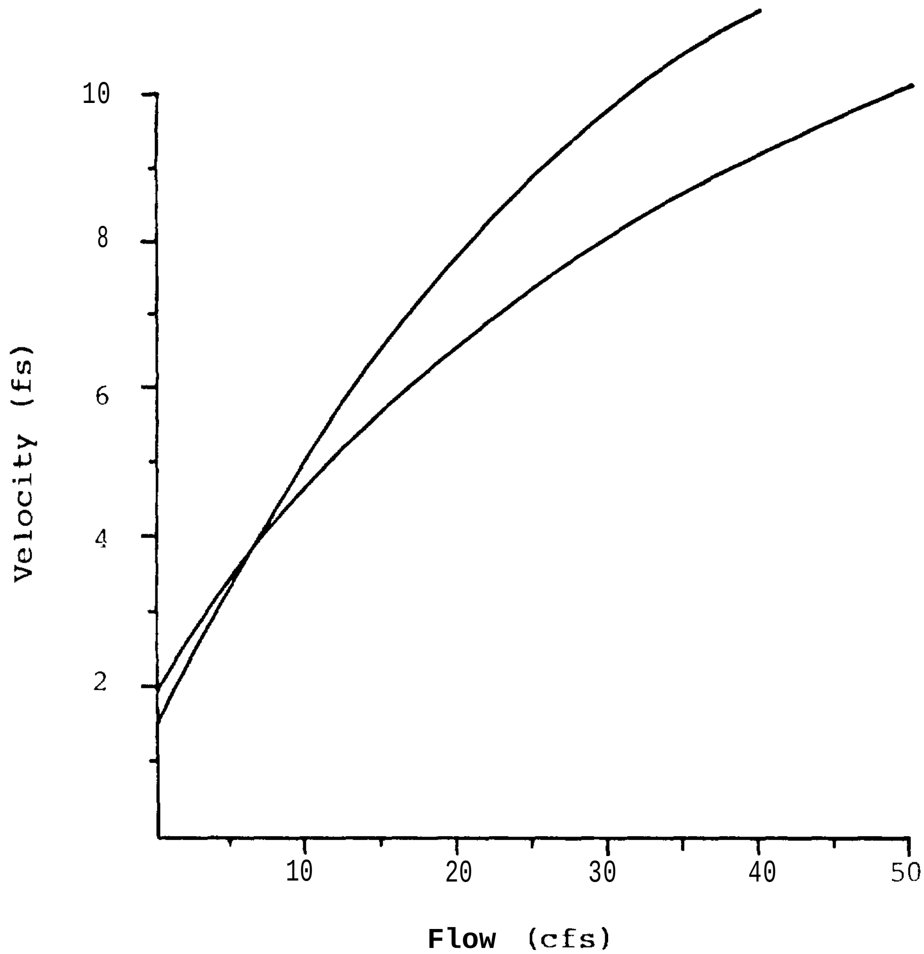
TAGGING DATA			RETURN DATA				
Data	Location	Length mm	Date	Loction	Length mm	Method of recapture	Distance Moved km
5/20/85	HHR-Sullivan Area	420	6/20/85	Sullivan Creek	-406	Angler	+6.4
6/30/84	HHR-Sullivan Area	352	5/31/85	Mouth of H.H.Creek	354	Angler	0.5
7/07/84	HHR-Sullivan Area	364	6/l/85	HHR - Riverside Bay	362	Angler	+15.1
7/01/85	HHR-Sullivan Area	380	9/02/85	HHR - Fire Island	- -	Angler	+9.5
7/09/85	HHR-Sullivan Area	374	10/5/85	HHR - Lid Creek	380	Angler	+10.4
5/02/84	Hungry Horse Creek	336	8/25/85	HHR - Riverside Bay	315	Angler	-26.4
5/02/84	Hungry Horse Creek						
5/28/85	Hunqrv Horse Creek	304	7/21/85	S.Fk.R.-near Soldier Cr.	313	Angler	+20.8
5/29/85	Hungry Horse Creek	378	7/07/85	Wheeler Creek	387	Angler	0.5
7/18/84	Forest Creek	285	5/17/85	HHR - Murray Area	322	G.N.	-22.7
7/30/84	Sullivan Creek	147	5/14/85	HHR - Sullivan Area	168	G.N.	-6.4
6/12/84	Hungry Horse Creek	378	8/16/85	HHR - Flossy Creek	-330	Angler	+16.1
7/17/84	Forest Creek	252	5/27/85	HHR - Lid Creek	-406	Angler	-31.0
6/17/85	S.Fk.R. - 2mi below Sp. Br. Riv.	285	6/30/85	same as tagged	---	Angler	--
6/17/85	S.Fk.R. - mouth of Sp. Br. Riv.	286	6/17/85	same as tagged	- -	Angler	--
6/06/85	S.Fk. R. – mouth of sp. Br. Riv.	360	6/14/85	same as tagged	---	Angler	
6/12/85	S.Fk.R. - mouth of L. Twin Creek	325	6/29/85	S.Fk.R. - mouth of L. Twin Creek	-337	Angler	--
5/28/85	HHR - Sull. Area	324	7/27/85	S.fk.R. - below main Rd. Bridge	-292	Angler	+28.0
5/29/85	HHR - Sull. Area	365	7/01/85	Sp. Br. Riv.	-351	Angler	+34.3
6/20/85	Hungry Horse Creek	372	10/13/85	HHR-Devils Corkscrew Cr.	303	Angler	+42.8
6/15/85	Hungry Horse Creek	362	7/07/85	Hungry Horse Creek	-330	Angler	--
7/19/84	Spotted Bear River	253	7/06/85	same as tagged	-330	Angler	-
7/22/84	Forest Creek	305	6/30/85	Hungry Horse Creek	345	Trap	-41.5
			********** DV **********				
5/20/85	HHR - Sull. Area	357	6/22/85	S.Fk.Riv, near Soldier Cr.	-343	Angler	+20.8
5/22/85	HHR - Sull. Area	550	7/26/85	S.Fk.Riv - pool below gorge	---	Angler	+49.9
5/29/85	HHR - Sull. Area	611	7/01/85	S.Fk.Riv - at foot bridge	-737	Angler	+49.2

Appendix G5. Tagging and return information for westslope cutthroat trout tagged in the upper South Fork of the Flathead River (SFFR) in 1985.

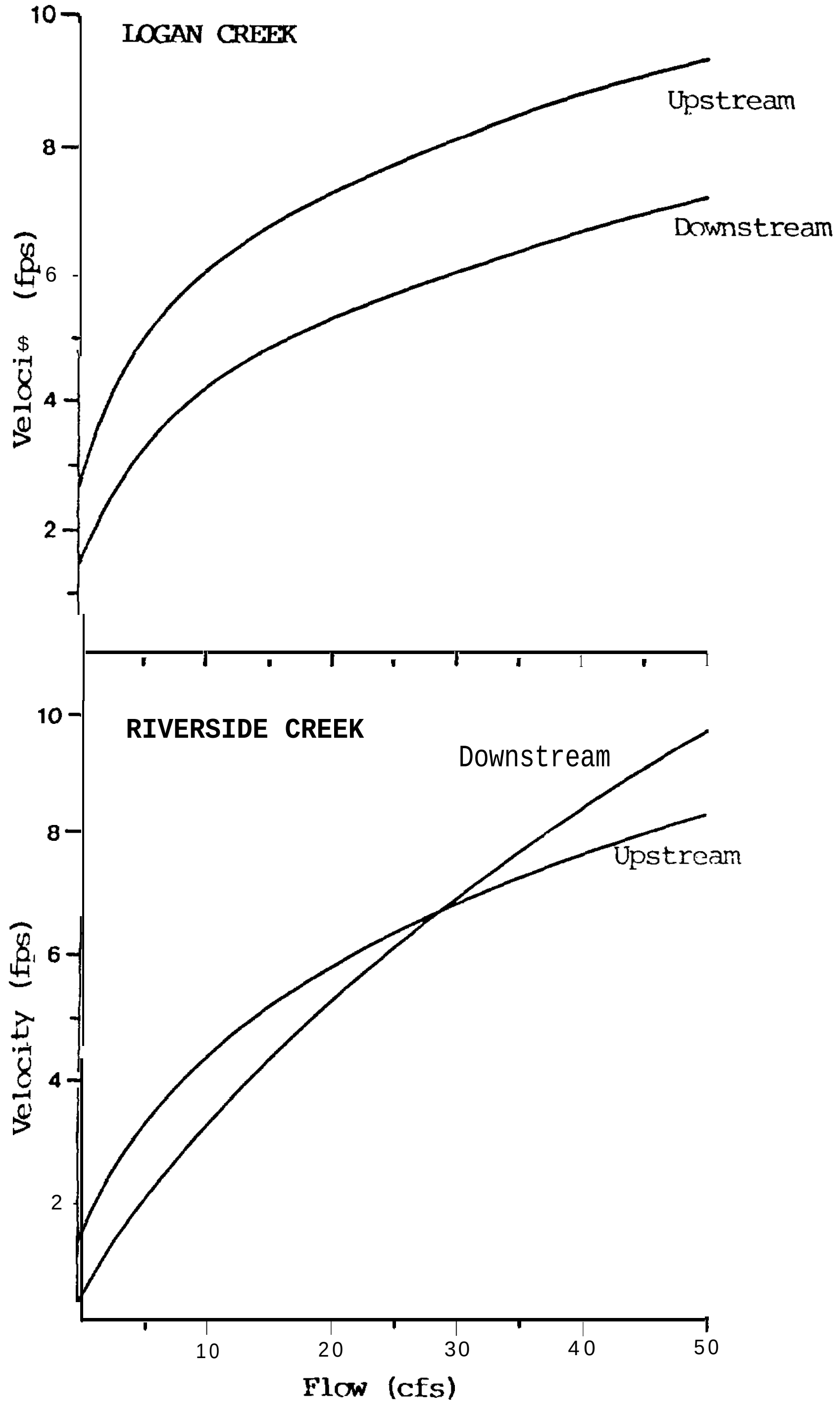
TAGGING DATA			RETURN DATA				
Date	Location	Length mm	Date	Location	Length mm	Method of recapture	Distance Moved km
			******************Adults******************				
7/17/85	SFFR Near Black Bear Creek	294	7/2/85	SFFR Near Balck 3ear Creek	--	Angler	0
7/18/85	SFFR Near Black Bear Creek	252	8/9/85	SFFR Near Black Bear Creek	--	Angler	0
7/18/85	SFFR Near Black Bear Creek	321	8/6/85	SFFR Near Black Bear Creek	--	Angler	0
8/5/85	SFFR Near Black Bear Creek	307	9/2/85	SFFR Near Balck Bear Creek	--	Angler	0
7/19/85	SFFR Near White River	300		SFFR Near White River	--	Angler	0
7/17/85	SFFR Near Whtie River	350	8/20/85	SFFR Near White River	--	Angler	0
7/19/85	SFFR Near White River	300	8/8/85	SFFR Near White River	--	Angler	0
7/19/85	SFFR Near White River	260	8/21/85	SFFR Near Gordon Creek	--	Angler	+35
7/18/85	SFFR Near Youngs Creek	284	8/15/85	SFFR Near Gordon Creek	--	Angler	-6
7/19/85	SFFR Near Youngs Creek	253	8/15/85	SFFR Near Youngs Creek	--	Angler	0
7/19/85	SFFR Near Youngs Creek	344	8/15/85	SFFR Near Youngs Creek	--	Angler	0
			***************Juveniles***************				
7/17/85	SFFR Near Black Bear Creek	225	8/11/85	SFFR Near Black Bear Creek	--	Angler	0
7/17/85	SFFR Near Black Bear Creek	222	8/16/85	SFFR Near Black Sear Creek	--	Angler	0
7/18/85	SFFR Near Black Bear Creek	250	8/9/85	SFFR Near Black Bear Creek	--	Angler	0
7/18/85	SFFR Near Black Bear Creek	243	8/9/85	SFFR Near Black Bear Creek	—	Angler	0
7/19/85	SFFR Near Black Bear Creek	250	8/9/85	SFFR Near Black Bear Creek	--	Angler	0
8/5/85	SFFR Near Black Bear Creek	222	8/11/85	SFFR Near Black Bear Creek	--	Angler	0
7/18/85	SFFR Near Black Bear Creek	246	8/3/85	SFFR Near Independence Park	--	Angler	+2
7/19/85	SFFR Near Black Bear Creek	203	8/21/85	SFFR Near Independence Park	--	Angler	+2
7/19/85	SFFR Near Black Bear Creek	225	8/7/85	SFFR Near Independence Park		Angler	+2
8/5/85	SFFR Near Black Bear Creek	220	9/16/85	SFFR Near Sig Prairie	--	Angler	+37
7/19/85	SFFR Near Youngs Creek	246	8/15/85	SFFR Near Big Prairie	--	Angler	-8



Appendix H1. Relationship between flow (cfs) and velocities at the upstream and downstream ends of Harris and McNernie creek culverts in 1984 and 1985.



Appendix H2. Relationship between flow and velocities at the upstream and downstream ends of Murray Creek culvert for 1984 and 1385.



Appendix 93. Relationship between flow and velocities at the upstream and downstream ends of Logan and Riverside creek culverts in 1984 and 1985.