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Dworshak Reservoir Investigations-

Trout, Bass and Forage Species

Annual Report
1989

by

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Submitted
to

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ABSTRACT

The Nez Perce Tribe and the Idaho Department of Fish and Game (IDFG) entered into separate intergovernmental agreements with the Bonneville Power Administration in a cooperative four-year effort to study impacts of Dworshak Dam operation on resident fisheries. This third annual report focuses on rainbow trout, smallmouth bass, and forage species. The kokanee assessment is included in the IDFG agreement, and is not addressed herein.

For the period March 1989 through February 1990, an estimated 152,700 angler-hours were expended to catch 20,426 rainbow trout, 13,064 smallmouth bass, and 179 bull trout. Estimated catch of other species, including cutthroat trout, whitefish, suckers, and squawfish totalled 151. Small rainbow trout caught and released by boat anglers during June through September comprised 70.9% (14,189) of the total catch of hatchery rainbow trout (20,025) and 42.0% of the total non-kokanee catch (33,820). An estimated 93.1% of the smallmouth bass caught were under the minimum legal size limit of 305 mm and were released. Estimated harvest of smallmouth bass was 895.

The highest monthly reservoir-wide catch rate documented for all species excluding kokanee was 1.431 fish per hour during November. Cumulative catch rates through the survey period for rainbow trout and smallmouth bass were .131 and .086 fish per hour, respectively. The lowest monthly catch rates generally occurred when fishing pressure was the highest, with fishing effort targeting on kokanee during the summer months.

Relative abundance of smallmouth bass captured in gill nets increased from 17.6% in 1988 to 32.6% in 1989, whereas rainbow trout decreased from 31.9% to 3.1%. No redside shiners were gill netted during 1989.

Length increases for both Shasta and Arlee strain rainbow trout from time of release (June 1989) through February 1990 were 92 mm.

Incremental annual length increases for smallmouth bass as determined by back-calculation from scales were very similar to the 1988 analysis. Overall growth is generally better than other smallmouth bass populations at similar latitudes, but slow for smallmouth bass in general.

The estimated instantaneous mortality rate (Z) of smallmouth bass was ,495, rate of survival (S) was .610 and the total actual mortality rate (A) was .390. The exploitation rate for harvestable smallmouth bass (2305 mm) was estimated at .206. For this segment of the population, instantaneous mortality rates from natural

causes and fishing were estimated at .234 and .261, respectively.

Proportional Stock Density (PSD) for smallmouth bass collected during gill netting and electrofishing was 23.1 (n=104). This PSD is characteristic of bass populations with slow growth and low mortality. The mean Relative Weight Index (W_r) for smallmouth bass, all size groups combined (n=302), was 91.4. Lower W_r values for bass from 101 mm to 300 mm in length may suggest greater competition for food within this size range.

Analysis. of 65 smallmouth bass stomachs indicated that 13 (20.0%) were empty and that fish were present in 32 of the 52 (61.5%) samples containing food. Fish comprised 71.1% by volume of all food items. Ephemeroptera also comprised a dominant portion of the smallmouth bass diet. Both Fish and Ephemeroptera were utilized by a broad size range of smallmouth bass. Diptera and Hemiptera were important primarily to smaller (1220 mm) bass.

INTRODUCTION

Following construction of Dworshak Dam by the U.S. Army Corps of Engineers (CE), initial filling of Dworshak Reservoir began on 27 September 1971. The subsequent conversion of 86.2 km of the North Fork Clearwater River to a 6,644 hectare artificial lake has had a profound influence on resident fish and fisheries. Also, reservoir operation results in annual pool level fluctuations that exert a chronic effect on reservoir habitat.

Recognizing the pervasive influence of Dworshak Dam on resident fisheries, the Northwest Power Planning Council in its Columbia River Basin Fish and Wildlife Program [903(e)(4)] provided that:

> BPA shall fund a study to assess the impacts of the original construction and current operation of Dworshak Dam on the resident fishery. This study will include the following research concerns of the Nez Perce Tribe: 1) population dynamics of kokanee; 2) reservoir productivity; 3) food habits of rainbow trout; 4) population dynamics and habitat preferences of smallmouth bass; and 5) the status of forage species. Recommendations detailing specific protection, mitigation and enhancement opportunities, consistent with the requirements of 804(e)(16), may be submitted to the Council [804(e)(12)].

The Nez Perce Tribe, along with the Idaho Department of Fish and Game (IDFG), executed intergovernmental agreements with Bonneville Power Administration in a cooperative effort to study the five concerns stated above. This report is the third annual report of a four-year project that addresses growth and food habits of rainbow trout (Oncorhynchus mykiss), food habits, population dynamics and habitat preferences of smallmouth bass (Micropterus dolomieui), and status of forage species. Findings reported herein are for the period March 1989 through February 1990. IDFG will address population dynamics of kokanee (Oncorhynchus nerka) and reservoir productivity.

DESCRIPTION OF THE PROJECT AREA

Dworshak Dam is located on the North Fork Clearwater River 3.2 km upstream from its confluence with the Mainstem Clearwater River (Figure 1). Maximum pool was first attained on July 3, 1973 (Horton 1981). At normal full pool elevation (1,600 feet mean sea level), Dworshak Reservoir extends 86.2 km along the North Fork Clearwater River Canyon, encompassing 6,644 hectares surface area with 282 km of shoreline. Maximum width at full pool is 2743 m, and average width is 547 m.

RESERVOIR OPERATION

The primary purposes of Dworshak Dam are flood control and power production. Dam operation is integrated with the total system of Columbia River reservoirs to meet power system load requirements and to provide flood control regulation on the lower Columbia, lower Snake, and lower Clearwater Rivers. Power production is highest during the fall, winter, and early spring.

Expected minimum discharge through the turbines from April to July is 2,000 cfs. Reservoir evacuation is scheduled to commence on September 1, in accordance with the U.S. Army Corps of Engineers' operating curve for flood control, and continues through March (Figure 2.). Refilling occurs with the influx of spring flows from April to July. The date of filling to normal full pool varies from mid-June to late July, depending on run-off conditions.

The normal operating range of Dworshak Reservoir is from 1,445 to 1,600 feet mean sea level. Annual pool level fluctuations in excess of 30.5 m are common (Figure 2.).

FISH SPECIES AND ABUNDANCE

Prior to impoundment, fish species present in the study area included steelhead trout (Oncorhvnchus mvkiss), chinook salmon (Oncorhvnchus tshawvtscha), cutthroat trout (Oncorhvnchus clarki), bull trout (Salvelinus confluentus), brook trout (Salvelinus fontinalis), mountain whitefish (Prosopium williamsoni), brown bullhead (Ictalurus nebulosus), smallmouth bass, chiselmouth (Acrocheilus alutaceus), northern squawfish (Ptychocheilus oregonensis), bridgelip sucker (Catostomus columbianus), largescale sucker (Catostomus macrocheilus), speckled dace (Rhinichthys osculus), longnose dace (Rhinichthys cataractae), redside shiner (Richardsonius balteatus), and Pacific lamprey (Entosphenus tridentatus).

Following impoundment, a Memorandum of Understanding between the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife

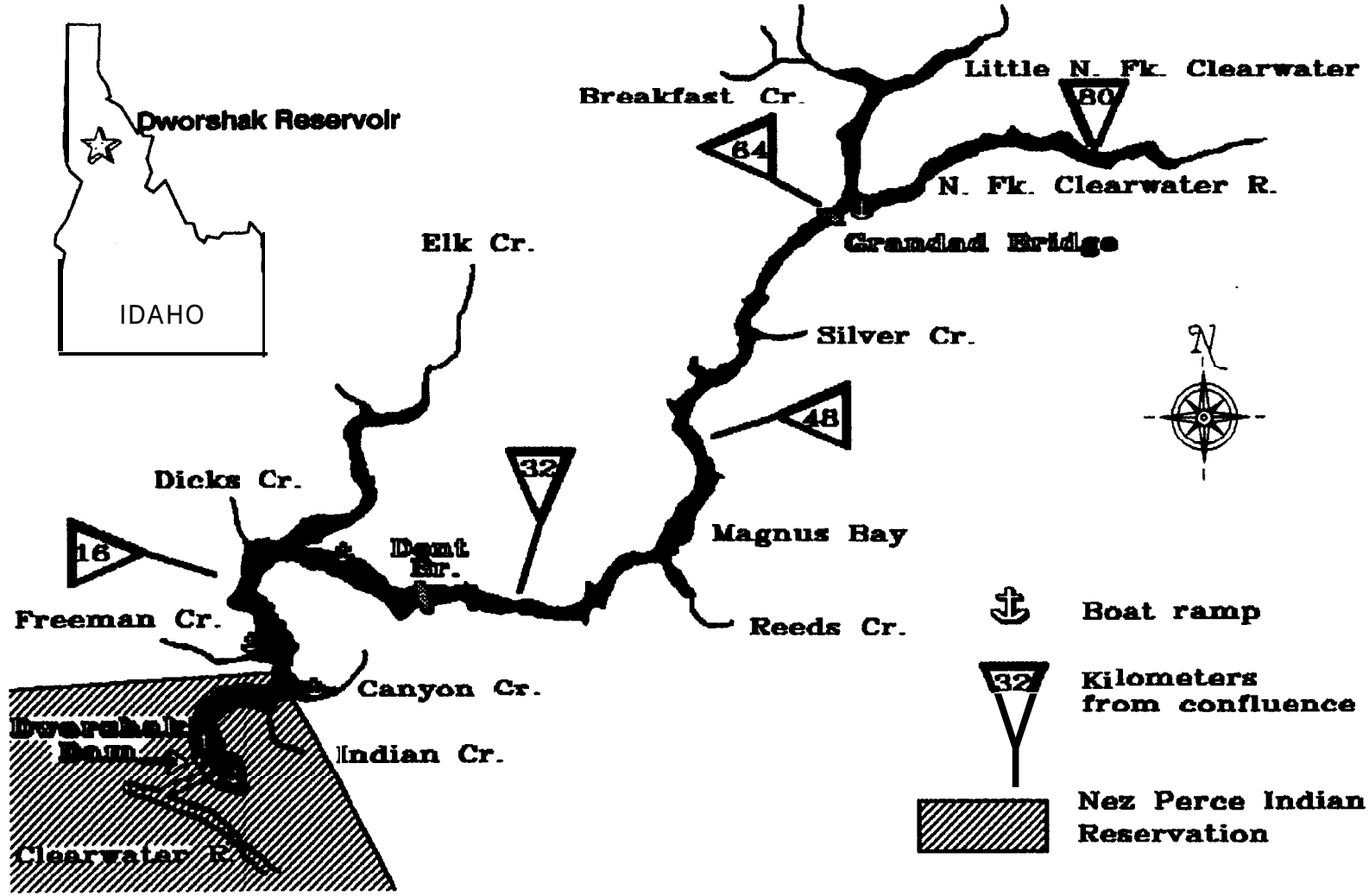


Figure 1. Dworshok Dam and Reservoir, North Fork Clearwater River, Idaho.

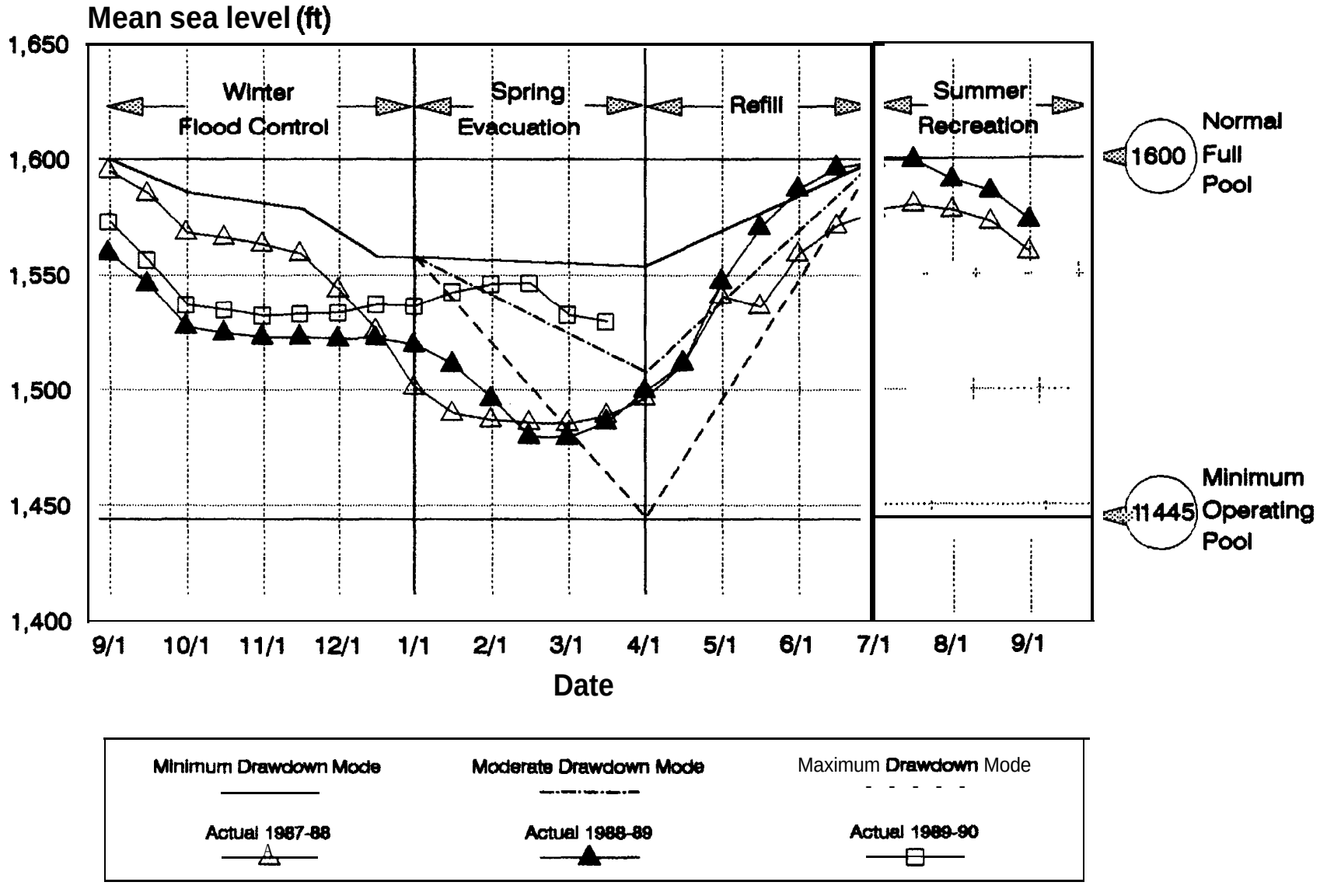


Figure 2. U.S. Army Corps of Egineers' operating curve for flood control and actual pool elevations for the 1987-88, 1988-89, and 1989-90 (partial) flood control cycles, Dworshak Reservoir, Idaho.

Service designated that 45,360 kg of resident fish be stocked annually to mitigate dam induced losses. A stocking program of various species, including cutthroat trout, bull trout, rainbow trout, smallmouth bass, and kokanee, followed (Miller 1987)(Table 1).

Horton (1981) reported that largemouth bass (Micropterus salmoides) entered the creel as early as 1976, apparently from contaminated smallmouth bass stocking. Horton (1981) also confirmed the presence of northern pike (Esox lucius), but indicated a low probability of a viable population becoming established. A lamprey ammocete was also collected by Horton while electrofishing near river mile 50. Lamprey parasitism on sport fish in Dworshak Reservoir has been reported by Ball and Pettit (1974), Pettit (1976), and Wallace and Ball (1978). Twenty-one fish species are currently known to inhabit Dworshak Reservoir (Table 2).

LIMNOLOGY AND HABITAT

Falter et. al (1979) characterized Dworshak Reservoir as a deep, coldwater reservoir with the lower 32.2 km being monomictic and the upper reservoir being dimictic. Falter's work showed that, after three years, the reservoir dropped from moderately productive to oligotrophic. Wave action on exposed side and bottom sediments was identified as a continuous source of turbidity. Phosphorus was noted as the nutrient generally limiting algal growth. Considering the pronounced oligotrophy of Dworshak Reservoir, Falter mentioned the possibility of using sterilized sewage wastes from recreation sites to stimulate productivity in certain embayments.

Tributary feeder streams influence reservoir habitat in the immediate inflow areas as well as in the major arms. Pettit (1976) stated that, because of the inflow of organisms in the vicinity of stream mouths, fish have a tendency to concentrate in these areas. Falter (1979) found water quality in Elk Creek Arm to be more similar to Elk Creek than the North Fork Clearwater River. During the 1977 low run-off year, Falter (1982) recorded a sharp early summer temperature increase in Elk Creek Arm, probably as a result of warm Elk Creek inflows.

Floating log rafts at specified log dump locations, such as Merry's Bay, Canyon Creek, and Little North Fork River, locally influence habitat parameters including water quality and cover. In situ bioassays by Falter et. al (1979) showed that log leachates generally increased algal production. A toxic response was noted in some algal genera. Pettit (1976) noted that invertebrates found in fish stomachs were associated with floating debris.

Fluctuations in water level, coupled with the characteristic

Table 1. Fish stocking into Dworshak Reservoir by year, 1972 through 1989.

Year	Species (size class) [1]	Number		Weight kg	Weight lbs	Fish/lb	Length (mm) [2]
1972	Rainbow trout						
	(catchables)	269026		---		---	---
	(fingerlings)	268060				---	---
	(fry)	505570		---	---	---	---
	Rbt total		1043456	45373	99941		
	Kokanee (fingerlings)		1012745	4620	10176	99.5	82
	Total		2056201	49993	110117		
1973	Rainbow trout						
	(catchables)	220526		53870	118657	1.9	279
	(fingerlings-large)	237900		2962	6524	36.5	104
	(fingerlings-small)	2086552		3077	6770	307.8	51
	Rbt total		2552978	59909	131959		
	Steelhead (adult)		834	--	--	---	---
	Kokanee (fingerlings)		591192	178	393	1504.3	33
	Smallmouth bass (fry)		50000	1	3	---	<25
	Total		3195004	60089	132355		
1974	Rainbow trout						
	(catchables)	16702		1715	3777	4.4	210
	(fingerlings)	750228		3375	7434	100.9	74
	Rbt total		766930	5090	11211		
	Steelhead (adult)		653	--	--	---	---
	Cutthroat trout (fingerlings)		45463	1037	2205	19.9	133
	Kokanee (fingerlings)		217300	908	1999	108.7	80
	Smallmouth bass (fingerlings)		105000	271	596	176.2	59
	Total		1135346	7305	16091		
1975	Rainbow trout						
	(catchables)	234695		48627	107107	2.2	264
	(fingerlings-large)	95520		1162	2560	37.3	103
	(fingerlings-small)	557506		240	529	1053.9	34
	Rbt total		887721	50029	110196		
	Cutthroat trout (fingerlings)		111010	362	797	139.3	70
	Bull trout (subcatchables)		122789	4843	10667	11.5	153
	Kokanee						
	early spawner (fingerlings)	74120		198	436	170	68
	late spanner (fingerlings)	3010753		1564	3446	873.7	40
	Kokanee total		3084073	1762	3882		
	Smallmouth bass (fingerlings)		100253	45	100	1002.5	33
	Total		4306646	57041	125642		

Table I (cont.). Fish stocking into Dworshak Reservoir by year, 1972 through 1989.

Year	Species (size class)	Number		Height kg	Height lbs	Fish/lb	Length (mm)
1976	Rainbow trout						
	catchables	97707		17982	39609	2.5	254
	fingerlings	615000		974	2146	206.6	52
	Rbt total		712707	18956	41755		
	Kokanee-late (fingerlings)		1326000	291	640	2071.9	30
	Smallmouth bass (fry)		50000	1	3	---	<25
	Total		2088707	19248	42398		
1977	Rainbow trout (various)		1162670	15535	34217	---	---
	Kokanee (fingerlings)		2450000	505	1113	2201.3	29
	Smallmouth bass (fry)		50000	7	15	3333.3	<25
	Total		3662670	1b047	35345	---	---
1978	Rainbow trout (various)		25936	6090	13414	---	---
1979	Rainbow trout						
	catchables	313088		35586	78384	4.0	217
	subcatchables	106906		4159	9161	11.7	152
	f ingerl ings	893530		2261	4981	179.4	61
	Rbt total		1313524	42007	92526		
	Kokanee (fingerlings)		1117464	447	985	1134.5	36
	Smallmouth bass (fry)		100000	9	20	5000.0	<25
	Total		2530988	42463	93531		
1980	Rainbow trout						
	catchables	75013		11478	25201	3.0	239
	fingerlings (large)	37200		1056	2325	16.0	137
	fingerlings (small)	1504232		3836	8449	178.0	61
	Rbt total		1616445	1b370	36055		
	Total		1616455	1b370	36055		
1981	Rainbow trout (various)	861429		39520	87049	---	---
1982	Rainbow trout [various)	153956		15863	34940	---	---
1983	Rainbow trout (various)	574255		26560	58503	---	---
1984	Rainbow trout (various)	67561		12387	27285	---	---
1985	Rainbow trout (catchables)	120000		18160	40000	3.0	239

Table 1 (cont.). Fish stocking into Dworshak Reservoir by year, 1972 through 1989.

Year	Species (size class)[1]	Number	Height kg	Height lbs	Fish/lb	Length (mm)[2]
1986	Rainbow trout					
	Shasta (subcatchables)	156773	6532	14388	10.9	156
1987	Rainbow trout					
	Kamloop (fingerlings)	93056	1705	3755	25.0	118
	Other (fingerlings)	80400	608	1340	60.0	88
	Total	174256	2313	5095		
1988	Rainbow trout					
	Arlee (subcatchables)	140910	5993	13200	10.7	157
	Shasta (subcatchables)	153998	6774	14920	10.3	158
	Total	294908	12766	28120		
1989	Rainbow trout					
	Arlee (subcatchables)	116271	5121	11280	10.3	158
	Shasta (subcatchables)	129109	5412	11920	10.8	156
	Total	245380	10533	23200		

[1] Size classes are defined as per Leitritz and Lewis (1980), as follows:

Size class	Criteria
fry	< 25.4mm (1 inch)
fingerling	> or = lb fish per pound
subcatchable	< lb and >6 fish per pound
catchable	< or = 6 fish per pound.

[2] Lengths were derived fror length-weight tables in Piper et. al (1982).

Table 2. Fish species inhabiting Dworshak Reservoir, Idaho (modified from Horton 1981).

Common Name	Scientific Name
Chiselmouth'	Acrocheilus alutaceus
Bridgelip sucker	Catostomus columbianus
Largescale sucker	Catostomus macrocheilus
Sculpin	Cottus spp.
Northern pike	Esox lucius
Pacific lamprey	Entosphenus tridentatus
Brown bullhead	Ictalurus nebulosus
Sunfish[2]	Lepomis spp.
Smallmouth bass	Micropterus dolomieui
Largemouth bass	Micronterus salmoides
Kokanee	Oncorhvnchus nerka
Black crappie[3]	Pomoxis nisromaculatus
Mountain whitefish	Prosopium williamsoni
Northern squawfish	Ptychocheilus oresonensis
Longnose dace	Rhinichthvs cataractae
Speckled dace	Rhinichthvs osculus
Redside shiner	Richardsonius balteatus
Cutthroat trout	Oncorhvnchus clarki
Rainbow trout	Oncorhvnchus mykiss
Bull trout	Salvelinus confluentus
Brook trout	Salvelinus fontinalis

[1] Chiselmouth were documented prior to impoundment. Ball and Cannon (1972) reported possible eradication from the 1971 squoxin treatment. Occurrence of chiselmouth was confirmed during 1988 project gill-netting.

[2] Occurrence of Lepomus spp. was confirmed during 1989 project gill netting.

[3] Occurrence of Pomoxis sp. reported by Roseberg (1988). Occurrence of Pomoxis nisromaculatis was confirmed by project gill-netting during 1988.

unstable steep-sided banks, essentially preclude establishment of rooted littoral vegetation. Rooted terrestrial vegetation does occur on some gentler slopes, however these areas are above the waterline during the reservoir evacuation period. Analysis of fish stomach contents by Pettit (1976) and Statler (1989) indicated that terrestrial insects, especially of the Order Hymenoptera, constitute a major portion of the diet of reservoir fish.

MATERIALS AND METHODS

CREEL SURVEY

Due to the large area1 extent of Dworshak Reservoir, the impoundment was divided into three sections: Dworshak Dam to Dent Bridge (Section I); Dent Bridge to Grandad Bridge (Section II); and Grandad Bridge to the upstream limit of the reservoir (Section III). These survey sections correspond to those used by Pettit (1976).

A stratified two-stage probability sampling regime as described by Malvestuto (1983) was employed using non-uniform probabilities commensurate with use data provided by CE. Sampling probabilities assigned were 0.8 for Section I, 0.1 for Section II and 0.1 for Section III. Thus, the area receiving the most fishing effort was sampled more frequently. CE use data and 1989 (Statler) angler effort data were utilized to adjust sampling probabilities to reflect seasonal use patterns.

Five weekdays and five weekend days per month were sampled to: (1) interview anglers for catch rates (fish per hour), (2) count anglers to determine fishing pressure (angler-hours) and (3) collect pertinent biological data from the creel. One A.M. angler count and one P.M. count were made on each sample day by boat. The A.M. angler count time was randomly selected and the interval between the A.M and P.M counts varied from 4.0 to 7.5 hours, depending on day length.

Monthly estimates of angler-hours were calculated as the product of the mean number of anglers per hour (mean instantaneous count) and the total monthly daylight hours (weekday and weekend). Catch rates were calculated for each species, as well as each identifiable hatchery rainbow trout strain, from monthly summaries of interview data. Monthly catch estimates were calculated as the product of the monthly catch rates of each species (or strain) and estimated effort.

Lengths, weights, scale samples, and stomach samples were taken from specimens observed in the creel.

The creel survey was conducted jointly with IDFG.

FISH ABUNDANCE AND DISTRIBUTION

Variable mesh horizontal gill nets were used to determine relative abundance and species composition. Nets used were 1.8 m by 45.8 m and consisted of six equal panels of 13, 19, 25, 38, 51, and 63 mm bar mesh monofilament. Net design was equivalent to that used by Ball and Cannon (1972) except for the addition of the 13 mm bar mesh panel.

Gill net sample sites approximated locations used by Pettit (1976) and Horton (1981). One floating and one sinking net were fished per sample set. Nets were set at dusk and retrieved the following morning.

Gill net data reported by Pettit (1976) were used as bases for comparison.

GROWTH

Hatchery Rainbow Trout Strains

Data collection for growth comparisons of Shasta and Arlee strain hatchery rainbow trout was initiated in the late spring of 1988. As of June 1989, both the Shasta and Arlee strains were represented by 1988 and 1989 release groups. All stocked rainbow trout were reared at Hagerman National Fish Hatchery, Hagerman, Idaho. Hatchery rearing was conducted to minimize differences between strains at time of release. Mean sizes of Shasta and Arlee strain rainbow trout released in 1989 were 156 mm and 158 mm, respectively (Table 3). Pre-release health evaluations were conducted for both strains and no differences in fish health were detected.

Project personnel were present during fish stocking to direct balanced releases at individual release sites. Fish were released from fish transportation trucks ferried to specific release sites by a CE barge.

The 1989 Shasta strain and Arlee strain release groups were marked with left ventral-adipose (lvad) and right ventral-adipose (rvad) fin clips, respectively. Length and weight data were obtained from anglers, gill netting and electro-fishing.

Smallmouth Bass

Length, weight and scale samples were obtained from anglers, hook and line sampling, gill netting and electro-fishing. As in Horton (1981), the relationship of the scale radius to total fish length was determined by linear regression. Acetate impressions were made from readable scales and were magnified (24X) for reading on a microfiche projector. Distances in mm from the focus to the outer edge of the scale (radius) and from the focus to the outer edge of each annulus were measured. The y-intercept of the body-scale regression was used for back-calculation of length at age, L_i, following the Lee formula as described by Carlander (1981):

Table 3. Date, location, number, weight and length of Shasta and Arlee strain rainbow trout released in Dworshak Reservoir by the U.S. Fish & Wildlife Service, 1989.

Date	Strain	Fin Clip	Location	Weight	Number	Fish/pound	Length (mm)
06/01/89	Shasta	lvad	Indian Creek	800	9144	11.43	153
06/01/89	Shasta	lvad	Canyon Creek	800	9144	11.43	153
06/01/89	Shasta	lvad	Canyon Creek	255	2915	11.43	153
06/01/89	Shasta	lvad	Canyon Creek	545	6289	11.54	152
06/01/89	Shasta	lvad	Freeman Creek	800	9232	11.54	152
06/01/89	Shasta	lvad	Freeman Creek	540	6232	11.54	152
06/01/89	Shasta	lvad	Freeman Creek	190	2084	10.97	155
06/01/89	Shasta	Lvad	Bruce's Eddy	800	8496	10.62	157
06/01/89	Shasta	lvad	Opposite Bruce's Eddy	800	8496	10.62	157
06/01/89	Shasta	lvad	Big Eddy	400	4248	10.62	157
06/01/89	Shasta	lvad	Big Eddy	400	4388	10.97	155
06/01/89	Shasta	lvad	Big Eddy	800	8776	10.97	155
06/01/89	Shasta	lvad	Point opposite Big Eddy	800	8776	10.97	155
06/06/89	Shasta	lvad	Dent Acres	800	8272	10.34	158
06/06/89	Shasta	lvad	Dent Acres	800	8272	10.34	158
06/06/89	Shasta	lvad	Dent Bridge	550	5687	10.34	158
06/06/89	Shasta	lvad	Dent Bridge	250	2535	10.14	159
06/06/89	Shasta	lvad	Elk Creek 0.8	790	8011	10.14	159
06/06/89	Shasta	lvad	Elk Creek 2.5	800	8112	10.14	159
06/06/89	Arlee	rvad	Dent Acres	774	7590	9.80	161
06/06/89	Arlee	lvad	Dent Acres	26	250	9.80	161
06/06/89	Arlee	rvad	Dent Acres	774	7590	9.80	161
06/06/89	Arlee	lvad	Dent Acres	26	250	9.80	161
06/06/89	Arlee	rvad	Dent Bridge	436	4273	9.80	161
06/06/89	Arlee	lvad	Dent Bridge	14	141	9.80	161
06/06/89	Arlee	rvad	Dent Bridge	350	3455	9.87	161
06/06/89	Arlee	rvad	Elk Creek 0.8	800	7896	9.87	161
06/06/89	Arlee	rvad	Elk Creek 2.5	800	7896	9.87	161
06/08/89	Arlee	rvad	Indian Creek	700	7616	10.88	156
06/08/89	Arlee	rvad	Canyon Creek	700	7616	10.88	156
06/08/89	Arlee	rvad	Canyon Creek	700	7616	10.88	156
06/08/89	Arlee	rvad	Freeman Creek	470	5114	10.88	156
06/08/89	Arlee	rvad	Freeman Creek	230	2450	10.65	157
06/08/89	Arlee	rvad	Freeman Creek	700	7455	10.65	157
06/08/89	Arlee	rvad	Bruce's Eddy	700	7455	10.65	157
06/08/89	Arlee	rvad	Opposite Bruce's Eddy	690	7349	10.65	157
06/08/89	Arlee	rvad	Big Eddy	800	8120	10.15	159
06/08/89	Arlee	rvad	Bid Eddy	790	8019	10.15	159
06/08/89	Arlee	rvad	Point opposite Big Eddy	800	8120	10.15	159
Subtotal Shasta and weighted mean length (mm)				11920	129109		156
Subtotal Arlee and weighted mean length (mm)				11280	116271		158
Total				23200	245380		

$$L_i = a + \frac{L_c - a}{S_c} S_i$$

Where a = y-intercept of the body-scale regression

L_c = length of the fish at capture

S_c = scale measurement to the edge of the scale

S_i = scale measurement to each annulus.

Mean length at age was obtained from back-calculated lengths. These data were used to fit the von Bertalanffy growth equation, $l_t = L_\infty (1 - e^{-K(t-t_0)})$. Per Everhart and Young (1981), a Walford plot of mean length at age n versus length at age n+1 was used to derive estimates of ultimate length, L_∞, and the growth coefficient, K. Linear regression of the natural logarithm of $L_\infty - L_t$ versus age t was used to determine t_0.

The resulting von Bertalanffy growth curve was compared to curves derived from 1988 (Statler 1989) and 1980 (Horton 1981) smallmouth bass data from Dworshak Reservoir.

SMALLMOUTH BASS POPULATION INDICES

Mortality

The total instantaneous mortality rate (Z) was estimated using a catch curve as described by Ricker (1975). The log, of the sample (y-axis) is plotted against age (x-axis), and the slope of the descending limb of the plot, with sign changed, approximates Z. The rate of exploitation from fishing (u) was estimated from angler tag recovery during the 1989 fishing season. Floy tags indicating a $5.00 reward for tag returns were inserted near the posterior base of the dorsal spiny rays on legal size smallmouth bass (1305 mm). Additional indices relative to smallmouth bass mortality were calculated as follows:

Survival rate	$S = e^{-Z}$
Total actual mortality	$A = 1 - S$
Instantaneous fishing mortality	$F = (Z / A) u$
Instantaneous natural mortality	$M = Z - F$.

Proportional Stock Density

Proportional stock density (PSD) (Anderson and Weithman 1978) was calculated for smallmouth bass collected by electro-fishing and gill netting during 1989. PSD for smallmouth bass is defined as follows:

$$\frac{\text{Number of fish 1280 mm}}{\text{Number of fish 1180 mm}} \times 100 = \text{PSD}$$

Smallmouth bass 1180 mm are considered to be stock size and those 1280 mm are quality size. Anderson and Weithman (1978) suggested that smallmouth bass populations with PSD near or within a range of 30-60 exhibit a favorable or balanced stock structure.

Relative Weight

Mean relative weight (W,) indices were calculated for four size groups (1100 mm, 101-200 mm, 201-300 mm, and >300 mm) of smallmouth bass from Dworshak Reservoir, with W_r defined as:

$$(W / W_s) \times 100 = W_r$$

Where W = individual weight of fish

W_s = length and species specific standard weight.

The length-weight equation identified by Anderson (1980) for calculation of length specific standard weights for smallmouth bass is:

$$\log W_s = -4.983 + 3.055 \log L$$

Where W_s = standard weight (gm)

L = total length (mm).

A mean W_r of 100 for a broad range of size groups within a population may reflect generally efficient utilization of available food resources. When mean W_r values fall well below 100 for a size group, problems exist in food and feeding relationships. W_r values well above 100 for a size group may indicate that fish within the population may not be making the best use of available prey.

FOOD HABITS

Stomach samples were collected from gill netting, electro-fishing, hook and line sampling and fish brought to the creel. Preserved stomach contents were labeled and sent to the University of Idaho aquatic entomology laboratory for identification, enumeration and volumetric analysis.

Hynes (1950), Usinger (1971) and Bowen (1983) cited limitations in the various approaches to quantitatively describe diet. For example, frequency of occurrence data describe the uniformity with which groups of fish select their diet, but do not indicate the importance of various types of food selected. The use of percent by number of different food items may give distorted results if the fish species ingests a large number of small prey. Usinger (1971) indicated that, until dietetic food values of food species are known, there is no practical advantage of weight values over volume. Bowen (1983) mentioned that hybrid indices developed to compensate for the perceived biases of individual methods have no biological basis for their interpretation.

To provide a diverse reference for analyzing diet, fish stomach contents were analyzed by percent by volume, percent by number, frequency of occurrence, and the Coefficient of Importance (C.I.) as used by Ersbak and Haase (1983).

RESULTS AND DISCUSSION

CREEL SURVEY

Creel survey data indicated an estimated 152,700 angler-hours were expended on Dworshak Reservoir from March 1989 through February 1990 to catch 33,820 fish (excluding kokanee), at an overall catch rate of .221 fish per hour (Figure 3). Monthly total fishing pressure for the period ranged from a low of 92 angler-hours during December 1989 to a high of 49,784 angler-hours during July 1989. The combined monthly catch rates (fish per hour) for all species excluding kokanee were highest during November (1.431), December (1.185), and January (.991). The highest estimated monthly catch for all species excluding kokanee was during June (18,313), comprising 54.1% of the total catch.

Bank angling constituted 4.1% of the total effort (6,257 angler-hours) and 7.2% (2,423) of the total catch (Figure 4.). Boat anglers accounted for 95.9% (146,443 angler-hours) of the total effort and 92.8% of the catch. Cumulative catch rates for the period for bank and boat anglers were .387 and .214 fish per hour, respectively.

An estimated 53.7% (3,357 angler-hours) of the bank angling occurred on weekdays and 46.3% (2,900 angler-hours) occurred on weekends (Figure 5.). Weekday activity for boat anglers accounted for 60.4% (88,487 angler-hours), while weekend fishing constituted 39.6% (57,956 angler-hours).

Bank angling peaked during April at 1,323 angler-hours for the month. All fishing effort expended from November 1989 through January 1990 was by bank anglers. Boat angling was highest from May through August, peaking in July at 48,776 angler-hours.

Total fishing pressure for sections I, II, and III was 105,817 (69.3%), 27,883 (18.3%), and 19,000 (12.4%), respectively (Figures 6 and 7). Section I produced the highest bank angling effort, catch and catch rates, at 5,023 angler-hours (80.2%), 2,263 fish (93.4%) and .450 fish per hour, respectively. Section I also supported the highest boat fishing effort, catch and catch rates, at 100,794 angler-hours (68.8%), 24,912 fish (79.3%) and .247 fish per hour, respectively.

The respective periods of highest bank fishing effort for sections I, II, and III were April, June and July. Boat angling in section I peaked in June, whereas sections II and III both peaked during July. Boat angling above Dent Bridge was virtually non-existent from October through February. Section III was closed to fishing from September 10 through February per state regulation.

Hatchery rainbow trout and naturally produced smallmouth bass

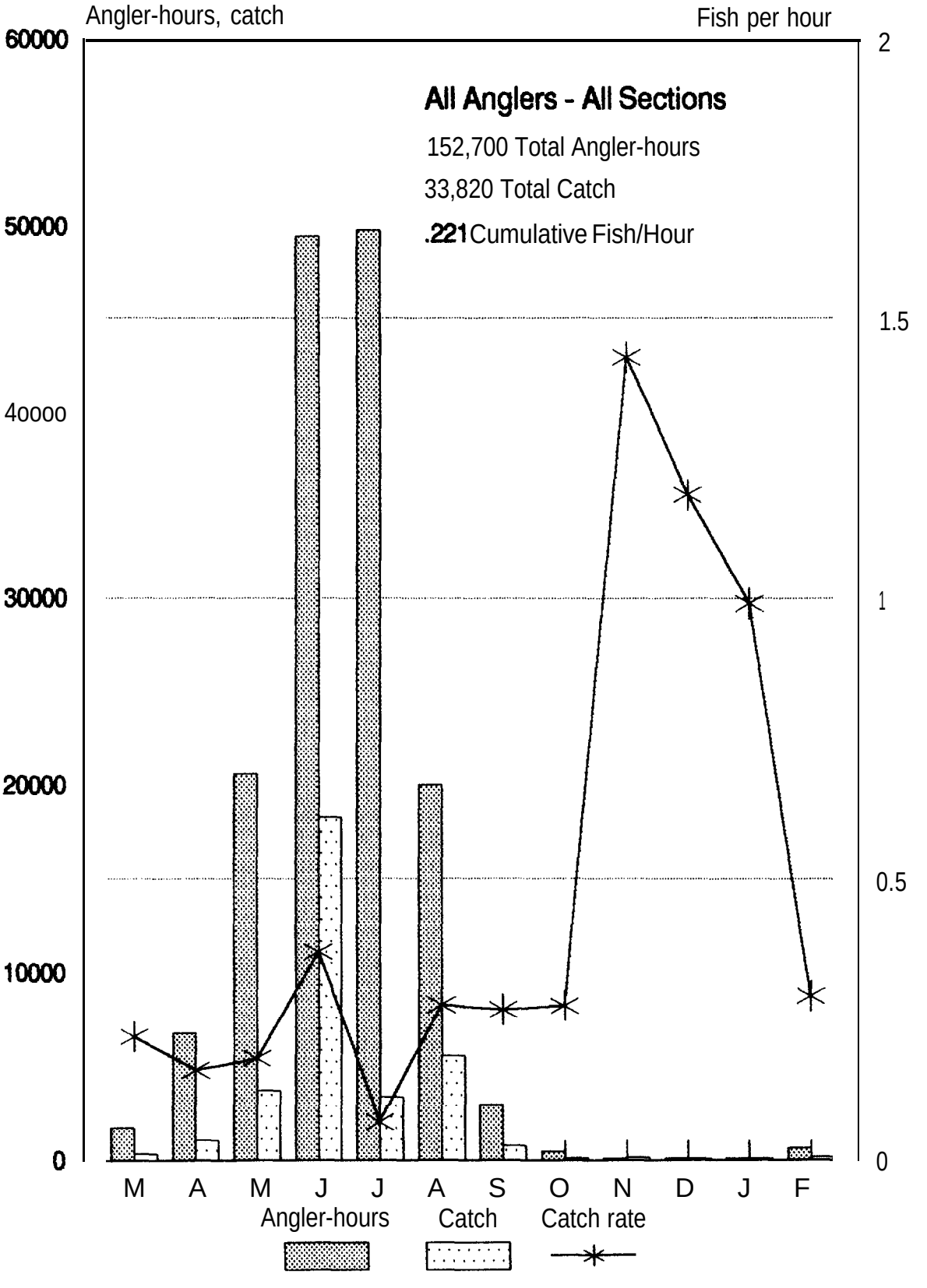


Figure 3. Total effort (angler-hours), catch and catch rate for species excluding kokanee, March 1989 through February 1990, Dworshak Reservoir. Idaho.

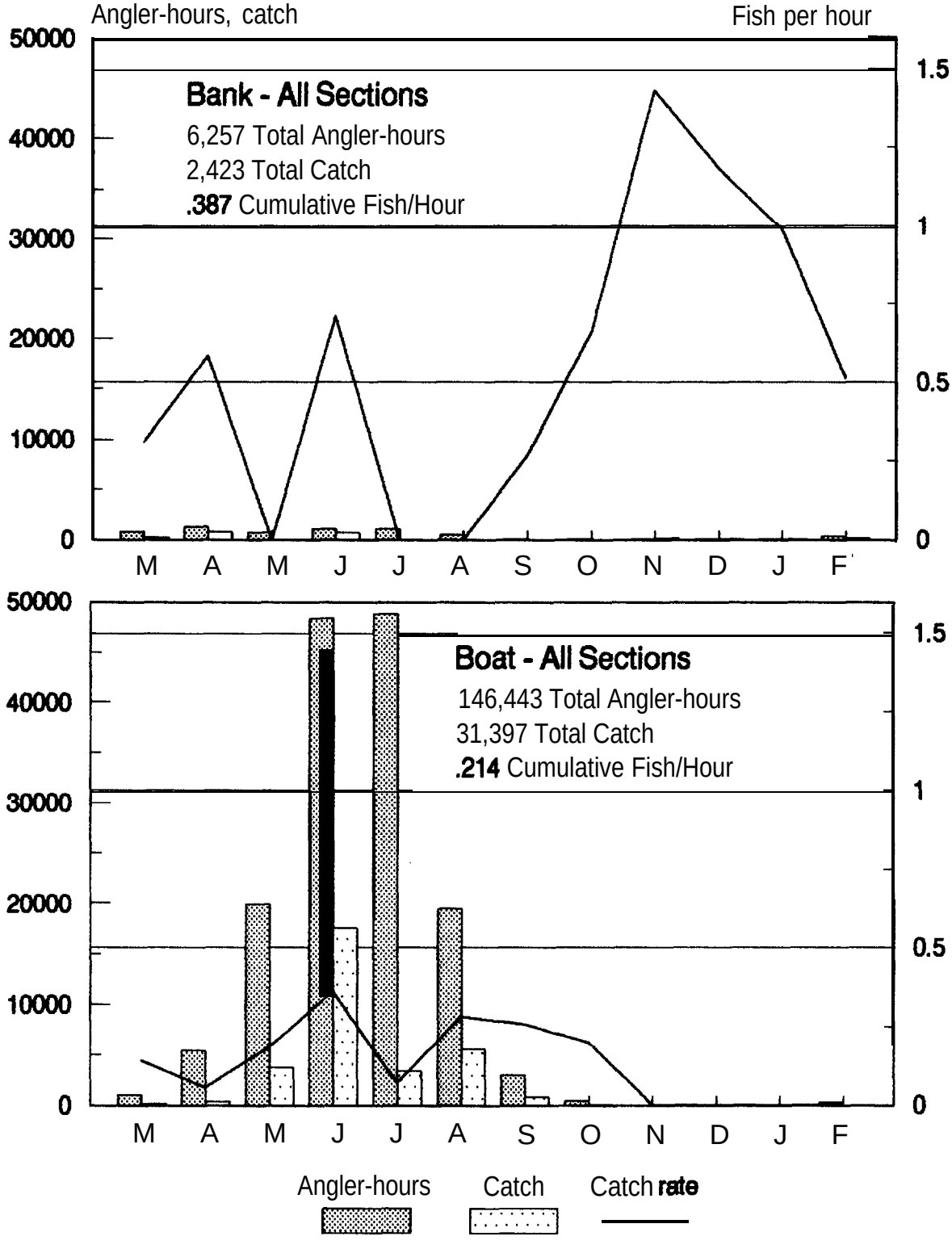


Figure 4. **Bank and boat angling effort (angler-hours), catch and catch rates for species excluding kokanee, March 1989 through February 1990, Dworshak Reservoir, Idaho.**

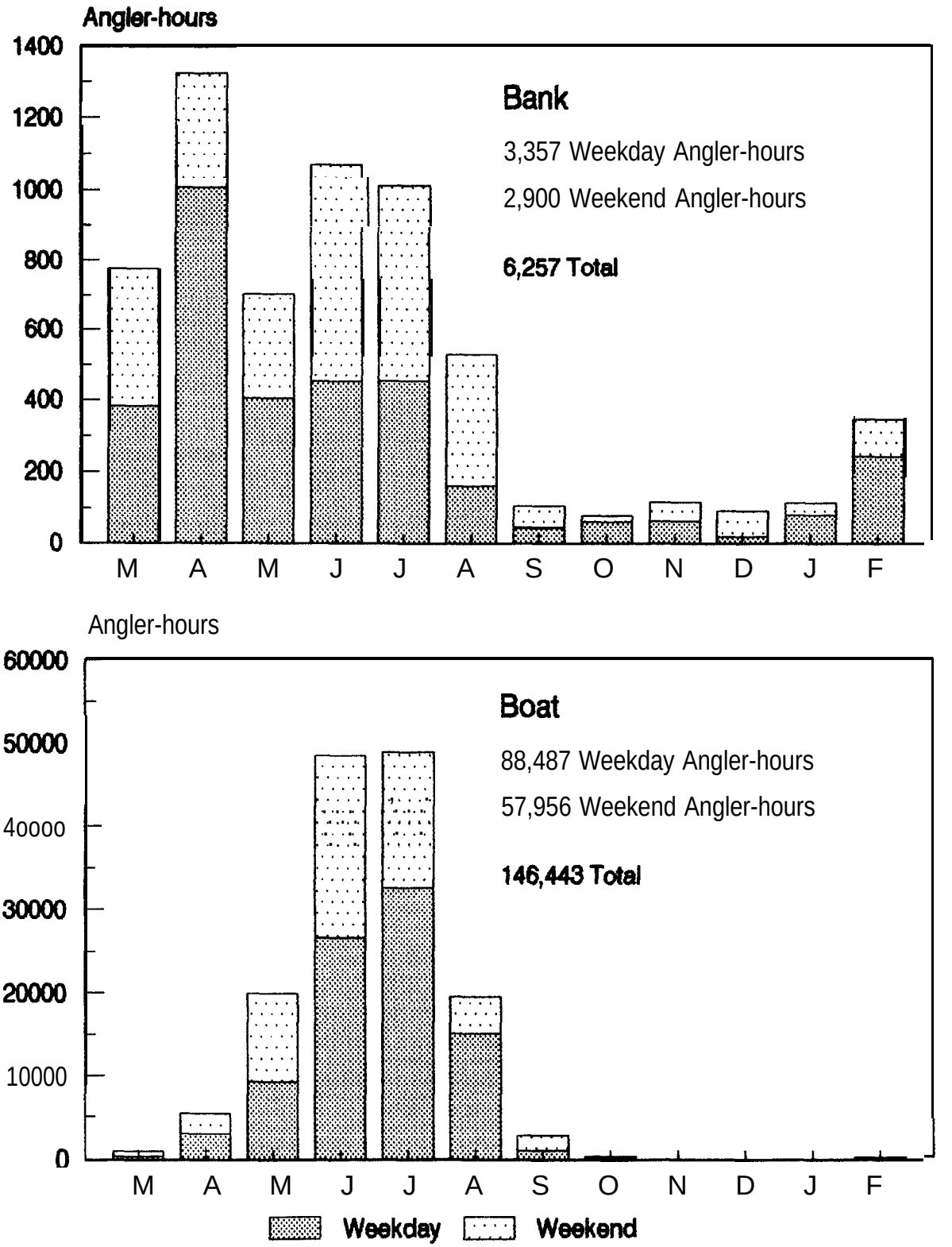


Figure 5. Monthly bank and boat fishing effort (angler-hours) during weekdays and weekends, March 1989 through February 1990, Dworshak Reservoir, Idaho.

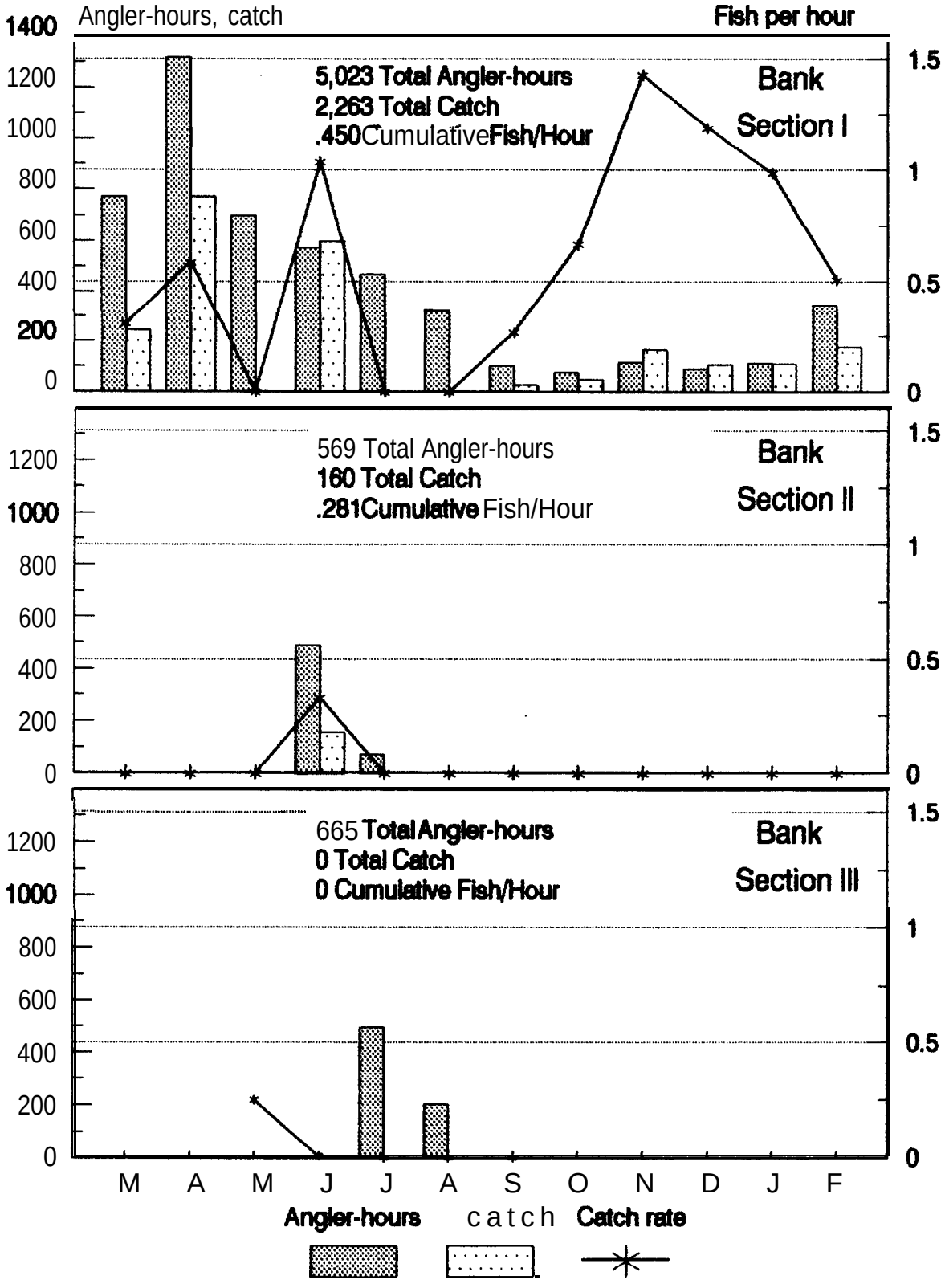


Figure 6. **Bank angling effort (angler-hours), catch, and catch rate by section for species excluding kokanee. March 1989 through February 1990. Dworshok Reservoir, Idaho.**

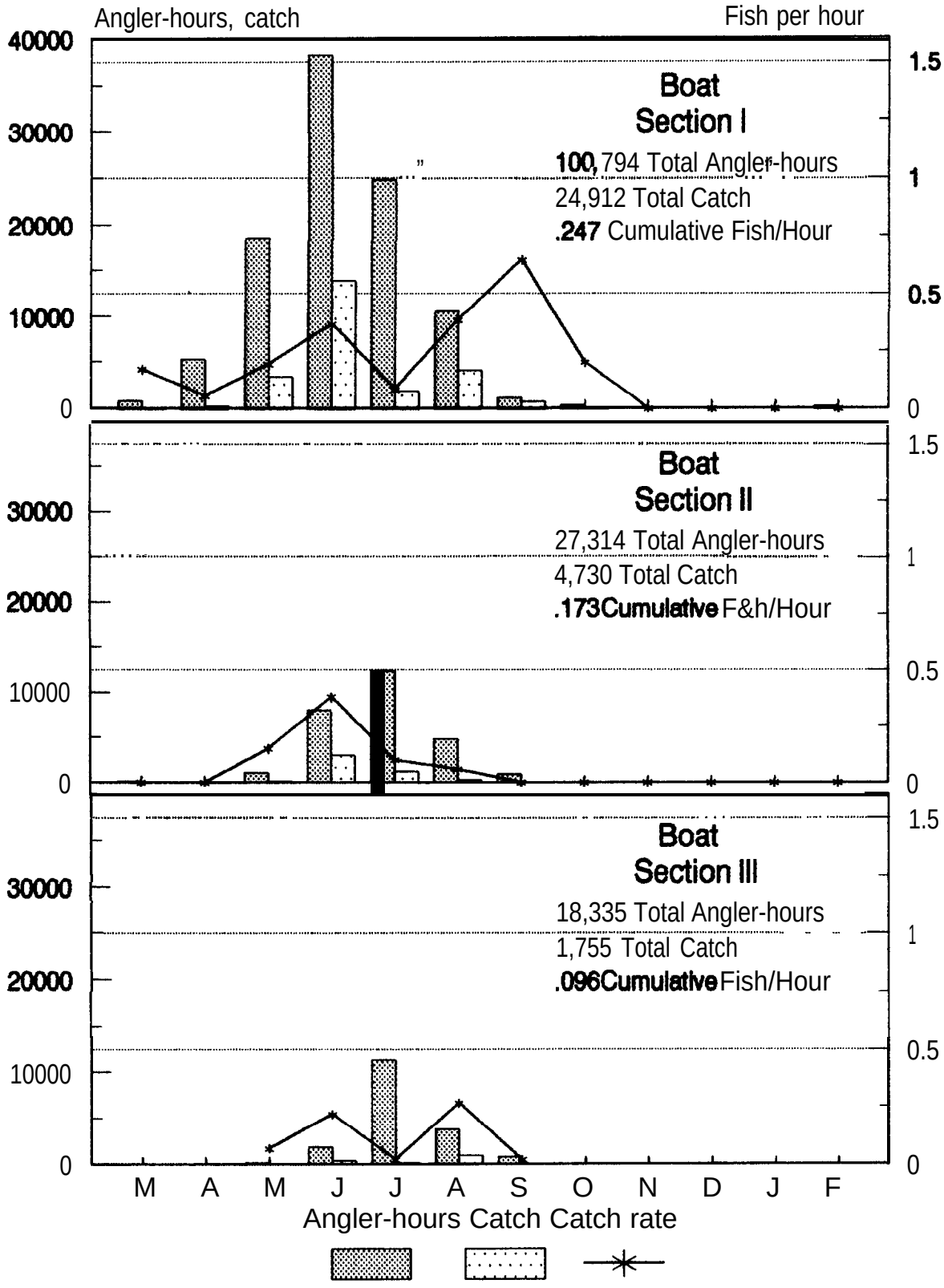


Figure 7. Boat angling effwt (angler-hours), catch and catch rate by section for species excluding kokanee, March 1989 through February 1990, Dworshak Reservoir, Idaho.

supported the highest catch rates, accounting for 59.2% (20,025) and 38.8% (13,064) of the total estimated catch, respectively. Rainbow trout and smallmouth bass comprised the bulk of the (non-kokanee) catch by both bank and boat anglers in all three sections (Tables 4, 5, 6, 7, 8, and 9)(Figures 8 and 9).

Cumulative bank angling catch rates for hatchery rainbow trout and smallmouth bass, all sections, were .278 and .093 fish per hour, respectively. Boat anglers caught hatchery rainbow trout and smallmouth bass at cumulative rates of .125 and .085 fish per hour, respectively. The respective catch rates for hatchery rainbow trout and smallmouth bass for bank and boat anglers (all sections) combined were .131 and .086 fish per hour.

Shasta and Arlee strain rainbow trout planted in 1988 were dominant in the catch during March and April. Following the June 1989 release of Shasta and Arlee strain rainbow trout, these groups generally dominated the hatchery trout catch. During October, however, the bank angling catch rate of . 338 fish per hour for the 1988 Shasta release group equalled that of the Shasta 1989 group.

Appearance in the creel of Shasta and Arlee strain rainbow trout released in June 1989 was immediate and dramatic. Boat anglers caught and released an estimated 14,189 small rainbow trout from June through September. This catch accounted for 42.0% of the total annual non-kokanee catch and 70.9% of the hatchery rainbow trout catch.

June, August and September provided the highest catch rates for smallmouth bass. Smallmouth bass under the 305 mm legal size limit (93.1%) were released. The estimated harvest of smallmouth bass was 895 (.006 overall harvest rate).

The Dworshak Reservoir fishery is dominated by boat anglers targeting on kokanee. This pattern is exemplified by the up-reservoir movement of boat anglers during late summer, corresponding to kokanee migration. The less intensive non-kokanee fisheries, primarily for rainbow trout and smallmouth bass, are localized, seasonal, and are generally more important to bank anglers than boat anglers. The winter fishery is essentially limited to bank anglers seeking rainbow trout at the most accessible areas near Dworshak Dam. Smallmouth bass fishing activity is primarily during the spring and late summer months.

Winter catch rates for rainbow trout are respectable, typically exceeding 1 fish per hour. The rainbow trout stocking program has concentrated on late spring releases of subcatchable trout (<16 and >6 fish per pound) since 1986. This approach has successfully provided several age/size groups of catchable size rainbow trout to the target fishery, due to the longevity of the fish in the system (Figure 10). Both the Shasta and Arlee strains appear to be suitable for this purpose.

Table 4. Estirated monthlv catch rates (fish per hour) for bank and boat anglers per species and strain from March 1989 through February 1990, Dworshak Dar to Dent Bridge (Section II, Drorshak Reservoir, Idaho.

Species/ Strain	March		April		May		June		July		August		September		October		November		December		January		February	
	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo
Shasta 3 rbt [1]	-	-	-	-		-	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.12	0.33	0.00	0.94	0.00	0.75	0.00	0.57	0.00	0.15	0.00
Arlee 2 rbt [2]		-	-			-	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.13	0.00	0.00	0.49	0.00	0.25	0.00	0.36	0.00	0.31	0.00
Shasta 2 rbt [3]	0.16	0.06	0.28	0.01	0.00	0.02	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arlee rbt [4]	0.10	0.01	0.21	0.00	0.00	0.01	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shasta 1 rbt [5]	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kamloops rbt	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wild rbt	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
Other rbt	0.02	0.09	0.03	0.03	0.00	0.02	0.17	0.25	0.00	0.05	0.00	0.00	0.00	0.17	0.00	0.20	0.00	0.00	0.06	0.00	0.07	0.00	0.00	0.00
Bull trout	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.05	0.00
Smallmouth bass	0.00	0.00	0.00	0.00	0.00	0.13	0.74	0.09	0.00	0.00	0.00	0.35	0.27	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al 1 species/ strains	0.31	0.17	0.59	0.05	0.00	0.19	1.04	0.37	0.00	0.08	0.00	0.39	0.27	0.65	0.67	0.20	1.43	0.00	1.19	0.00	0.99	0.00	0.51	0.00
Da and bo combined	0.24		0.16		0.18		0.38		0.07		0.37		0.62		0.27		1.43		1.19		0.99		0.29	

1 Shasta strain rainbow trout planted in 1989.

2 Arlee strain rainbow trout planted in 1989.

3 Shasta strain rainbow trout planted in 1988.

4 Arlee strain rainbow trout planted in 1988.

5 Shasta strain rainbow trout planted in 1986.

Table 5. Estimated ronthlv catch rates (fish per hour) for bank and boat anglers per soecies and strain from March 1989 through February 1990, Dent Bridge to Grandad Bridge (Section II), Dworshak Reservoir, Idaho.

Species/ Strain	March		April		May		June		Julv		August		September		October		Noverber		December		January		February	
	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo
Shasta 3 rbt [1]	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arlee 2 rbt [2]	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shasta 2 rbt [3]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arlee rbt [4]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shasta 1 rbt [5]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kamloops rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wild rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.22	0.00	0.08	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bull trout	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smallmouth bass	0.00	0.00	0.00	0.00	0.00	0.12	0.26	0.13	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
411 species/ strains	0.00	0.00	0.00	0.00	0.00	0.15	0.33	0.38	0.00	0.10	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ba and bo combined	0.00		0.00		0.15		0.37		0.10		0.04		0.00		0.00		0.00		0.00		0.00		0.00	

[1] Shasta strain rainbow trout olanted in 1989.

[2] Rrlee strain rainbow trout olanted in 1989.

[3] Shasta strain rainbow trout planted in 1988.

[4] Arlee strain rainbow trout planted in 1988.

[5] Shasta strain rainbow trout planted in 1986.

Table 6. Estirated ronthlv catch rates (fish per hour) for bank and boat anglers per species and strain from March 1989 through February 1990, Grandad Bridge to end of pool (Section III), Dworshak Reservoir, Idaho.

Species/ Strain	March		April		May		June		July		August		Septerber		October		November		December		January		February	
	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo
[1] Shasta 3 rbt	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
[2] Arlee 2 rbt	-	-	-	-	-	-	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
[3] Shasta 2 rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
[4] Arlee rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
[5] Shasta 1 rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Kamloops rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wild rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other rbt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.01	0.00	0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bull trout	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Smallmouth bass	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.17	0.00	0.00	0.00	0.25	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
All species/ strains	0.00	0.00	0.00	0.00	0.25	0.07	0.01	0.22	0.00	0.02	0.00	0.27	0.00	0.02	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ba and bo combined	0.00		0.00		0.07		0.22		0.02		0.26		0.02		n/a		n/a		n/a		n/a		n/a	

[1] Shasta strain rainbow trout planted in 1989.

[2] Arlee strain rainbow trout planted in 1989.

[3] Shasta strain rainbow trout planted in 1988.

[4] Arlee strain rainbow trout planted in 1988.

[5] Shasta strain rainbow trout planted in 1986.

Table 7. Estirated ronthlv catch for bank and boat anglers per species and strain fror March 1989 through February 1990, Dworshak Dar to Dent Bridge (Section I), Dworshak Reservoir, Idaho.

Species/ Strain	March		April		May		June		July		Auqus t		September		October		Noverber		December		January		February	
	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo
[1] Shasta 3 rbt	-	-	-	-	-	-	0	307	0	474	0	0	0	132	26	0	109	0	69	0	64	0	53	0
[2] Arlee 2 rbt	-	-	-	-	-	-	0	154	0	125	0	346	0	150	0	0	57	0	23	0	40	0	107	0
[3] Shasta 2 rbt	126	46	369	43	0	373	50	384	0	0	0	0	0	0	26	0	0	0	0	0	0	0	0	0
[4] Arlee rbt	74	11	277	lb	0	168	25	230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[5] Shasta 1 rbt	0	0	19	0	0	0	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kamloops rbt	30	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wild rbt	0	0	19	0	0	168	0	77	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0
Other rbt	12	75	37	174	0	373	100	9442	0	1297	0	0	0	188	0	80	0	0	6	0	8	0	0	0
Bull trout	0	0	37	lb	0	56	0	0	0	0	0	0	0	0	0	0	0	0	b	0	0	0	18	0
Smallmouth bass	0	0	0	lb	0	2331	425	3339	0	0	0	3823	28	262	0	0	0	0	0	0	0	0	0	0
Other	0	0	19	0	0	56	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All species/ strains	244	133	775	293	0	3524	600	14086	0	1896	0	4169	28	731	51	80	166	0	109	0	112	0	178	0
Ba and bo combined	376		1068		3524		14686		1896		4169		759		131		166		109		112		178	

[1] Shasta strain rainbow trout planted in 1989.

[2] Arlee strain rainbow trout planted in 1989.

[3] Shasta strain rainbon trout planted in 1988.

[4] Arlee strain rainbow trout planted in 1988.

[5] Shasta strain rainbow trout planted in 1986.

Table 6. Estimated monthly catch for bank and boat anglers oer species and strain from March 1989 through Februarv 1990, Dent bridge to Grandad Bridge (Section III), Dworshak Reservoir, Idaho.

Species/ Strain	March		April		May		June		July		August		Septeaber		October		November		December		January		February	
	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo
Shasta 3 rbt [1]							0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ariee 2 rbt [2]							0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shasta 2 rbt [3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arlee rbt [4]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shasta 1 rbt [5]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Karlooos rbt	0	0	0	0	0	0	0	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wild rbt	0	0	0	0	0	0	0	112	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0
Other rbt	0	0	0	0	0	0	32	1749	0	1016	0	189	0	0	0	0	0	0	0	0	0	0	0	0
Bull trout	0	0	0	0	0	28	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth bass	0	0	0	0	0	136	128	1051	0	136	0	63	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All species/ strains	0	0	0	0	0	163	160	3025	0	1251	0	291	0	0	0	0	0	0	0	0	0	0	0	0
Da and bo combined	0		0		163		3185		1251		291		0		0		0		0		0		0	

1 Shasta strain rainbon trout planted in 1989.

2 Arlee strain rainbow trout planted in 1989.

3 Shasta strain rainbow trout planted in 1988.

4 Arlee strain rainbow trout planted in 1988.

5 Shasta strain rainbow trout planted in 1986.

Table 9. Estirated ronthlv catch for bank and boat anglers per species and strain from March 1989 through February 1990, Grandad Bridge to end of pool (Section III), Dworshak Reservoir, Idaho.

Species/ Strain	March		April		May		June		July		August		September		October		Novenber		December		January		February	
	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo	ba	bo
Shasta 3 rbt[1]							0	0	0	0	0	27	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Arlee 2 rbt[2]							0	0	0	57	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Shasta 2 rbt[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Arlee rbt[4]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Shasta 1 rbt[5]	0	0	0	0	0	0	0	28	0	0	0	0	0	11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Karloops rbt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wild rbt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	nia	n/a	n/a	n/a	n/a	n/a
Other rbt	0	0	0	0	0	0	0	83	0	160	0	54	0	11	n/a	n/a	nla	nla	n/a	n/a	n/a	n/a	n/a	n/a
Bull trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Smallmouth bass	0	0	0	0	0	12	0	331	0	0	0	982	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Al l soeciesl strain5	0	0	0	0	0	12	0	442	0	217	0	1063	0	21	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Ba and bo combined	0		0		12		442		217		1063		21		0		0		0		0		0	

1 Shasta strain rainbow trout planted in 1989.

2 Arlee strain rainbow trout planted in 1989.

3 Shasta strain rainbow trout planted in 1988.

4 Arlee strain rainbow trout planted in 1988.

5 Shasta strain rainbow trout planted in 1986.

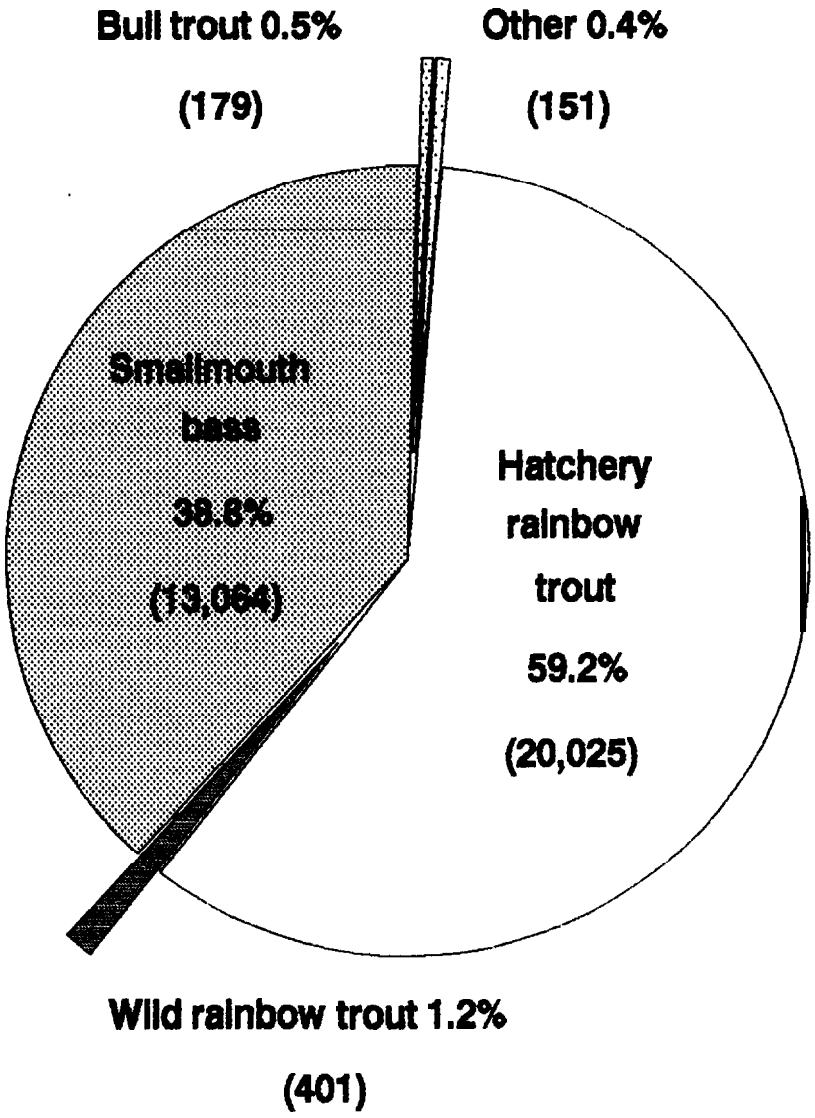


Figure 8. Percentages of total estimated catch for hatchery produced rainbow trout and naturally produced species, March 1989 through February 1990, Dworshak Reservoir, Idaho.

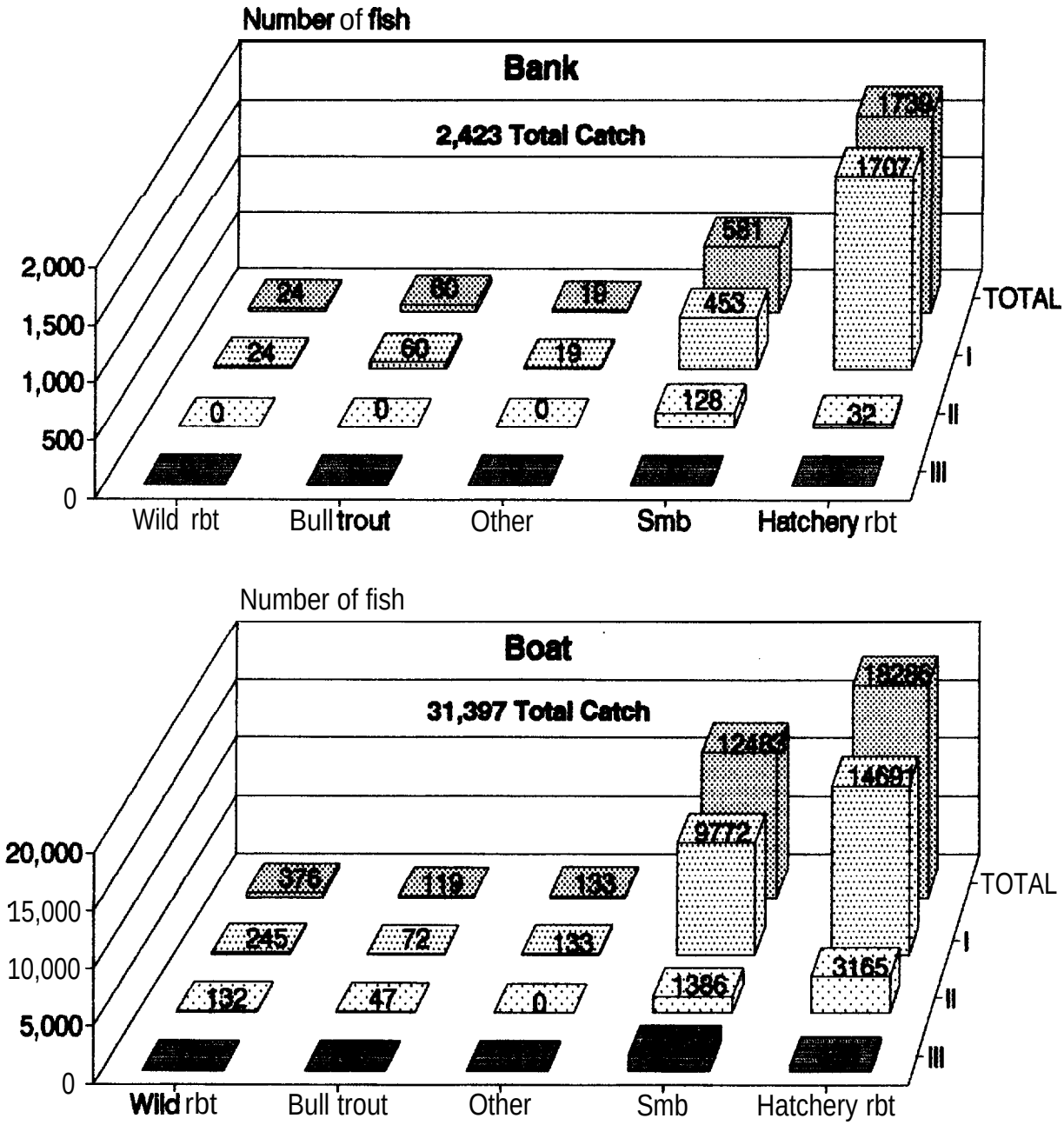
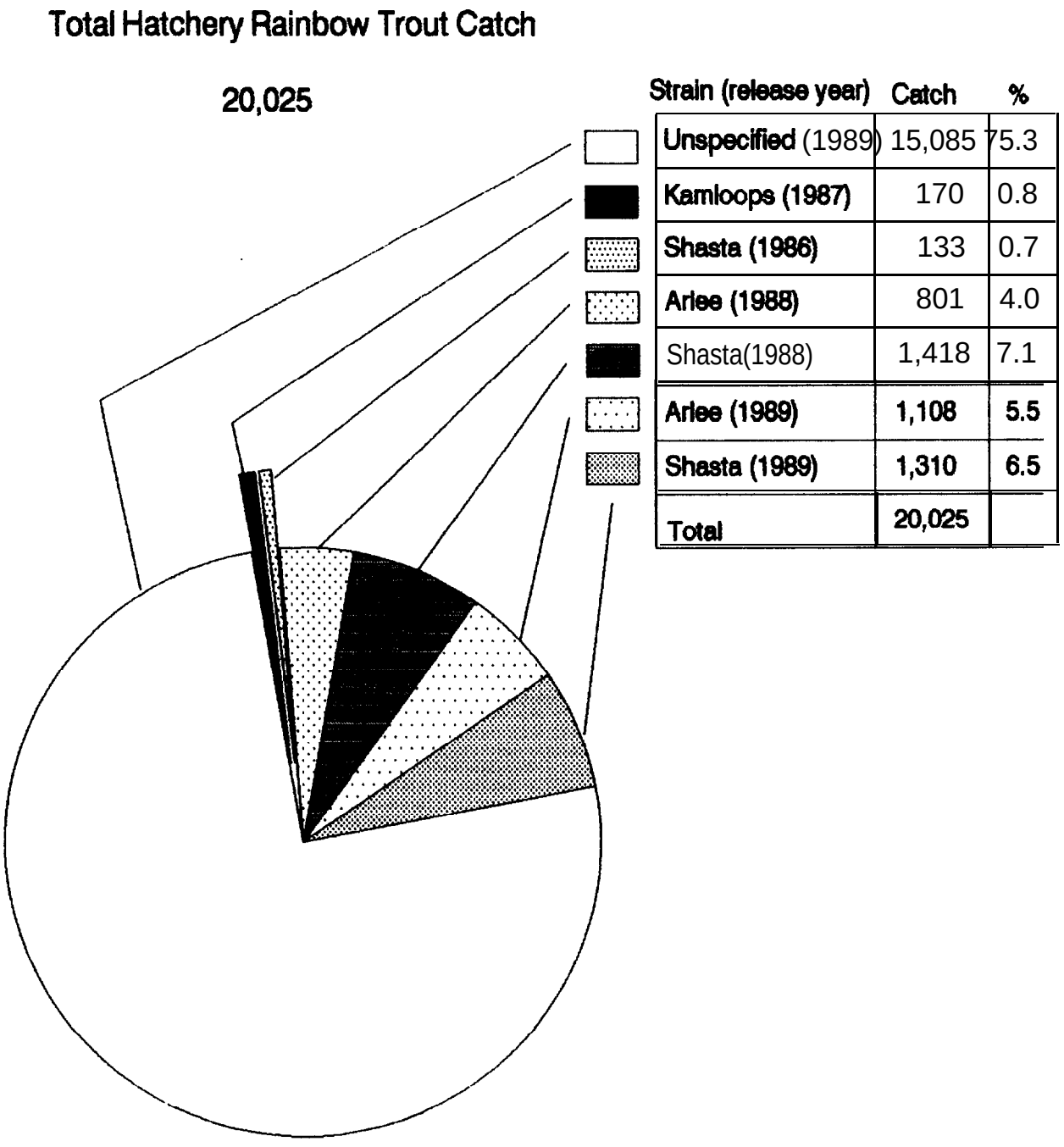


Figure 9. Catch estimates for bank and boat anglers per section for hatchery produced rainbow trout and naturally produced species. March 1989 through February 1990, Dworshak Reservoir, Idaho.



Strain (release year)	Catch	%
Unspecified (1989)	15,085	75.3
Kamloops (1987)	170	0.8
Shasta (1986)	133	0.7
Arlee (1988)	801	4.0
Shasta(1988)	1,418	7.1
Arlee (1989)	1,108	5.5
Shasta (1989)	1,310	6.5
Total	20,025	

Figure 10. Catch composition of hatchery rainbow trout by strain and year of release, 1989. Dworshak Reservoir, Idaho.

Improved fishing for trout anglers in Dworshak Reservoir may be accomplished by increasing the number of subcatchables stocked and/or reducing the incidental catch of subcatchables by the non-target kokanee anglers. The size of hatchery fish to be released during 1990 will be reduced by approximately 20 mm and stocked about three weeks earlier. Immediate post-release catches of these fish will be monitored to determine the affect on catchability.

The smallmouth bass fishery in Dworshak Reservoir merits attention because this is a naturally self-sustaining resource that provides a substantial portion of the non-kokanee catch. Increasing and sustaining the availability of legal size (2305 mm) bass should be a prime consideration in the management of this species. These criteria will be addressed in the final report, scheduled for completion December 31, 1991.

FISH ABUNDANCE AND DISTRIBUTION

A total of 224 fish were gill netted during 321.5 net-hours of effort (.70 fish per hour) at locations throughout the reservoir from April through August, 1989 (Table 10) (Appendix A). Smallmouth bass comprised 32.6% of the catch, followed by squawfish (27.7%), suckers (27.2%), rainbow trout (3.1%) and other trout (2.2%). Other species including kokanee and chiselmouth made up 7.1% of the catch. No redside shiners were collected.

The 1989 overall catch rate of .70 fish per net-hour was essentially the same as the 1988 catch rate of .67 fish per net-hour (Figure 11). Relative abundance of smallmouth bass in the catch increased and rainbow trout decreased.

Current catch rates and relative abundance of smallmouth bass compared with prior years suggest that this species is well established throughout the reservoir and bass numbers may be increasing.

Historical comparisons of total gill net catch rates suggest that overall fish production has stabilized subsequent to the post-fill rise and fall cycle experienced in the 1970's.

GROWTH

Hatchery Rainbow Trout Strains

Fish lengths obtained during the winter rainbow trout fishery indicated that growth rates were virtually identical for the two strains (Shasta and Arlee) of rainbow trout released in June 1989 (Figure 12). Measurements made from November 1989 through February 1990 showed mean lengths for the 1989 Shasta and Arlee groups to

Table 10. Horizontal gill net catch and catch rate by species and strains, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type[1]	Net-hours	Rainbow trout: Shasta 1988	Rainbow trout: Shasta 1989	Rainbow trout: Wild	Other trout	Smb	Kok	Sq	Su	Other	Total
04/27/89	Elk Cr. Arm	f	13.2	1				1	2	1	1		6
04/27/89	Elk Cr. Arm	s	12.5						1	1	1		3
04/27/89	Magnus Bay	f	15.0			1	1		1	3			6
04/27/89	Magnus Bay	s	15.8							1	1		2
04/28/89	Cranberry Cr.	f	12.5				2		1	1			4
04/28/89	Cranberry Cr.	s	12.5										0
04/29/89	Reed's Cr.	f	16.4				1			3	1		5
04/29/89	Reed's Cr.	s	17.2							1	2		3
05/31/89	Herry's Bay	f	15.8								2		2
05/31/89	Herry's Bay	s	15.8	1		1							2
05/31/89	Herry's Bay	s	16.0						3	2			5
05/31/89	Herry's Bay	s	16.0						2	1			3
06/01/89	Freeman Cr.	f	13.8			1		1	2	1	2		7
06/01/89	Freeman Cr.	f	14.8					1					1
06/01/89	Freeman Cr.	s	13.6					1			1		2
07/10/89	L.N.Fk. Arm	f	14.0							6			6
07/10/89	L.N.Fk. Arm	5	14.8		1					8	9		18
07/28/89	Elk Cr. Arm	f	14.0							3			3
07/28/89	Elk Cr. Arm	s	14.0					1		1			2
07/28/89	Elk Cr. Arm	5	14.0		1			1		1			3
08/16/89	Sal. Landing	f	14.8					7	1	18	14		40
08/16/89	Sal. Landing	s	15.0				1	60	1	10	27	2	101
Totals			321.5	2	2	3	5	73	14	62	61	2	224
Catch rate				0.01	0.01	0.01	0.02	0.23	0.04	0.19	0.19	0.01	0.70

[1] Floating net indicated by "f" and sinking net indicated by "s."

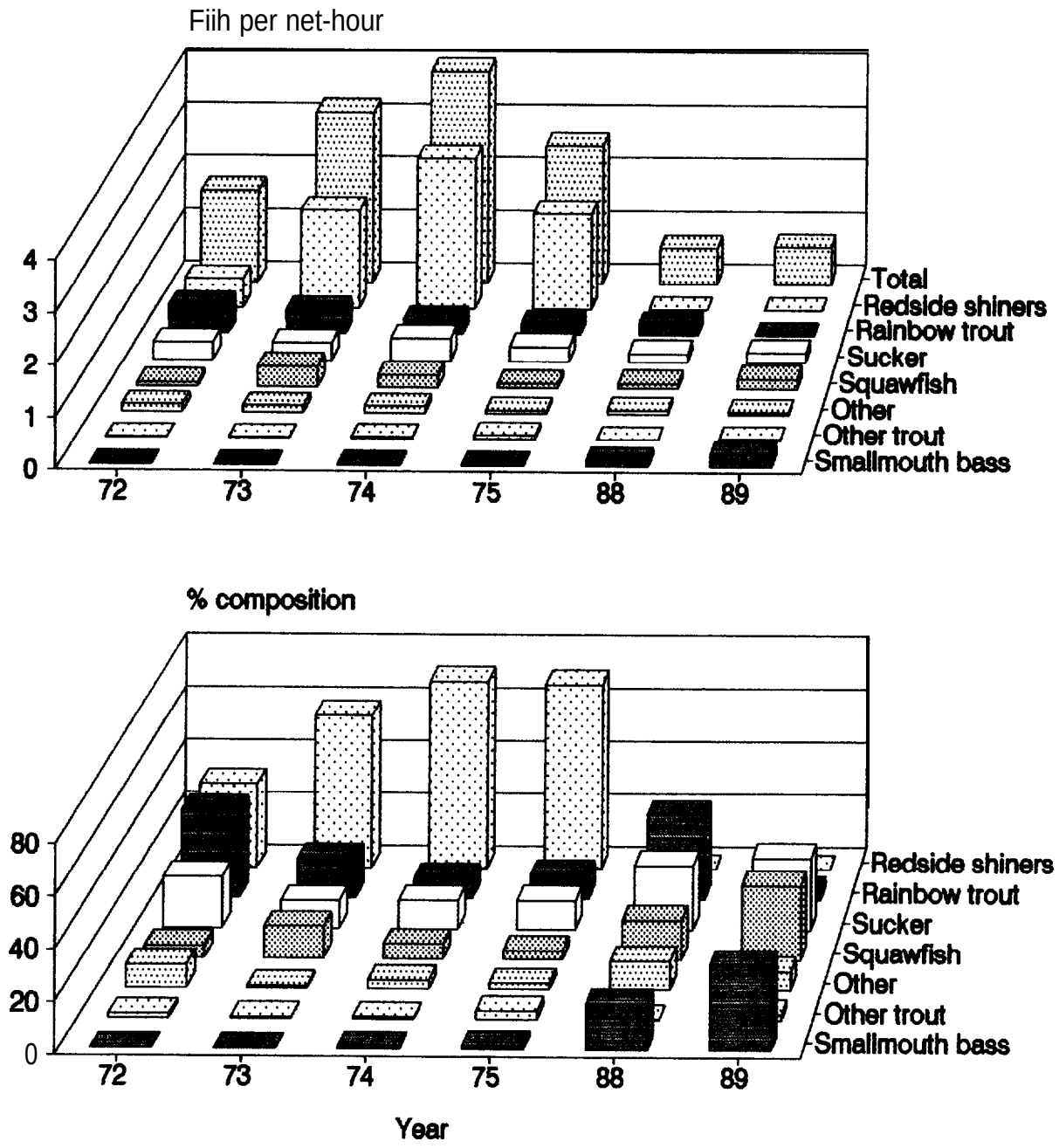


Figure 11. **Annual reservoir-wide horizontal gill net catch rates and percent species composition from 1972 through 1989, Dworshak Reservoir, Idaho.**

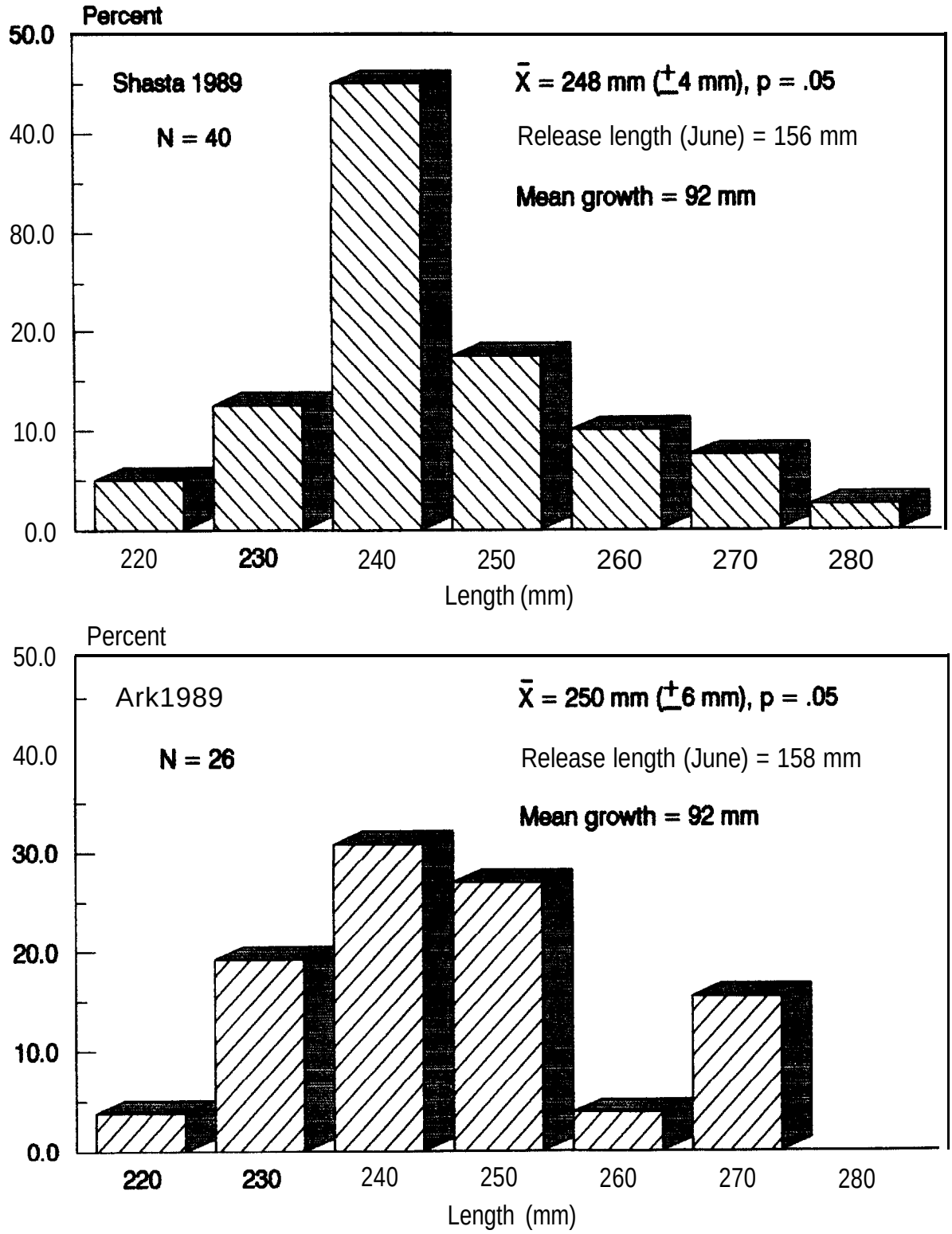


Figure 12. Length frequencies, mean lengths and length increases of 1989 release groups of Shasta and Arlee strain rainbow trout sampled from the creel, November 1989 through February 1990, Dworshak Reservoir, Idaho.

be 248 mm and 250 mm, respectively. Respective condition (K) factors for the Shasta and Arlee strains for the same winter period were 84.2 ±3.3 (n=14, p=.05) and 89.1 f3.8 (n=10, p=.05).

The above weight and length comparisons for the Shasta and Arlee strains approximate earlier comparisons made by Statler (1989). Data for two consecutive annual releases do not show appreciable differences among these two strains.

Smallmouth Bass

The mean length for 316 smallmouth bass collected from electro-fishing and gill netting was 153 mm (Figure 13). The strong correlation (r^2=.96) for the body-scale linear regression representing 176 smallmouth bass collected during 1989 was similar to that reported by Statler (1989) for 66 bass collected during 1988 (Figure 14).

Mean length at age data for 1989 indicated excellent early growth, averaging 90 mm at age I (Table 11). This compares closely with age-length data for 1988, which showed a mean age I length of 99 mm. Expected age at recruitment to legal size (305 mm) is age V.

Von Bertalanffy growth equations for 1988 and 1989 are comparable, and both indicate a considerable reduction in smallmouth bass growth rate and ultimate size since 1980 (Figure 15). Despite the post-1980 decline in growth rates of smallmouth bass, Dworshak Reservoir bass continue to exhibit better than average growth when compared to the mean growth compiled by Bennett et al. (1986) for bass populations at similar latitudes. Dworshak smallmouth bass approximate a slow growth pattern as described by Anderson and Weithman (1978).

SMALLMOUTH BASS POPULATION INDICES

Mortality

Catch curve analysis for 242 smallmouth bass sampled during 1989 conveys an estimated instantaneous mortality rate (Z) of .495 (Figure 16). Estimates for survival rate (S) and total actual mortality (A) are . 610 and .390, respectively. Segregated analysis for the unexploited portion of the population (ages 0 through 4) provides virtually identical mortality indices.

A total of 34 smallmouth bass 1305 mm were marked with Floy tags offering a $5.00 reward for return of the tag. Five of the 34 were returned. Because an estimated 24.1% of the smallmouth bass harvest occurred prior to marking, an adjustment in tag return equivalents was calculated to correct for pre-tagging exploitation, as follows:

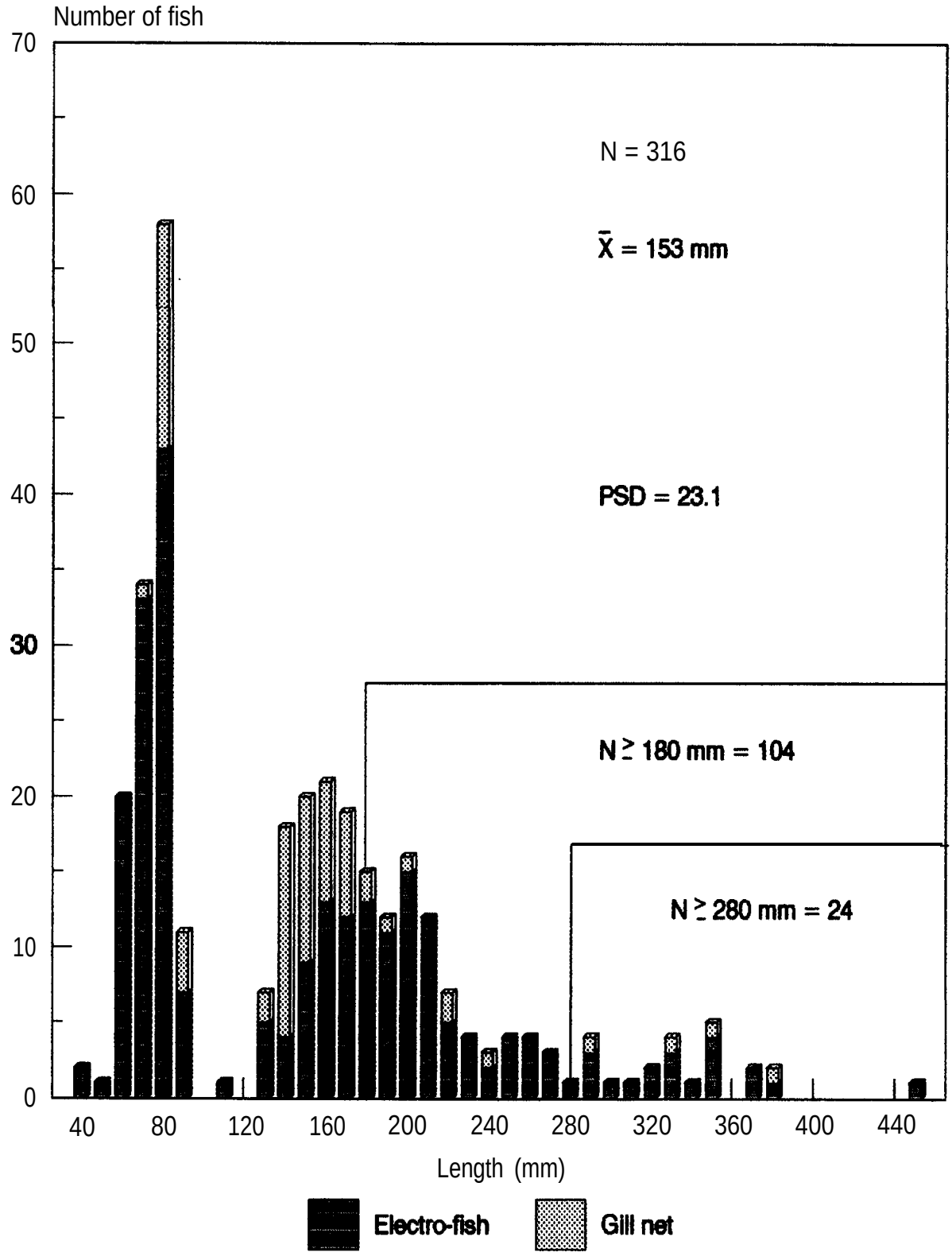


Figure 13. **Length frequency, mean length (n = 316) and proportional stock density (PSD) (n = 104) for smallmouth bass, 1989, Dworshak Reservoir, Idaho.**

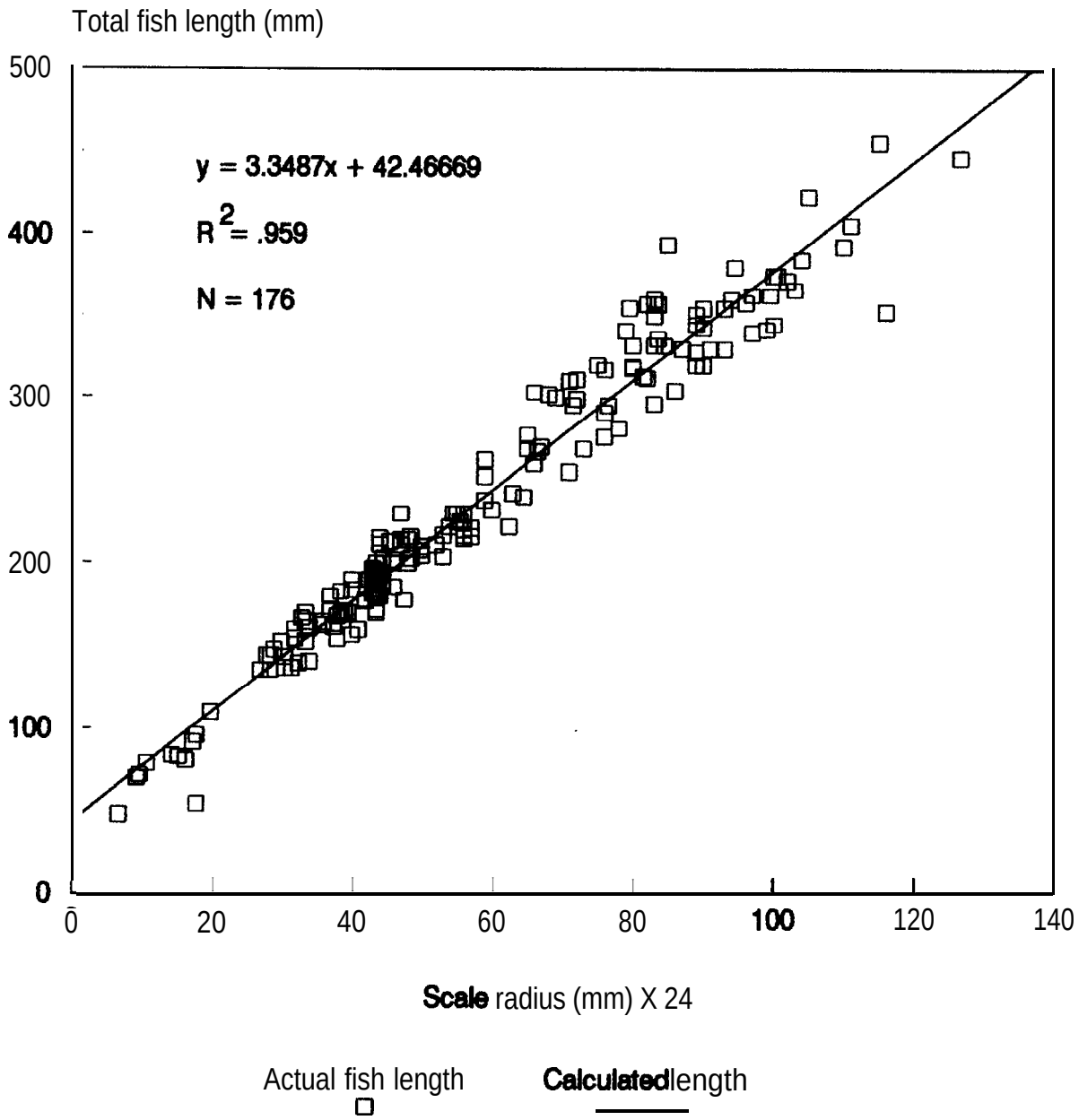


Figure 14. **Body-scale regression for 176 smallmouth bass, 1989, Dworshak Reservoir, Idaho.**

Table 11. Calculated total lengths (mm) at each annulus and annual increments of growth for 168 smallmouth bass, 1989, Dworshak Reservoir, Idaho.

Age class	Year class	Number of fish	Calculated mean length at each annulus (mm) 1	2	3	4	5	6	7	8	9	10
I	1988	17	97.3									
II	1987	39	97.0	155.6								
III	1986	44	89.9	160.7	199.7							
IV	1985	26	Bb.4	164.2	227.4	273.8						
V	1984	21	83.3	160.5	216.3	262.2	302.0					
VI	1983	12	8B.1	146.1	196.3	256.8	302.2	334.2				
VII	1982	8	81.1	144.9	203.3	258.0	305.2	344.9	381.2			
VIII	1981	0										
IX	1980	0										
X	1979	1	85.6	143.1	189.9	233.1	267.2	314.0	366.1	394.9	418.2	447.0
Number of fish			168	151	112	68	42	21	9	1	1	1
Weighted mean length			90.4	157.8	209.0	264.7	301.8	337.3	379.5	394.9	418.2	447.0
Mean growth increment			90.4	b7.4	51.2	55.7	37.1	35.5	42.2	15.4	23.3	28.8

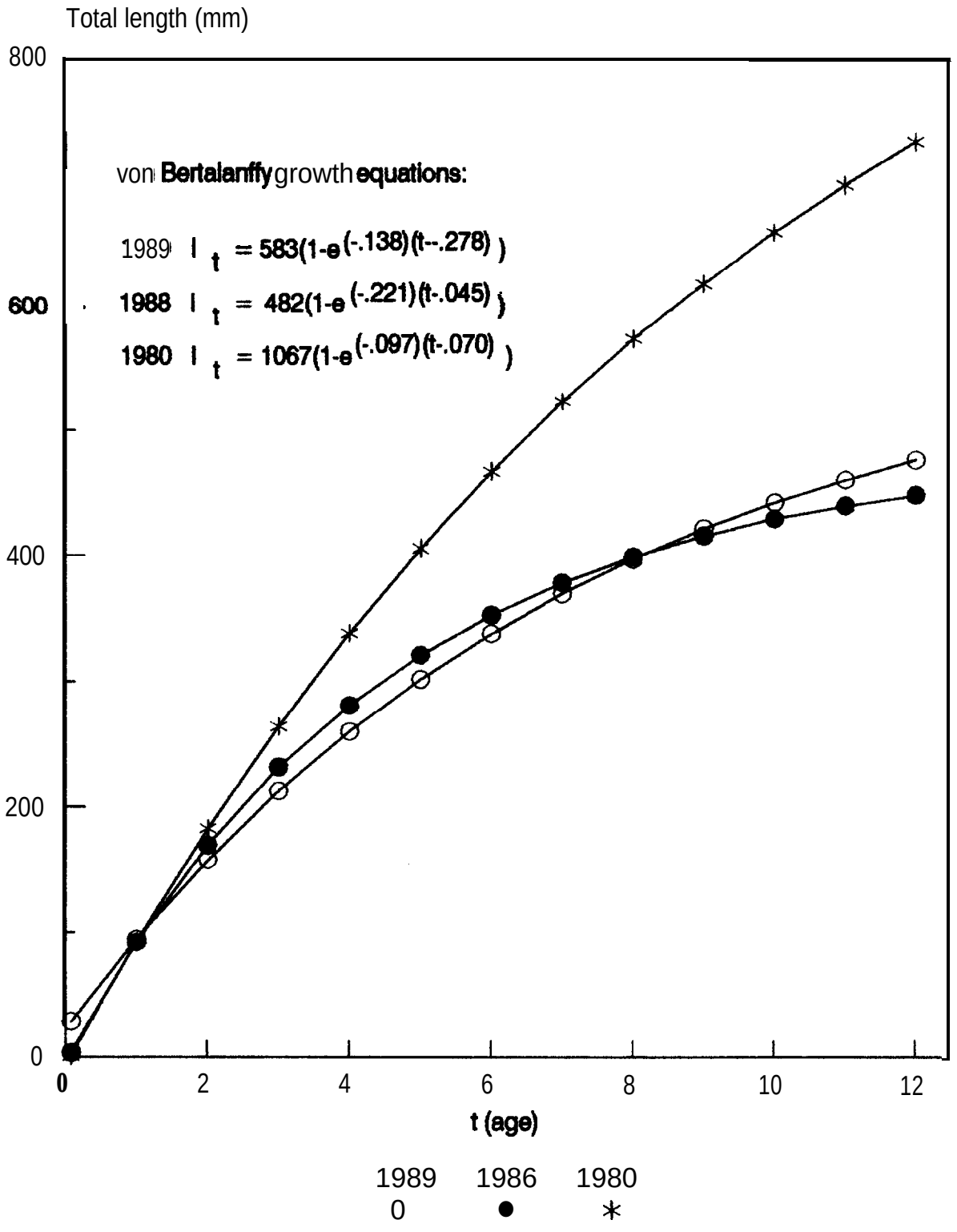


Figure 15. **Von Bertalanffy growth equations for smallmouth bass based on collections during 1989, 1988. and 1980 (Horton 1981), Dworshak Reservoir, Idaho.**

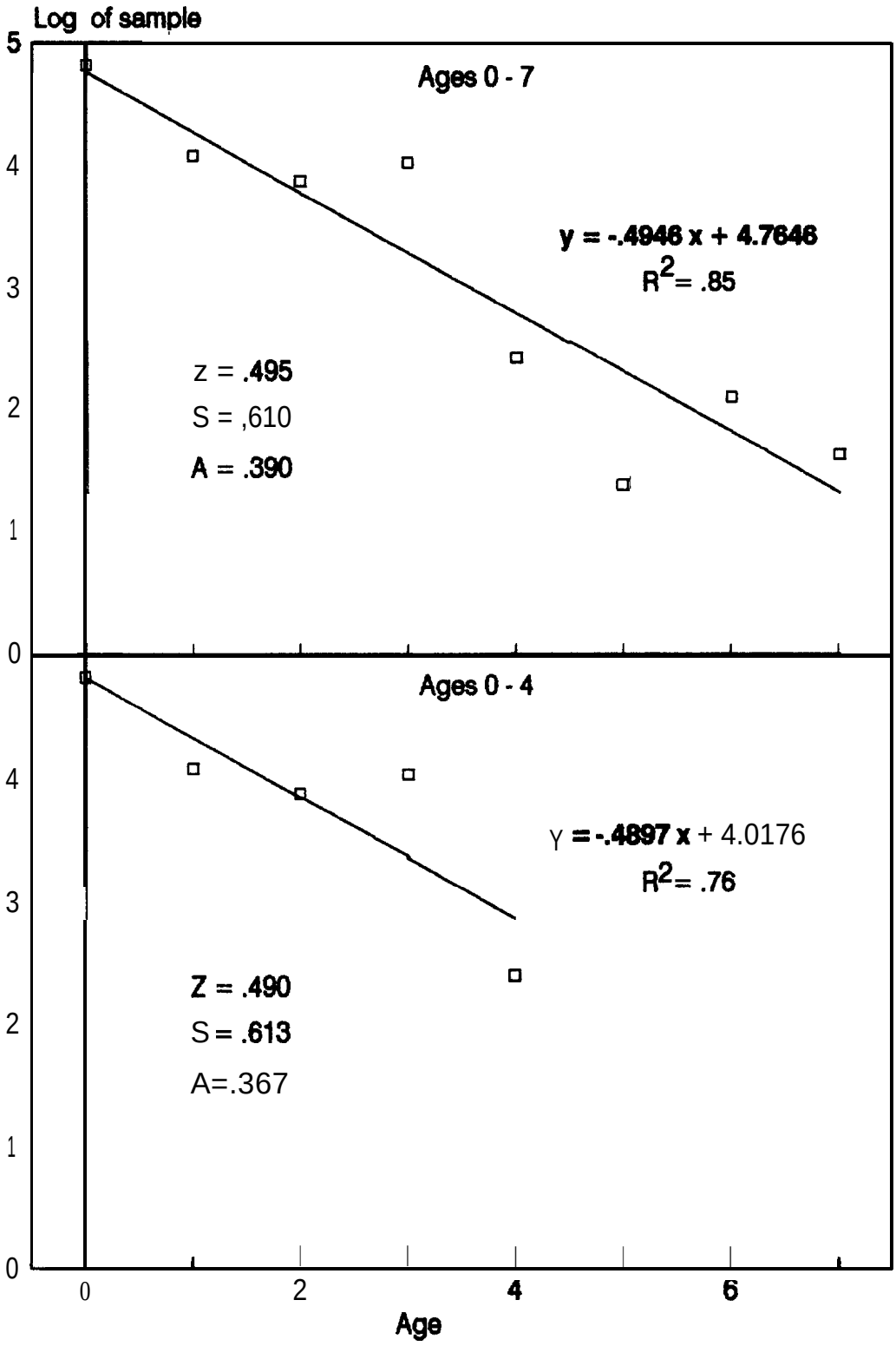


Figure 16. **Catch curves, instantaneous mortality (Z), survival rate (S) and total actual mortality (A) for ages O-7 and O-4 as estimated from 242 smallmouth bass collected by electro-fishing during 1989, Dworshak Reservoir, Idaho.**

$$\frac{5}{X} = \frac{75.9}{100}$$

Where X = adjusted tag equivalents = 7.

The estimated 1989 exploitation rate (u) for legal size bass, with the above correction factor, is 7/34 = .206. The estimated instantaneous fishing mortality (F) equals .261 and instantaneous natural mortality (M) equals .234.

Mortality indices suggest a moderate total actual (annual) mortality that is not appreciably influenced by the current rate of exploitation of age V and older bass.

Proportional Stock Density

Gill netting and electro-fishing during 1989 produced a total of 104 smallmouth bass 2180 mm and 24 bass 2280 mm, for a PSD of 23.1 (Figure 13). This PSD value is close to the PSD of 22 proposed by the Anderson and Weithman (1978) smallmouth bass population model depicting moderate total annual mortality (.43) with slow growth. The population structure of stock and quality sized smallmouth bass in Dworshak Reservoir is reasonably balanced commensurate with current productive capacity.

Relative Weight

The mean relative weight (W_r) for 302 smallmouth bass collected from Dworshak Reservoir during 1989 was 91.4 (Figure 17). Mean relative weight values per size group ranged from 88.0 for bass 101-200 mm to 95.8 for bass 1100 mm. Smallmouth bass from 101-300 mm exhibited the lowest relative weights, which may be indicative of greater competition for food within these size groups.

FOOD HABITS

Rainbow Trout

Too few stomachs from Shasta and Arlee strain rainbow trout were collected during 1989 to warrant quantitative analysis. Limited data provided for 1988 by Statler (1989) showed considerable similarity in food habits of the two strains, with Cladocera and terrestrial insects being of major importance.

Smallmouth Bass

Stomach samples were taken from 65 smallmouth bass during 1989. Thirteen (20.0%) of the stomachs were empty. Ephemeroptera and fish occurred most often in the greatest numbers, thus registering the highest Coefficient of Importance (C.I.) values (Figure 18)(Appendix B). Fish dominated the composition of food

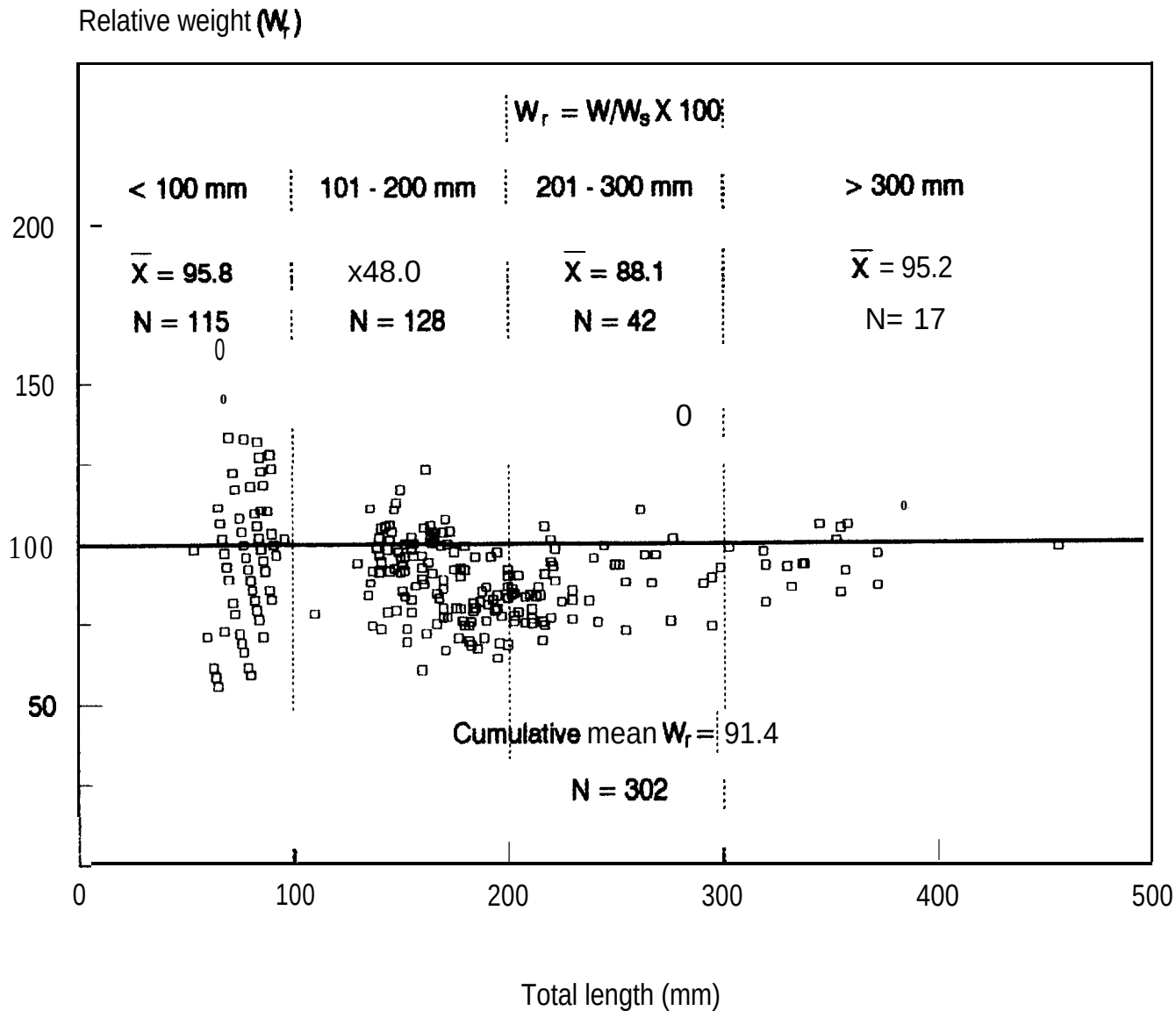


Figure 17. Mean relative weight (W_r) for 302 smallmouth bass and mean W_r values per size class, 1989, Dworshak Reservoir, Idaho.

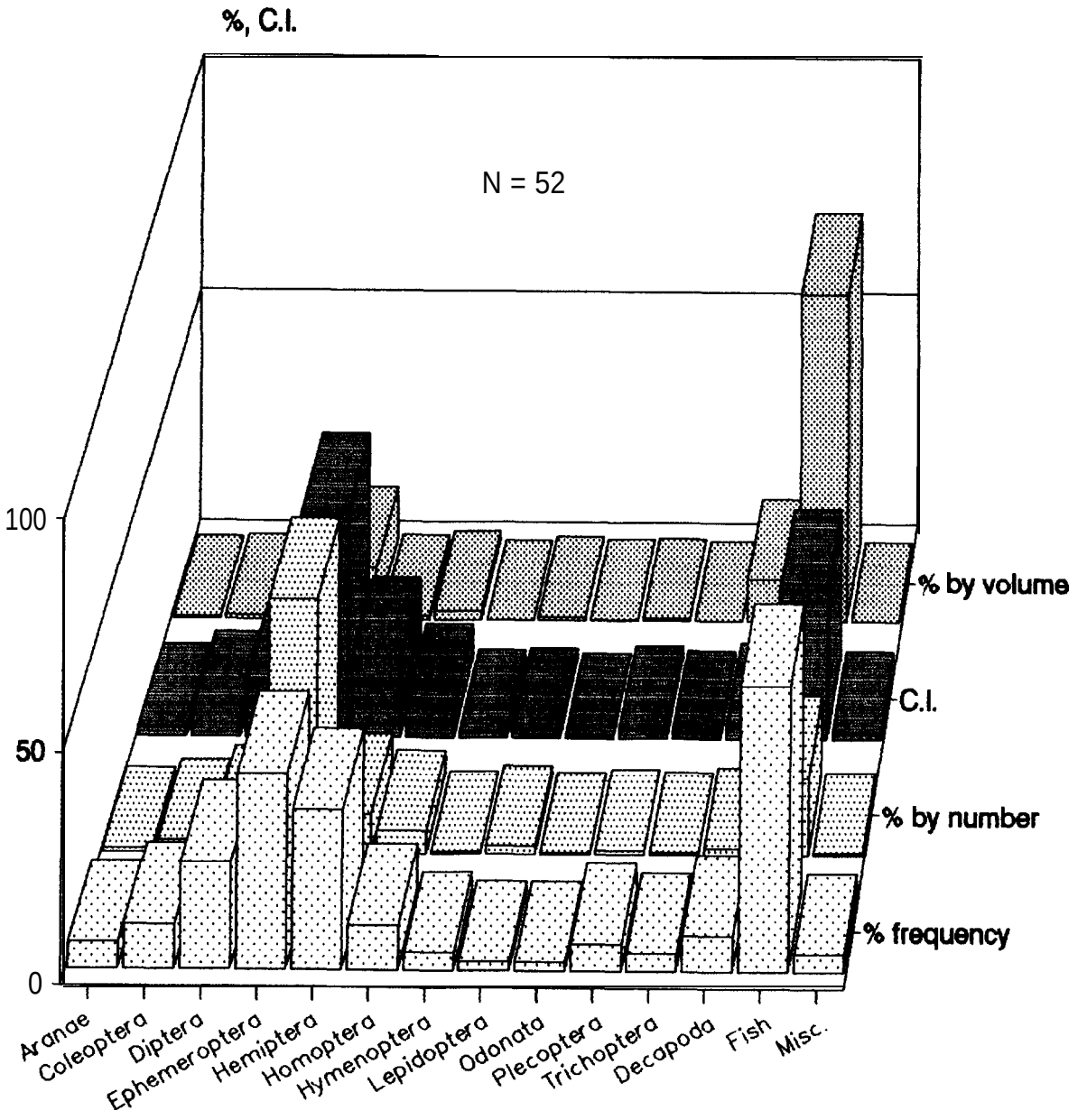


figure 18. Food items contained in stomachs of smollmouth bass (n = 52) by percent frequency of occurrence, percent by number, Coefficient of Importance (C.I.) and percent by volume, 1989, Dworshak Reservoir, Idaho.

items by volume at 71.1%. Ephemeroptera ranked a distant second at 11.4% by volume. C.I. values usually ranked closely with volume data. A gross exception is noted for Decapoda which ranked seventh for C.I. and third for percentage volume.

The predominance of Ephemeroptera and fish in the smallmouth bass stomachs sampled is further underscored by their utilization over a broad size range (Figure 19). Utilization of Diptera and Hemiptera was primarily by fish 1220 mm. Decapods (Pacifasticus leniusculus) were found in only four stomach samples, but were food for smallmouth bass from 80 mm to 330 mm.

The primary food items contained in stomachs of 25 Dworshak Reservoir smallmouth bass sampled during 1988 were Hymenoptera, fish, Trichoptera and Diptera. Findings to date suggest that fish constitute a mainstay of the smallmouth bass diet in Dworshak Reservoir. Diptera are also a consistent food source and are especially important to smaller bass.

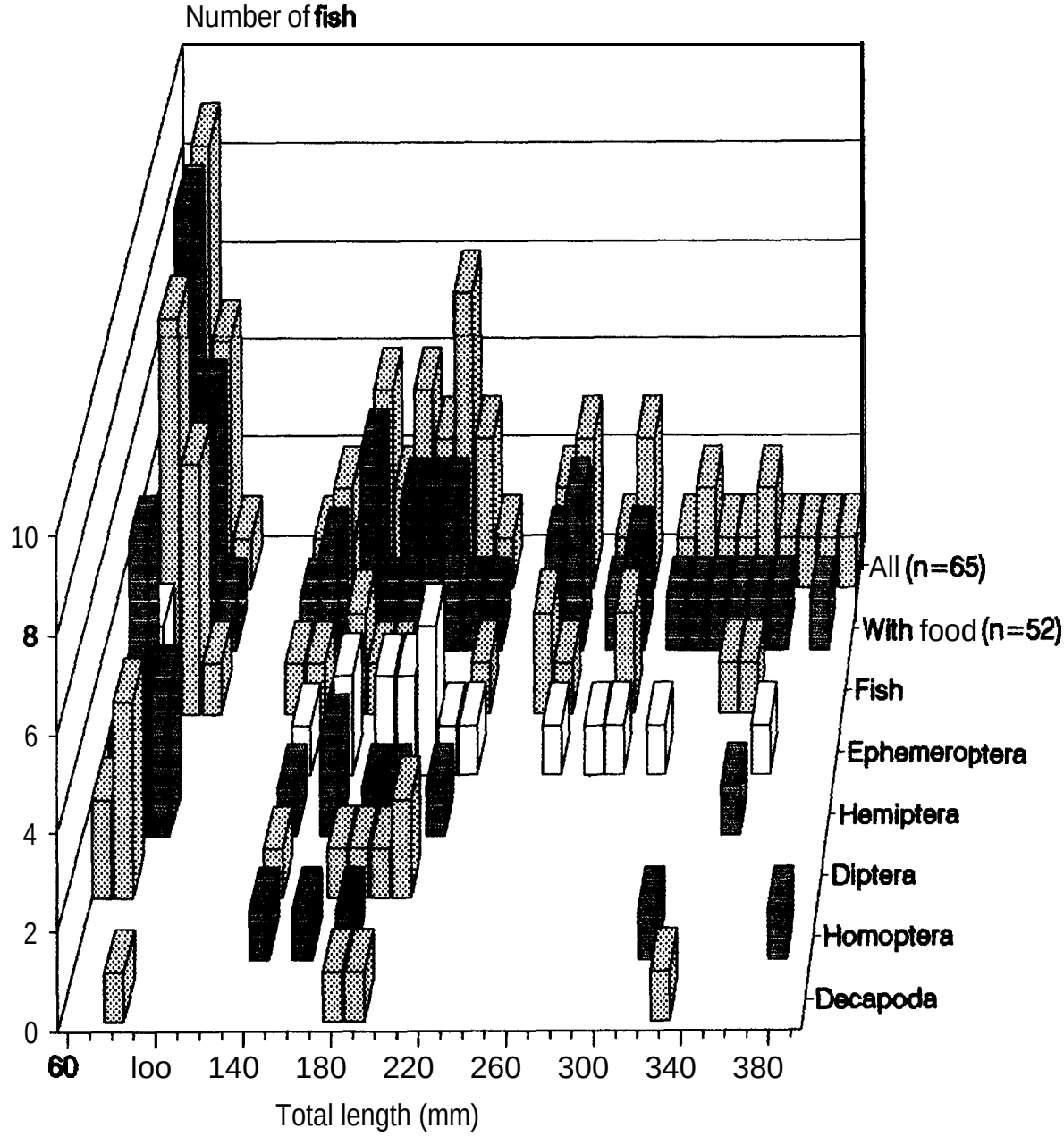


Figure 19. **Length frequencies of smollmouth bass analyzed for food contents in stomachs (n=65), sample fish containing food items (n=52) and number of fish per 10 mm size group containing the predominant food items as determined by the Coefficient of Importonce (C.I.) index and percent composition by volume, 1989, Dworshak Reservoir. Idaho.**

SUMMARY AND CONCLUSIONS

An estimated 152,700 angler-hours were expended from March 1989 through February 1990 to catch a total of 20,426 rainbow trout, 13,064 smallmouth bass, and 179 bull trout. Estimated catch of other species, including cutthroat trout, whitefish, suckers, and squawfish totalled 151. An estimated 98% of the rainbow trout caught were of hatchery origin. Catches of Shasta and Arlee strain rainbow trout released during 1989, estimated from differential mark recognition in the creel, were similar at 1,310 and 1,108, respectively. Small rainbow trout caught and released by boat anglers from June through September comprised an estimated 42.0% (14,189) of the total non-kokanee catch and 70.9% of the hatchery rainbow trout catch through the survey period. The estimated harvest of legal size smallmouth bass (305 mm minimum total length) was 895.

The highest monthly combined catch rate documented for all species excluding kokanee was 1.431 fish per hour during November. The lowest monthly catch rates for species other than kokanee occurred when fishing pressure was the highest, with fishing effort targeting on kokanee during the summer months.

Relative abundance of smallmouth bass captured in gill nets increased from 17.6% in 1988 to 32.6% in 1989. Smallmouth bass are well established throughout the reservoir and numbers may be increasing. Overall fish production has apparently stabilized subsequent to the rise and fall cycle experienced during the 1970's.

Shasta and Arlee strain rainbow trout had identical length increases of 92 mm from June 1989 (release) through February 1990. Incremental annual length increases for smallmouth bass were similar to the 1988 analysis. Overall growth is generally better than other smallmouth bass populations at similar latitudes, but is comparatively slow for smallmouth bass in general.

Estimated total actual (annual) mortality (A) for smallmouth bass was .390. This moderate mortality is not appreciably influenced by the current rate of exploitation (.206) of age V and older bass.

The proportional stock density (PSD) of 23.1 is characteristic for smallmouth bass populations with moderate annual mortality and slow growth. Increasing the growth rate of bass >180 mm would improve PSD.

Overall mean relative weight (W_r) for smallmouth bass collected in 1989 was 91.4. Smallmouth bass from 101-200 mm and 201-300 mm exhibited W_r values of 88.0 and 88.1, respectively, suggesting greater competition for food within these size groups.

Fish and Ephemeroptera dominated the frequencies of occurrence, numbers and volumes of food items found in 52 smallmouth bass stomachs analyzed. These taxa were utilized by a broad size range of smallmouth bass. Diptera and Hemiptera were important primarily to smaller (≤220 mm) bass.

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APPENDIX A

Gill net field data, 1989, Dworshak Reservoir, Idaho.

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type	Net-hours[1]	Species/Strain[2]	Length (mm)	Weight (gm)
04/27/89	Elk Cr. Arm 0.8	float	13.2	kok	235	0
04/27/89	Elk Cr. Arm 0.8	float		hrblv	250	0
04/27/89	Elk Cr. Arm 0.8	float		su		
04/27/89	Elk Cr. Arm 0.8	float		sq		
04/27/89	Elk Cr. Arm 0.8	float		smb	380	0
04/27/89	Elk Cr. Arm 0.8	float		kok	228	0
04/27/89	Elk Cr. Arm 0.8	sink	12.5	su		
04/27/89	Elk Cr. Arm 0.8	sink		sq		
04/27/89	Elk Cr. Arm 0.8	sink		kok	244	0
04/27/89	Magnus Bay	float	15.0	cut	302	260
04/27/89	Magnus Bay	float		sq	500	1690
04/27/89	Magnus Bay	float		kok	223	86
04/27/89	Magnus Bay	float		sq	445	910
04/27/89	Magnus Bay	float		sq	496	1530
04/27/89	Magnus Bay	float		wrbt	230	96
04/27/89	Magnus Bay	sink	15.8	sq	377	490
04/27/89	Magnus Bay	sink		su	370	495
04/28/89	Cranberry Cr. 0.4	float	12.5	cut	265	
04/28/89	Cranberry Cr. 0.4	float		kok	227	
04/28/89	Cranberry Cr. 0.4	float		cut	268	
04/28/89	Cranberry Cr. 0.4	float		sq		
04/28/89	Cranberry Cr. 0.4	sink	12.5	none		
04/29/89	Reed's Cr.	float	16.4	blt	512	1590
04/29/89	Reed's Cr.	float		sq	510	1790
04/29/89	Reed's Cr.	float		sq	251	130
04/29/89	Reed's Cr.	float		sq	360	400
04/29/89	Reed's Cr.	float		su	425	880
04/29/89	Reed's Cr.	sink	17.2	su	358	420
04/29/89	Reed's Cr.	sink		su	436	710
04/29/89	Reed's Cr.	sink		sq	520	1760

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type	Net-hours[1]	Species/Strain[2]	Length (mm)	Weight (gm)
05/31/89	Merry's Bay	float	15.8	hrblv	260	
05/31/89	Merry's Bay	float		wrbt	281	
05/31/89	Merry's Bay	float	15.8	su	482	
05/31/89	Merry's Bay	float		su	433	
05/31/89	Merry's Bay	sink	16.0	kok	230	
05/31/89	Merry's Bay	sink		kok	245	
05/31/89	Merry's Bay	sink		kok	218	
05/31/89	Merry's Bay	sink		sq	383	
05/31/89	Merry's Bay	sink		sq	393	
05/31/89	Merry's Bay	sink	16.0	sq	386	
05/31/89	Merry's Bay	sink		kok	242	
05/31/89	Merry's Bay	sink		kok	249	
06/01/89	Freeman Cr.	float	14.8	smb	357	595
06/01/89	Freeman Cr.	float	13.8	sq	387	
06/01/89	Freeman Cr.	float		kok	100	
06/01/89	Freeman Cr.	float		su	510	
06/01/89	Freeman Cr.	float		kok	262	150
06/01/89	Freeman Cr.	float		smb	171	46
06/01/89	Freeman Cr.	float		su	447	
06/01/89	Freeman Cr.	float		wrbt	229	82
06/01/89	Freeman Cr.	sink	13.6	smb	148	35
06/01/89	Freeman Cr.	sink		su	394	
07/10/89	Little N. Fk. 0.3	float	14.0	sq	287	
07/10/89	Little N. Fk. 0.3	float		sq	387	
07/10/89	Little N. Fk. 0.3	float		sq	222	
07/10/89	Little N. Fk. 0.3	float		sq	184	
07/10/89	Little N. Fk. 0.3	float		sq	235	
07/10/89	Little N. Fk. 0.3	float		sq	190	

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type	Net-hours[1]	Species/ Strain[2]	Length (mm)	Weight (gm)
07/10/89	Little N. Fk. 0.3	sink	14.8	sq	180	
07/10/89	Little N. Fk. 0.3	sink		su	450	
07/10/89	Little N. Fk. 0.3	sink		su	225	
07/10/89	Little N. Fk. 0.3	sink		sq	225	
07/10/89	Little N. Fk. 0.3	sink		su	415	
07/10/89	Little N. Fk. 0.3	sink		su	375	
07/10/89	Little N. Fk. 0.3	sink		1vad	190	68
07/10/89	Little N. Fk. 0.3	sink		sq	222	
07/10/89	Little N. Fk. 0.3	sink		sq	250	
07/10/89	Little N. Fk. 0.3	sink		su	396	
07/10/89	Little N. Fk. 0.3	sink		sq	270	
07/10/89	Little N. Fk. 0.3	sink		sq	222	
07/10/89	Little N. Fk. 0.3	sink		su	395	
07/10/89	Little N. Fk. 0.3	sink		su	370	
07/10/89	Little N. Fk. 0.3	sink		sq	279	
07/10/89	Little N. Fk. 0.3	sink		su	370	
07/10/89	Little N. Fk. 0.3	sink		su	383	
07/10/89	Little N. Fk. 0.3	sink		sq	221	
07/28/89	Elk Cr. Arm 1.5	float	14.0	sq	395	
07/28/89	Elk Cr. Arm 1.5	float		sq	495	
07/28/89	Elk Cr. Arm 1.5	float		sq	405	
07/28/89	Elk Cr. Arm 1.5	sink	14.0	1vad	224	94
07/28/89	Elk Cr. Arm 1.5	sink		sq	290	0
07/28/89	Elk Cr. Arm 1.5	sink		smb	220	114
07/28/89	Elk Cr. Arm 1.5	sink	14.0	smb	170	58
07/28/89	Elk Cr. Arm 1.5	sink		sq	230	
08/16/89	Salmon Landing	float	14.8	sq	115	
08/16/89	Salmon Landing	float		sq	225	
08/16/89	Salmon Landing	float		sq	210	
08/16/89	Salmon Landing	float		sq	115	
08/16/89	Salmon Landing	float		sq	130	
08/16/89	Salmon Landing	float		sq	118	
08/16/89	Salmon Landing	float		sq	127	
08/16/89	Salmon Landing	float		sq	212	
08/16/89	Salmon Landing	float		sq	240	

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type	[1] Net-hours	[2] Species/ Strain	Length (mm)	Weight (gm)
08/16/89	Salmon Landing	float		sq	182	
08/16/89	Salmon Landing	float		sq	280	
08/16/89	Salmon Landing	float		sq	219	
08/16/89	Salmon Landing	float		sq	171	
08/16/89	Salmon Landing	float		sq	124	
08/16/89	Salmon Landing	float		sq	115	
08/16/89	Salmon Landing	float		sq	227	
08/16/89	Salmon Landing	float		sq	247	
08/16/89	Salmon Landing	float		sq	224	
08/16/89	Salmon Landing	float		su	382	
08/16/89	Salmon Landing	float		su	384	
08/16/89	Salmon Landing	float		su	380	
08/16/89	Salmon Landing	float		su	367	
08/16/89	Salmon Landing	float		su	412	
08/16/89	Salmon Landing	float		su	416	
08/16/89	Salmon Landing	float		su	382	
08/16/89	Salmon Landing	float		su	395	
08/16/89	Salmon Landing	float		su	457	
08/16/89	Salmon Landing	float		su	406	
08/16/89	Salmon Landing	float		su	370	
08/16/89	Salmon Landing	float		su	374	
08/16/89	Salmon Landing	float		su	377	
08/16/89	Salmon Landing	float		su	455	
08/16/89	Salmon Landing	float		kok	272	195
08/16/89	Salmon Landing	float		smb	86	
08/16/89	Salmon Landing	float		smb	85	
08/16/89	Salmon Landing	float		smb	89	
08/16/89	Salmon Landing	float		smb	88	
08/16/89	Salmon Landing	float		smb	91	
08/16/89	Salmon Landing	float		smb	87	
08/16/89	Salmon Landing	float		smb	90	
08/16/89	Salmon Landing	sink	15.0	sq	344	
08/16/89	Salmon Landing	sink		sq	125	
08/16/89	Salmon Landing	sink		sq	130	
08/16/89	Salmon Landing	sink		sq	137	
08/16/89	Salmon Landing	sink		sq	271	
08/16/89	Salmon Landing	sink		sq	122	
08/16/89	Salmon Landing	sink		sq	222	

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type	Net-hours[1]	Species/ Strain[2]	Length (mm)	Weight (gm)
08/16/89	Salmon Landing	sink		sq	208	
08/16/89	Salmon Landing	sink		sq	220	
08/16/89	Salmon Landing	sink		sq	207	
08/16/89	Salmon Landing	sink		su	375	
08/16/89	Salmon Landing	sink		su	477	
08/16/89	Salmon Landing	sink		su	365	
08/16/89	Salmon Landing	sink		su	374	
08/16/89	Salmm Landing	sink		su	454	
08/16/89	Salmon Landing	sink		su	380	
08/16/89	Salmon Landing	sink		su	392	
08/16/89	Salmm Landing	sink		su	443	
08/16/89	Salmon Landing	sink		su	420	
08/16/89	Salmon Landing	sink		su	350	
08/16/89	Salmon Landing	sink		su	445	
08/16/89	Salmon Landing	sink		su	405	
08/16/89	Salmon Landing	sink		su	354	
08/16/89	Salmon Landing	sink		su	400	
08/16/89	Salmon Landing	sink		su	450	
08/16/89	Salmon Landing	sink		su	457	
08/16/89	Salmon Landing	sink		su	435	
08/16/89	Salmon Landing	sink		su	400	
08/16/89	Salmon Landing	sink		su	427	
08/16/89	Salmon Landing	sink		su	380	
08/16/89	Salmon Landing	sink		su	375	
08/16/89	Salmon Landing	sink		su	395	
08/16/89	Salmon Landing	sink		su	460	
08/16/89	Salmon Landing	sink		su	356	
08/16/89	Salmon Landing	sink		su	420	
08/16/89	Salmon Landing	sink		su	340	
08/16/89	Salmm Landing	sink		su	385	
08/16/89	Salmon Landing	sink		cut	251	130
08/16/89	Salmon Landing	sink		kok	300	270
08/16/89	Salmon Landing	sink		smb	84	10
08/16/89	Salmon Landing	sink		smb	147	40
08/16/89	Salmm Landing	sink		smb	89	12
08/16/89	Salmon Landing	sink		smb	152	46
08/16/89	Salmon Landing	sink		smb	178	70
08/16/89	Salmon Landing	sink		smb	140	38
08/16/89	Salmm Landing	sink		stnb	85	10

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Location	Net type	Net-hours[1]	Species/ Strain[2]	Length (mm)	Weight (gm)
08/16/89	Salmon Landing	sink		smb	185	84
08/16/89	Salmon Landing	sink		smb	80	8
08/16/89	Salmon Landing	sink		smb	82	8
08/16/89	Salmon Landing	sink		smb	85	9
08/16/89	Salmon Landing	sink		smb	86	10
08/16/89	Salmon Landing	sink		smb	173	74
08/16/89	Salmon Landing	sink		smb	295	32%
08/16/89	Salmon Landing	sink		smb	147	48
08/16/89	Salmon Landing	sink		smb	165	62
08/16/89	Salmon Landing	sink		smb	222	150
08/16/89	Salmon Landing	sink		smb	150	42
08/16/89	Salmon Landing	sink		smb	151	44
08/16/89	Salmon Landing	sink		smb	79	6
08/16/89	Salmon Landing	sink		smb	148	50
08/16/89	Salmon Landing	sink		smb	180	80
08/16/89	Salmon Landing	sink		smb	150	44
08/16/89	Salmon Landing	sink		smb	166	64
08/16/89	Salmon Landing	sink		smb	91	10
08/16/89	Salmon Landing	sink		smb	240	185
08/16/89	Salmon Landing	sink		smb	87	8
08/16/89	Salmon Landing	sink		smb	195	100
08/16/89	Salmon Landing	sink		smb	141	36
08/16/89	Salmon Landing	sink		smb	143	42
08/16/89	Salmon Landing	sink		smb	145	44
08/16/89	Salmon Landing	sink		smb	152	40
08/16/89	Salmon Landing	sink		smb	130	20
08/16/89	Salmon Landing	sink		smb	156	52
08/16/89	Salmon Landing	sink		smb	160	54
08/16/89	Salmon Landing	sink		smb	152	48
08/16/89	Salmon Landing	sink		smb	161	60
08/16/89	Salmon Landing	sink		smb	170	70
08/16/89	Salmon Landing	sink		smb	164	64
08/16/89	Salmon Landing	sink		smb	164	62
08/16/89	Salmon Landing	sink		smb	172	70
08/16/89	Salmon Landing	sink		smb	150	54
08/16/89	Salmon Landing	sink		smb	90	12
08/16/89	Salmon Landing	sink		smb	83	10
08/16/89	Salmon Landing	sink		smb	162	72
08/16/89	Salmon Landing	sink		smb	139	36

Appendix A. Gill net field data, 1989, Dworshak Reservoir, Idaho.

Date	Locatim	Net type	Net-hours[1]	Species/Strain[2]	Length (mm)	Weight (gm)
08/16/89	Salmon Landing	sink		smb	200	102
08/16/89	Salmon Landing	sink		smb	330	475
08/16/89	Salmon Landing	sink		smb	155	52
08/16/89	Salmon Landing	sink		smb	149	44
08/16/89	Salmon Landing	sink		smb	88	10
08/16/89	Salmon Landing	sink		smb	144	40
08/16/89	Salmon Landing	sink		smb	146	44
08/16/89	Salmon Landing	sink		smb	160	54
08/16/89	Salmon Landing	sink		smb	141	40
08/16/89	Salmon Landing	sink		smb	145	42
08/16/89	Salmon Landing	sink		smb	152	44
08/16/89	Salmon Landing	sink		smb	175	72
08/16/89	Salmon Landing	sink		smb	151	40
08/16/89	Salmon Landing	sink		smb	140	34
08/16/89	Salmon Landing	sink		chis	226	95
08/16/89	Salmon Landing	sink		chis	230	104

[1] Net hours per set are shown at the beginning of individual sets.

[2] Abbreviations used are as follows:

blt - bull trout
chis - chiselmouth
cut - cutthroat trout
hrblv - 1988 Shasta rainbow trwt
kok - kokanee
lvad - 1989 Shasta rainbow trout
smb - smallmouth bass
sq - squawfish
su - suc ker
wrbt - wild/natural rainbow trout.

APPENDIX B

Diet rankings for Coefficient of Importance (C.I.) and percent by volume and associated values from 52 smallmouth bass stomachs, 1989, Dworshak Reservoir, Idaho.

Appendix B. Diet rankings for Coefficient of Importance (CI.) and percent by volume and associated values from 52 smallmouth bass stomachs, 1989, Dworshak Reservoir, Idaho.

	% frequency	% by number	C.I.	% by volume	C.I. rank	% by volume rank
Ephemeroptera	42.3	54.6	48.1	11.4	1	2
Fish	61.5	16.8	32.1	71.1	2	1
Hemiptero	34.6	a.4	17.0	1.0	3	5
Diptero	23.1	5.8	11.6	1.0	4	5
Homoptero	9.6	4.9	6.9	2.0	5	4
Coleoptero	9.6	2.6	5.0	1.0	6	5
Decapoda	7.7	1.4	3.3	9.3	7	3
Aranae	5.8	0.9	2.3	0.7	a	7
Plecoptera	5.8	0.9	2.3	0.7	a	7
Lepidoptera	1.9	1.7	1.8	0.8	9	6
Trichoptera	3.8	0.6	1.5	0.1	10	10
Misc.	3.8	0.6	1.5	0.2	10	9
Hymenoptera	3.8	0.6	1.5	0.1	10	10
Odonoto	1.9	0.3	0.8	0.4	11	8