UMPQUA RIVER SMALLMOUTH BASS INVESTIGATION

1987-1988

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INTRODUCTION

Smallmouth bass were illegally introduced into the Umpqua River system sometime in the early 1970's. They were first documented in 1977 in the South Umpqua River from Roseburg (River Mile 10) to the mouth of Cow Creek (RM 47). By 1985 smallmouth bass were found throughout most of the Umpqua and South Umpqua rivers, and supported a popular fishery. Expansion of the smallmouth bass population, both in numbers and distribution, brought with it a number of concerns. Advocates of smallmouth bass were concerned about impacts of the growing fishery on the bass population. Others were concerned about the impacts of smallmouth bass on other species of game fish in the system. This investigation was begun in 1987 to address these concerns. Results from work completed in 1987 and 1988 are presented in this report.

We had three primary study objectives. The first was to develop effective techniques for sampling smallmouth bass in the stream system, and to use these to collect data to describe bass distribution, population density, habitat associations, age and growth, and population structure. Our second objective was to assess the smallmouth bass fishery in terms of location, intensity, timing, relationship to other fisheries, catch rate, and catch composition. A third objective was to describe the diet of smallmouth bass, especially as related to possible predation on salmonids.

STUDY AREA

The study area consisted of all streams in the Umpqua River system that could potentially be inhabited by smallmouth bass based on the accessibility of these streams to known smallmouth bass populations. This included the entire 89 miles of the Umpqua River above tidewater, the lower 7 miles of the North Umpqua River up to Winchester Dam, 83 miles of the South Umpqua River from the mouth to 8 miles above Tiller, 42 miles of Cow Creek up to Glendale, and the lower sections of 20 tributaries totaling 65 miles in length for a grand total of 286 stream miles (Figure 1).

The major streams in the total study area were the Umpqua River, South Umpqua River, and Cow Creek. All are characterized by bedrock channels with long pools connected by riffles or chutes in the bedrock. However, some habitat differences exist among stream areas. The Umpqua River from the zone of tidal influence near Scottsburg (RM 27) upstream to Elkton (RM 49) has bedrock that is generally more rounded in structure than further

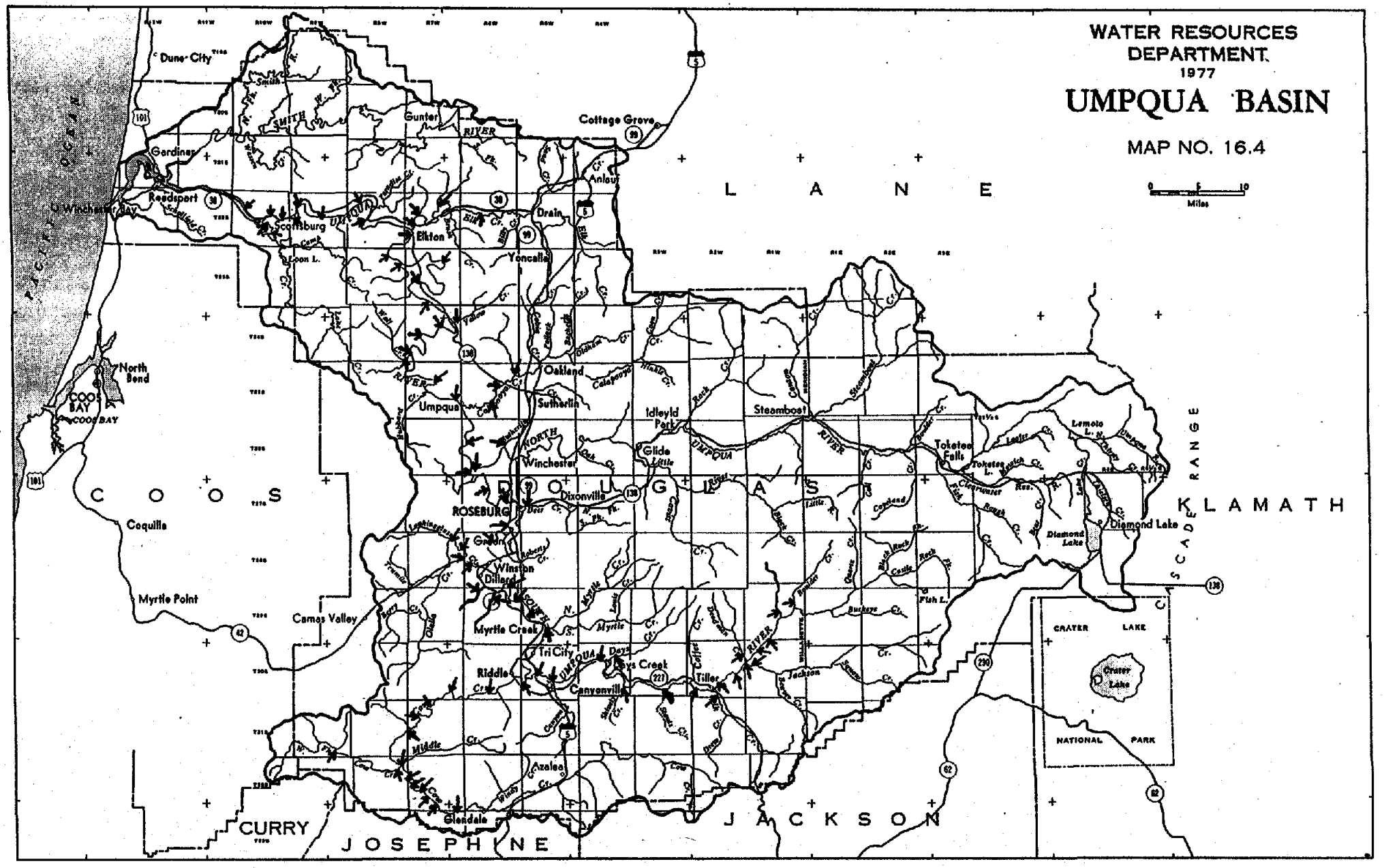


Figure 1. Study area showing fish sampling sites.

upstream. Large boulders are prevalent. Fine materials consist mostly of sand and silt. Algae is abundant on the substrate, but higher aquatic plants are scarce. Pools are long with few connecting riffles or chutes.

From Elkton upstream to Kellogg (RM 71) the river has many large, deep pools, but the steeper gradient results in more riffles and chutes than in the lower section. Steep bedrock ledges are prevalent. Fines consist of sand and gravel. Plant life consists mainly of benthic algae.

The river from Kellogg to Umpqua (RM 103) also has many pools connected by long riffles or chutes, but pool size and depth are more variable than in downstream reaches with more smaller and shallower pools. Bedrock ledges are common but not as numerous as between Elkton and Kellogg. Boulder, rubble, and gravel substrate is more common. Aquatic plants become more abundant than in the lower river.

In the remainder of the river from Umpqua to the forks (RM 112) the habitat becomes even more variable in terms of pool size, pool depth, and the occurrence of bedrock ledges. Substrate material consists mostly of gravel.

The North and South Umpqua Rivers join at river mile 112 to form the Umpqua River. The North Umpqua River is the larger of the two but is less suitable for smallmouth bass due to low year-around water temperatures and steep gradient. Summer temperatures in the North Umpqua River seldom reach the preferred temperature range for adult smallmouth bass of 70 to 80 degrees (Clancey 1980). Winchester Dam at River Mile 7.0 is laddered. However, smallmouth bass have never been observed in the ladder during year around monitoring of fish movement.

The South Umpqua River is subject to low summer flows and high water temperatures. The lower portion has a relatively low gradient and high pool to riffle ratio. Up to Dillard (RM 27) the habitat consists primarily of long, shallow pools connected by gravel riffles. Only the larger pools are over 6 feet deep at low flow. Bedrock ledges are common but are often in shallow water. Algae is abundant on the substrate but aquatic macrophytes are scarce.

The South Umpqua River from Dillard to Myrtle Creek (RM 40) is characterized by many small pools connected by riffles and a few narrow bedrock chutes. It contains two very large pools comparable to those in the Umpqua River. Rock ledges are prevalent but are usually associated with shallow water. Gravel bars are common. Algae is abundant.

Upstream from Myrtle Creek the pools become progressively smaller and shallower and bedrock ledge structure is scarce. Substrate varies in composition, with sand, gravel, rubble, and boulders all well represented. Boulders become more prevalent in the upper reaches. Because of the narrower channel, streamside bushes and trees are closer to the water than in downstream reaches and provide shade and cover from overhanging branches, root structure in the water, and fallen material. Algae is abundant in unshaded areas, but macrophytes remain scarce.

Cow Creek is similar to the upper reaches of the South Umpqua River. The channel is bedrock, but ledge structure is limited. The creek has a number of large pools, despite low summer flows. However, most of the pool area is less than 10 feet deep. Gravel is abundant. Streamside vegetation, fallen trees, and brush provide cover in many areas.

All other tributaries in the study area were small with maximum pool depths of less than 10 feet.

MATERIALS AND METHODS

Fish Sampling

We tested four methods of sampling the smallmouth bass population. These were beach seining, boat electrofishing, backpack electrofishing, and snorkeling. Two person teams were used for each sampling method. Beach seining was conducted with three sizes of standard bag seines ranging from 25 to 125 feet in length, 4 to 6 feet in depth, and 1/4 to 2 1/2 inch mesh size (stretch measurement). Seines were set by wading, or from a pram by rowing. Seining was limited to pools where current was light and bottoms were free of major obstacles.

Two types of boat electrofishing units were used--a 2500 watt Coffelt unit mounted in an aluminum driftboat, and a 5000 watt Smith-Root GPP-5 unit in a motor-powered jonboat. The jonboat was equipped with lights for nighttime use. We used the driftboat unit in May on Cow Creek and the South Umpqua River to obtain bass for diet analysis when juvenile fall chinook salmon were migrating. The technique with the driftboat unit was to electrofish while drifting downstream over habitat that would appear to hold smallmouth bass. The jonboat was used in July during daylight and darkness on larger pools of the Umpqua River where the boat could be launched. The design of the jonboat prevented river travel between pools. The technique used with the jonboat was to electrofish the perimeters of pools and habitat under 6 feet deep in open water while traveling slowly under power. With both boat units one person operated the boat

while the other controlled the output switch and netted fish. We used a battery-powered backpack electrofisher manufactured by Coffett Electronics to sample fish in the small tributary streams during the low flow period of July through September. Electrofishing was conducted in an upstream direction with one person carrying and operating the electrofisher and the other netting fish.

We used snorkeling extensively to inventory fish populations and describe habitat in all but the smallest study streams. Snorkeling has proven to be an effective technique for obtaining information on fish populations in large, clear streams with little cover (Zubik and Fraley 1988). The snorkel surveys were conducted from July 28 through September 3, 1987, when stream flows were low and clear. Minimum visibility was 6 feet and usually exceeded 10 feet. Samplers were equipped with wetsuits, masks, fins, and snorkels. PVC wristbands and pencils were used to record data. The time snorkeled at each site was determined by pool size, natural boundaries (i.e. rapids), and the time required to obtain an adequate sample. Snorkelers used the technique of moving downstream parallel to each other at the maximum distance that would allow visual contact. In smaller streams this allowed fish to be observed across the entire stream width. In large pools with uniform depth, the samplers zigzagged to observe fish in all parts of the pool. Where deep channels bisected pools, the samplers paralleled opposite sides of the channel to count fish along the ledges where bass were concentrated. Smallmouth bass observed were classified into three size groups (0" - 5", 5" - 10", and over 10"), and counted. Samplers practiced estimating lengths of fish and other items of known length underwater prior to classifying fish by size. Time counted was recorded to allow calculation of the number of bass of each size group observed per hour. Snorkelers also recorded relative abundance of other fish species observed as scarce, common, or abundant. Each snorkel site was described as to type of substrate, relative velocity, instream and streamside vegetation, maximum depth, average width, instream structure and cover, and other channel characteristics.

Smallmouth Bass Distribution

Snorkeling and backpack electrofishing proved to be the most effective techniques for determining the presence or absence of smallmouth bass. Therefore, we used these techniques to progressively sample selected sites in each stream in an upstream direction until the upstream limit of smallmouth bass distribution was determined. Snorkeling and electrofishing sites are shown in Figure 1.

Population Density

We expressed bass counts from snorkeling as fish counted per hour to provide an index of population density. Density indices were calculated for each size group of bass and each stream section.

Habitat Associations

Bass population densities derived from snorkeling counts were related to the frequency of occurrence of various habitat parameters to determine the habitat types utilized by smallmouth bass. Descriptions of sample sites included average width, average depth, maximum depth, substrate type, channel structure, instream cover, aquatic vegetation, and streamside vegetation.

Age and Growth

We collected scale samples for age and growth analysis from bass obtained by electrofishing, seining, and creel census. Our goal was to sample 10 bass in each 1-inch size group from each major stream (Umpqua River, South Umpqua River, and Cow Creek). Scales were mounted on gummed cards and pressed to make plastic impressions which were then read with a scale projector and measured. Length at each age was calculated from scale measurements by the direct proportion formula. We used ages and lengths of scale-sampled bass to estimate population age structure and mortality rates. Data were stored and analyzed on microcomputer.

Population Structure

We used snorkeling counts of each size group of bass to describe the size composition of the smallmouth bass population and relate it to stream area. Electrofishing and seining did not provide representative samples of the bass population.

Mortality

We calculated age frequencies for bass populations in the Umpqua and South Umpqua rivers from the relative numbers of fish in three size groups counted during snorkel surveys. Mortality was estimated as the slope of a line fit by regression to a plot of the natural logarithm of age frequency against age (Ricker 1975).

Fishery

We made aerial counts of anglers and interviewed anglers to obtain information about the smallmouth bass fishery. The aerial counts were made to monitor and describe the location, timing, duration, and intensity of the fishery. Angler interviews

ellowed us to distinguish the bass fishery from other fisheries and obtain information about catch.

For the angler survey we divided the Umpqua and South Umpqua rivers into eight areas to facilitate data collection and analysis (Figure 2). The areas were:

Umpqua River

1. Scottsburg Bridge (RM 27) to Elkton Bridge (RM 49)
2. Elkton Bridge (RM 49) to Kellogg Bridge (RM 71)
3. Kellogg Bridge (RM 71) to Umpqua Bridge (RM 103)
4. Umpqua Bridge (RM 103) to River Forks Park (RM 112)

South Umpqua River

5. Singleton Park (RM 0) to Dillard Bridge (RM 27)
6. Dillard Bridge (RM 27) to Myrtle Creek RR Bridge (RM 40)
7. Myrtle Creek RR Bridge (RM 40) to Stanton Park (RM 51)
8. Stanton Park (RM 51) to Tiller Bridge (RM 75)

Aerial counts were made from a single-engine fixed-winged aircraft. We started counting at the Scottsburg Bridge (RM 27) on the Umpqua River and proceeded upriver to the Tiller Bridge (RM 75) on the South Umpqua River for a total distance of 160 miles. Angler numbers were recorded by location on a map of the stream system and later compiled by area. In 1987 we made three counts during the period of August 8-28. In 1988, we made 15 counts between June 4 and September 25. Flights were made on Saturdays between 9:00 A.M. and 12:00 P.M. to coincide with peak angler use as observed during creel census. On July 9, we made two counts, one at the regular time and one between 6:00 P.M. and 8:30 P.M. to confirm the hours of peak use.

In 1987 we interviewed anglers encountered during other project activities and on six weekend creel census days during the period of July 15 - September 15. On creel census days, two checkers interviewed anglers in all study areas of the Umpqua and South Umpqua Rivers. We used standard Department catch record booklets to record stream, date, number of anglers per car or party, hours fished, method (bait, lure, or combination), boat or bank, fish harvested by species and size, the number of bass released, and whether or not anglers were finished for the day.

Our survey of the fishery in 1988 was more intensive. It was conducted form April 23 through September 30 to encompass most of the smallmouth bass fishery. We used one checker to interview anglers three days per week. The weekly schedule included every Saturday and two other randomly-selected days. Emergencies and

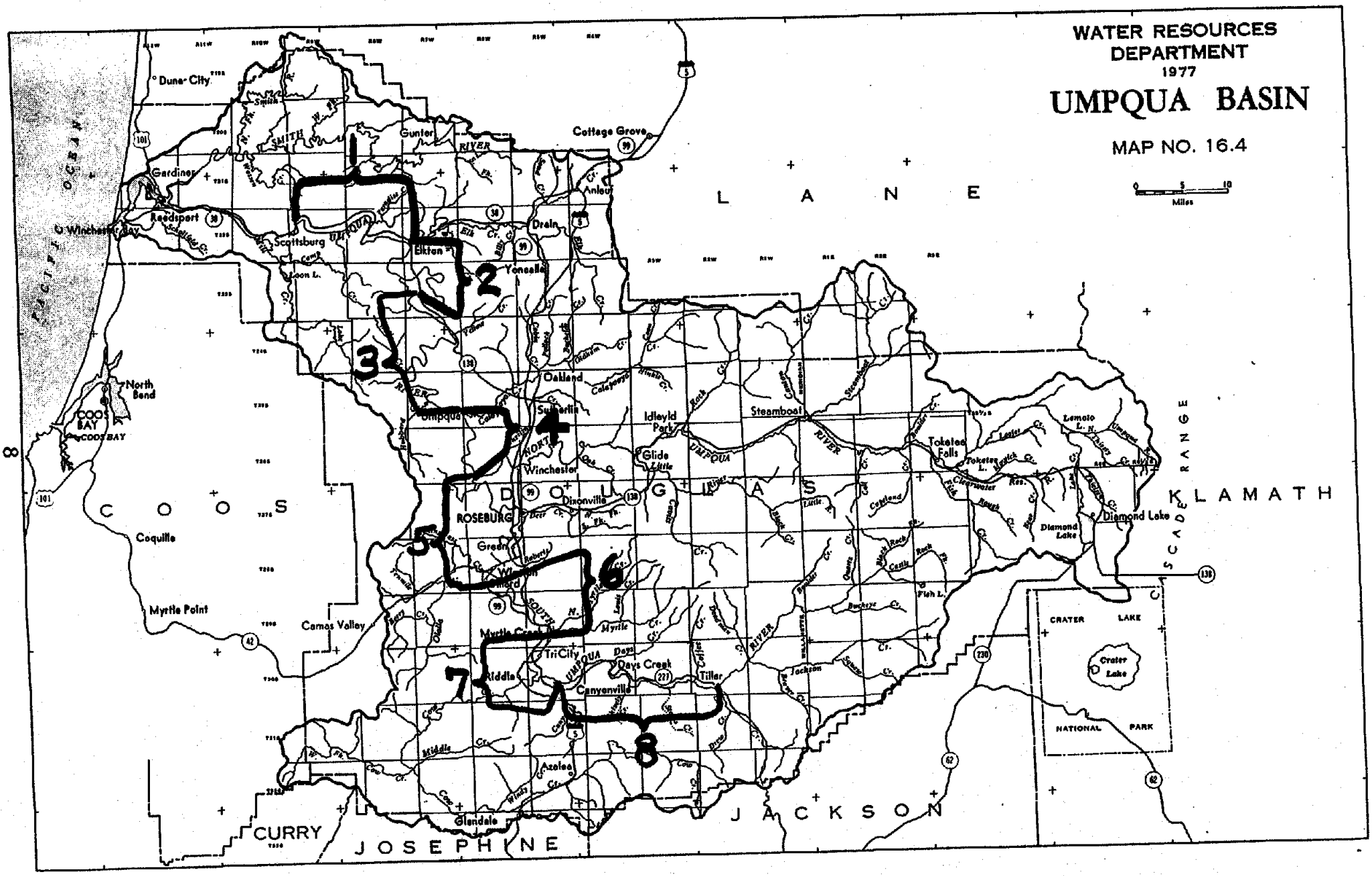


Figure 2. Study subareas of the Umpqua and South Umpqua rivers.

weather and water conditions caused some deviations from this schedule. We established two survey routes--one on the Umpqua River from Scottsburg boat ramp (RM 25) to River Forks Park (RM 112) and one on the South Umpqua River from Singleton Park (RM 0) to the Tiller Bridge (RM 75). The route on the South Umpqua River was shortened in July to end at the Milo Bridge (RM 69) because no anglers had been observed above that point. Only one route was checked on each sample day. For each sample day we randomly selected the route, starting time (8:00 A.M. or 2:00 P.M.) and starting point (either end). We collected the same information as during the 1987 survey but also determined the species of fish each angler was trying to catch. Data were recorded on special forms to facilitate entry into the computer.

To obtain more information from boat anglers in 1988, we placed postcard questionnaires on vehicles with boat trailers that were parked at boat ramps along the sample routes. Postcards were stamped and addressed to the Roseburg Regional Office of Oregon Department of Fish and Wildlife. The questions asked on the postcards included those asked at interviews, except for "Number of bass released?" which was omitted. Cars parked along survey routes were counted and recorded by location to provide an index of angler use.

Yield per Recruit

Yeild-per-recruit analyses were conducted for bass populations in the Umpqua and South Umpqua rivers using a population modeling program called MOCPOP (Beamesderfer, 1988). For model input we used total annual mortality as natural mortality for bass up to age 1. Natural mortality for bass over age 1 was estimated from studies reported by Coble (1975). We used the length-weight relationship from smallmouth bass in John Day Reservoir as model input for yeild calculations (Beamesderfer, et al, 1987).

Diet

We obtained smallmouth bass stomachs for diet analysis from fish harvested by anglers. After angler permissions was granted, we recorded the fork length of the fish and removed the stomach, which was then injected with 5 cc of 10% formalin to stop digestion. It was then sealed in a plastic bag with more formalin and taken back to the office to be frozen and analyzed at a later time. For analysis the contents of each stomach was removed and sorted into four categories: fish, crayfish, insects, and "other". Empty stomachs were also noted. Total weight of each category was recorded, and fish were identified to the lowest taxa possible.

RESULTS

Fish Sampling

Beach seining was ineffective for sampling the smallmouth bass population. This was primarily because of underwater obstacles such as rock outcroppings, ledges, and woody cover in areas inhabited by smallmouth bass. In the larger streams most bass over fingerling size were found in pools that were too deep to seine. Fast current also prevented us from seining many sites. Low numbers of small bass were captured by seine at some sites.

Boat electrofishing was also largely ineffective as a sampling technique. The driftboat unit could only be tested during daylight when the water was relatively clear. Most adult smallmouth bass successfully avoided the electrical field under these conditions. The jonboat unit was tested on large pools of the Umpqua River at night. Depths greater than the effective limit of 6 to 8 feet reduced the efficiency of this unit. Also most of the river was inaccessible to the jonboat because of a lack of launching facilities and the inability to navigate though the shallow areas between pools. Low numbers of smallmouth bass of all sizes were captured with this electrofishing unit.

The backpack electrofisher was effective for sampling juvenile smallmouth bass in small tributary streams where flows were less than 10 cfs. It was an effective technique for discovering and capturing small bass that were hidden by rocks, brush, or other cover. However, only two of the fifteen tributaries electrofished contained smallmouth bass and populations were low, so few bass were captured by this technique.

Snorkeling was our most effective sampling technique for obtaining information on the presence, abundance, and size composition of the smallmouth bass population in the Umpqua River, South Umpqua River, and Cow Creek. Shallow water prevented us from snorkeling in most of the tributary streams. We snorkel surveyed 55 sites, including 21 on the Umpqua River, 21 on the South Umpqua River, and 13 on Cow Creek. Snorkeling offered a number of advantages over other techniques. One was mobility, which allowed us to sample areas where access with other equipment was difficult or impossible. Snorkeling also allowed us to sample all habitat types and thereby observe all size classes of bass. At sites that were less than 10 feet deep, visibility was sufficient for samplers to observe bass throughout the water column. In deeper water bass reacted to the presence of snorkelers by rising in the water column to a depth where they could be observed and counted. Another advantage of the technique was that it allowed us to describe habitat types and

observe bass use of these habitats. It also provided information on the other fish species associated with smallmouth bass. Despite these advantages, snorkel surveys are not a precise sampling technique. The width and depth of the larger streams prevented samplers from covering the entire area and observing all of the bass. Therefore, the bass observed may not have been representative of the entire population. Also a number of variables could affect counts. These variables include visibility, technique of individual samplers, duplication of counts, and errors in estimation of fish size. Standardization of personnel, techniques, and sampling conditions minimize the effects of these variables on sample results.

Bass Distribution

In 1987 smallmouth bass occupied 208 miles of stream in the Umpqua River drainage (Figure 3). This included the 88 miles of the Umpqua River above Mill Creek (RM 24), the lower 2 miles of the North Umpqua River, and 78 miles of the South Umpqua River from the mouth to 3 miles above Tiller. The only tributary containing a significant smallmouth bass population was Cow Creek, which enters the South Umpqua River at River Mile 47. Smallmouth bass occupied the lower 33 miles of Cow Creek up to 8 miles below Glendale. Of the Umpqua River tributaries, only the lower 1 mile of Elk Creek contained smallmouth bass. The only tributary to the South Umpqua River containing smallmouth bass besides Cow Creek was Lookingglass Creek which had a few bass in the lower 7 miles.

We observed some differences in the distribution of smallmouth bass by size group. Most notable was the lack of bass under 5 inches in length near the downstream and upstream limits of bass distribution. No bass less than 5 inches long were found downstream from Scottsburg (RM 27) in the Umpqua River or in the upper 20 miles of the South Umpqua River and upper 13 miles of Cow Creek that contained bass.

Population Density

Snorkeling counts in the Umpqua River showed that smallmouth bass were most abundant between Elkton (RM 49) and Kellogg (RM 71) (Table 1). The number of bass counted per hour was significantly lower in all other sections. This pattern applied to all three size groups.

In the South Umpqua River total bass density was highest in the lowest section of the river and decreased with distance upstream (Table 2). A marked drop in bass abundance occurred above Myrtle Creek (RM 40). Bass in the 0-5 inch and over 10 inch size groups followed this same pattern, but mid-size bass were most abundant

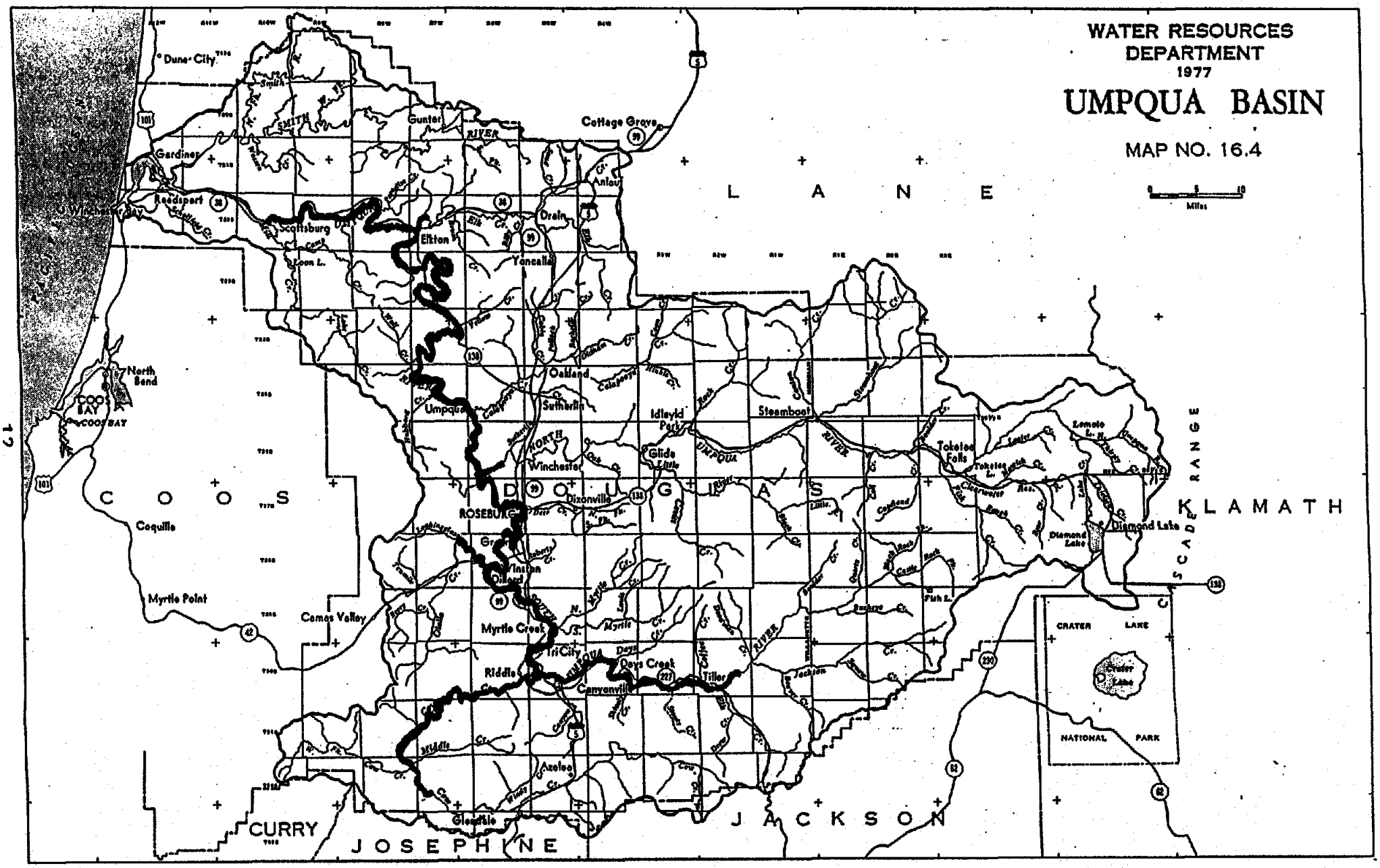


Figure 3. Distribution of smallmouth bass in the Umpqua River Basin, 1987.

TABLE 1
SMALLMOUTH BASS OBSERVED IN THE UMPQUA RIVER DURING SNORKEL SURVEYS,
JULY 28 - SEPT. 3 , 1987

AREA	NUMBER OF SITES	HOURS	TOTAL BASS OBSERVED	<---BASS OBSERVED PER HOUR---> 0"-5"	5"-10"	10+"	TOTAL
BELOW SCOTTSBURG (RM 23-27)	3	2.3	19	0.0	5.2	3.0	8.2
SCOTTSBURG TO ELKTON (RM 27-49)	5	3.9	240	27.2	27.2	7.2	61.6
ELKTON TO KELLOGG (RM 49-71)	6	4.8	943	52.3	109.0	35.2	196.5
KELLOGG TO UMPQUA (RM 71-103)	6	6.0	617	32.2	56.2	14.5	102.9
UMPQUA TO FORKS (RM 103-112)	1	1.3	88	4.6	44.6	18.5	67.7
TOTALS	21	18.3	1907				
WEIGHTED AVERAGES (BY LENGTH OF AREA)				30.4	56.6	17.2	104.2

TABLE 2
SMALLMOUTH BASS OBSERVED IN THE SOUTH UMPQUA RIVER AND COW CREEK DURING SNORKEL SURVEYS
JULY 28 - SEPT. 3 , 1987

AREA	NUMBER OF SITES	HOURS	TOTAL BASS OBSERVED	<---BASS OBSERVED PER HOUR---> 0"-5"	5"-10"	10+"	TOTAL
MOUTH TO DILLARD (RM 0-27)	5	2.2	951	137.3	285.7	16.9	439.9
DILLARD - MYRTLE CR (RM 27-40)	4	3.3	496	55.8	85.8	8.8	150.4
MYRTLE CR - CANYONVILLE (RM 40-51)	2	1.6	121	45.0	28.1	2.5	75.6
CANYONVILLE TO TILLER (RM 51-75)	5	2.8	140	10.4	37.5	2.1	50.0
ABOVE TILLER (RM 75-83)	5	2.8	5	0.0	1.8	0.0	1.8
TOTALS	21	12.6	1713				
WEIGHTED AVERAGES (BY LENGTH OF AREA)				63.6	37.4	8.1	109.1
COW CREEK	13		405	28.3	14.3	2.3	44.9

between Dillard (RM 27), and Myrtle Creek (RM 40), and less abundant both upstream and downstream from that section.

Snorkeling counts in Cow Creek showed a total population density similar to the South Umpqua River above Canyonville (Table 2). However, a higher percentage of the Cow Creek population consisted of bass in the 0-5 inch size group.

Habitat Associations

Smallmouth bass distribution and densities were related to habitat characteristics. In the Umpqua River, bass in the 5-10 inch and over 10 inch size groups, were associated with the same habitat types. This habitat was characterized by low velocity, a maximum pool depth of over 20 feet, a bedrock channel with underwater ledges, and fines consisting of gravel and sand rather than silt. Forage size fish of other species, including redsided shiners, shad, squawfish and suckers, were less abundant than at sites with low bass densities. Bass in the 0-5 inch size group were also associated with a bedrock channel with underwater ledges. However, the better sites for juvenile bass were shallower, had an abundance of gravel, and often had aquatic vegetation in the shallows for cover.

Habitat associations in the South Umpqua River differed from the Umpqua River because of the smaller stream size. Highest densities of bass over 5 inches were associated with low velocity, depths over 8 feet, bedrock edges, riprap, and an abundance of algae and rooted aquatic plants. Nongame fish species, including redsided shiners, squawfish, suckers, and shad, were also common to abundant in these areas. Juvenile bass were associated with bedrock ledges, gravel substrate and the presence of aquatic vegetation or other instream cover.

In Cow Creek, where maximum depths were generally less than 10 feet, mid-size and adult bass were associated with bedrock ledges and the presence of other instream cover such as logs and rootwads. Juvenile bass were not as closely associated with rock ledges but were nearly always found near other instream cover.

Age and Growth

We read scales from 166 smallmouth bass from the Umpqua River, 77 from the South Umpqua River, and 18 from Cow Creek. Results are summarized in Tables 3, 4 and 5, and Figure 4. Growth rates in the Umpqua and South Umpqua rivers were similar for the first 3 years of life, after which bass in the South Umpqua River appeared to grow faster. However, the samples of bass over age 4 from both streams were too small to provide reliable information. Back-calculated lengths at time of annulus formation showed that bass in both rivers are about 3 inches in length at age 1, 8

TABLE 3
AGE AND GROWTH DATA FROM SCALE SAMPLES COLLECTED FROM SMALLMOUTH BASS
UMPQUA RIVER, 1987-88

ACTUAL AGE	NUMBER	ACTUAL MEAN FORK LGTH	MEAN CALCULATED LENGTH AT EACH YEAR OF LIFE 1	2	3	4	5	6	7
1 +	69	8.2	4.07						
2 +	76	10.7	3.37	7.99					
3 +	14	13.2	2.85	7.80	10.91				
4 +	6	13.6	3.37	7.44	10.35	12.44			
5 +	1	15.5	3.6	7.5	10.4	12.7	14.5		
6 +	0								
7 +	1	15.8	3.6	9.1	11.3	12.7	13.2	14.9	
MEAN FORK LENGTH			3.48	7.96	10.75	12.62	13.85	14.93	
MEAN ANNUAL INCREMENT			3.48	4.48	2.79	1.87	1.23	1.08	
NUMBER OF FISH			166	97	22	8	2	1	

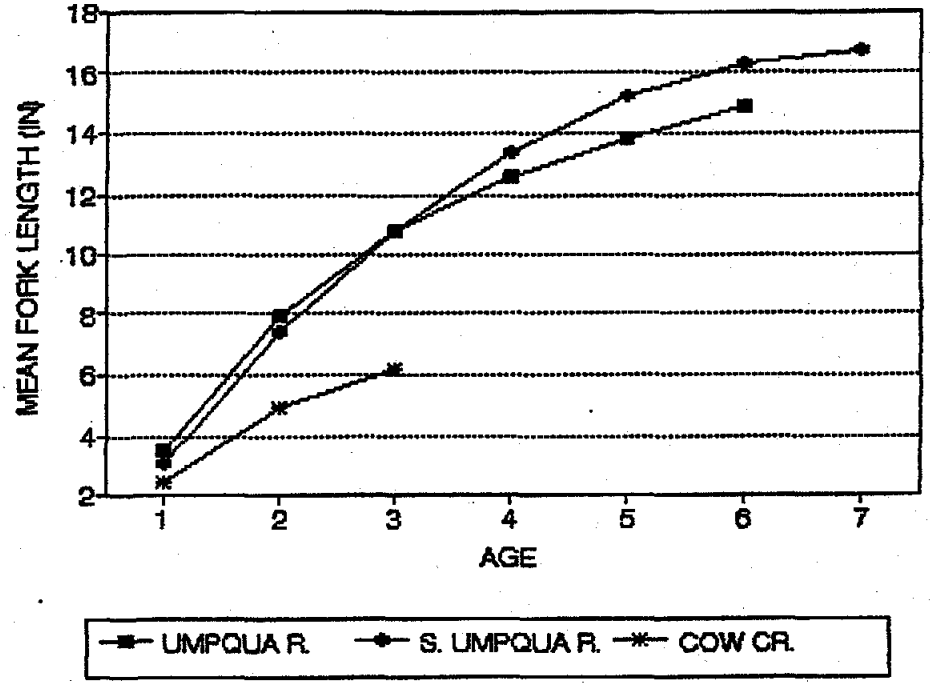
TABLE 4
AGE AND GROWTH DATA FROM SCALE SAMPLES COLLECTED FROM SMALLMOUTH BASS
SOUTH UMPQUA RIVER, 1987-88

ACTUAL AGE	NUMBER	ACTUAL MEAN FORK LGTH	<--------MEAN CALCULATED LENGTH AT EACH YEAR OF LIFE---------> 1	2	3	4	5	6	7
0 +	9	4.6							
1 +	52	7.7	3.71						
2 +	12	10.7	3.48	8.04					
3 +	6	12.1	2.75	6.76	9.97				
4 +	2	15.4	1.94	6.17	11.94	14.16			
5 +	1	17.0	4.27	8.96	11.88	14.56	16.03		
6 +	3	17.8	3.03	8.12	11.78	13.80	15.39	16.87	
7 +	0	---							
8 +	1	17.8	2.54	6.66	8.60	11.04	14.22	15.76	16.76
MEAN FORK LENGTH			3.10	7.45	10.83	13.39	15.21	16.32	16.76
MEAN ANNUAL INCREMENT			3.10	4.35	3.38	2.56	1.82	1.10	0.44
NUMBER OF FISH			77	25	13	7	5	4	1

TABLE 5
AGE AND GROWTH DATA FROM SCALE SAMPLES COLLECTED
FROM SMALLMOUTH BASS IN COW CREEK , 1987-88

ACTUAL AGE	NUMBER	ACTUAL MEAN FORK LGTH	<-MEAN CALCULATED LENGTH-> AT EACH YEAR OF LIFE 1.0	2.0	3.0
0 +	8.0	3.7			
1 +	14.0	8.7	3.7		
2 +	3.0	9.2	2.2	5.9	
3 +	1.0	8.4	1.6	3.8	6.2
MEAN FORK LENGTH			2.5	4.9	6.2
MEAN ANNUAL INCREMENT			2.5	2.4	1.4
NUMBER OF FISH			18	4	1

FIGURE 4. SMALLMOUTH BASS GROWTH



inches at age 2, 11 inches at age 3, and 13 inches at age 4. Bass growth to age 3 in Cow Creek was much slower than in either of the rivers. No bass over age 3 were sampled from Cow Creek.

Age-length keys were developed from smallmouth bass in the Umpqua and South Umpqua rivers based on the ages and actual lengths of bass sampled over the duration of the study (Tables 6 and 7). Data were insufficient to develop a key for Cow Creek. Size and age composition of bass from the two rivers were similar. No young-of-the-year bass were sampled from the Umpqua River. Those from the South Umpqua were 3 to 6 inches in length. Most of the older bass were in these size groups: Age 1, 5 to 9 inches; Age 2, 9 to 13 inches; Age 3, 10 to 15 inches. The few Age 4 and older bass were all over 13 inches in length.

Population Structure

Classification of bass into size groups during snorkeling surveys provided information on population structure (Tables 8 and 9). The three size groups (0"-5", 5"-10", and over 10") corresponded closely with young-of-the-year, age 1, and age 2 and older bass. In the Umpqua River, young-of-the-year bass were absent below Scottsburg (RM 27) but comprised 27% to 44% of the bass observed in study areas from Scottsburg to Umpqua (RM 103). Few young-of-the-year were found upstream from Umpqua. Age 1 bass were the most abundant age-class throughout the river. Age 2 and older bass comprised from 12% to 27% of the bass observed in the areas of the river above Scottsburg. They comprised 18% of the count between Elkton and Kellogg where total bass density was highest.

In the South Umpqua River, young-of-the-year bass comprised 75% of the observed population from the mouth to Dillard (RM 27) where bass density was highest. Age 1 bass were dominant in the section from Dillard (RM 27) to Myrtle Creek (RM 40) which also had a high bass density. Young-of-the-year were again the most abundant age-class from Myrtle Creek (RM 40) to Canyonville (RM 51), but age 1 bass dominated above that section. The percentage of age 2 and older bass observed was low throughout the river, comprising only 4% to 9% of the count.

In Cow Creek young-of-the-year were the most abundant age-class in the downstream portion but were absent upstream from River Mile 20. Overall they comprised 63% of the count. Most of the other bass counted were age 1. Age 2 and older bass were scarce throughout the stream.

Mortality

The age frequency of bass calculated from snorkel counts in the Umpqua River provided a good fit to the regression line for ages 1 to 5 ($R = 0.95$) resulting in an estimated total annual

TABLE 6
LENGTH DISTRIBUTION OF EACH AGE-CLASS OF SMALLMOUTH BASS SAMPLED FROM THE UMPQUA RIVER BY ONE-INCH SIZE GROUP

FISH AGE (YEARS)	LENGTH (INCHES) 5	6	7	8	9	10	11	12	13	14	15	16	TOTAL FISH PER AGE
1+	1	6	18	9	22	11	1	1					69
2+			1	4	6	11	26	18	6	4			76
3+							2	3	4	4	1		14
4+									3	2	1		6
5+											1		1
6+													0
7+											1		1
TOTAL FISH PER INCH GROUP	1	6	19	13	28	22	29	22	13	10	4	0	167

TABLE 7
LENGTH DISTRIBUTION OF EACH AGE-CLASS OF SMALLMOUTH BASS SAMPLED FROM THE SOUTH UMPQUA RIVER BY ONE-INCH SIZE GROUP

FISH AGE (YEARS)	LENGTH (INCHES) 3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	TOTAL FISH PER AGE
0+	2	3	3	1													9
1+		1	3	17	9	7	3		2								52
2+						3	4	3	1	1							12
3+							2	1	1	1	1						6
4+											1		1				2
5+													1				1
6+													1		1	1	3
7+																	
8+													1				1
TOTAL FISH PER INCH GROUP	2	4	6	18	9	10	9	4	4	2	2	0	4	0	1	1	86

TABLE 8

SIZE COMPOSITION OF SMALLMOUTH BASS OBSERVED IN THE UMPQUA RIVER DURING SNORKEL SURVEYS, JULY 28 - SEPT 3, 1987, SHOWING THE PERCENTAGE OF BASS IN EACH SIZE GROUP

	<------SIZE GROUPS------>			
AREA	0"-5"	5"-10"	10+"	TOTAL
BELOW SCOTTSBURG (RM 23-27)	0%	63%	37%	100%
SCOTTSBURG TO ELKTON (RM 27-49)	44%	44%	12%	100%
ELKTON TO KELLOGG (RM 49-71)	27%	55%	18%	100%
KELLOGG TO UMPQUA (RM 71-103)	31%	55%	14%	100%
UMPQUA TO FORKS (RM 103-112)	7%	66%	27%	100%

TABLE 9

SIZE COMPOSITION OF SMALLMOUTH BASS OBSERVED IN THE SOUTH UMPQUA RIVER AND COW CREEK DURING SNORKEL SURVEYS, JULY 28 - SEPT. 3, 1987, SHOWING THE PERCENTAGE OF BASS IN EACH SIZE GROUP

	<------SIZE GROUPS------>			
AREA	0"-5"	5"-10"	10+"	TOTAL
MOUTH TO DILLARD (RM 0-27)	75%	16%	9%	100%
DILLARD - MYRTLE CR (RM 27-40)	37%	57%	6%	100%
MYRTLE CR - CANYONVILLE (RM 40-51)	60%	37%	3%	100%
CANYONVILLE TO TILLER (RM 51-75)	21%	75%	4%	100%
ABOVE TILLER (RM 75-83)	0%	100%	0%	100%
COW CREEK (RM 0-37)	63%	32%	5%	100%

mortality rate of 58%. Young-of-the-year bass were not fully recruited to the population or to the sampling method so were excluded from the mortality estimate. Bass older than age 5 were also excluded because of insufficient age frequency data.

The estimated annual mortality rate for bass of age 0 to 5 in the South Umpqua River was 50% (R = 0.90). Young-of-the-year bass were observed in more representative numbers than in the Umpqua River and were included in the estimate. However, age frequency data for bass over age 5 were insufficient for inclusion in the estimate.

Fishery

Location and Intensity

Aerial counts and angler interviews showed that the smallmouth bass fishery occurs along the entire length of the Umpqua River above Scottsburg (RM 27) and on the South Umpqua River from the mouth upstream to Canyonville (RM 51). The bass fishery on the Umpqua River was about three times as large as the fishery on the South Umpqua River.

On the Umpqua River angler distribution was strongly related to access (Table 10). Large stretches of the river are not accessible by road or because of private property bordering the river. As a result approximately two-thirds of the angling was from a boat. The entire Umpqua River up to the Forks is floatable by drift boat throughout the period of the smallmouth bass fishery.

Area 3 between Kellogg (RM 71) and Umpqua (RM 103) is paralleled by highway and received 51% of the bass angler use. Area 1 between Scottsburg (RM 17) and Elkton (RM 49) has similar access and received 28% of the use even though bass numbers in this area were low. Area 2 between Elkton and Kellogg has limited bank access and received only 20% of the total use even though snorkel surveys showed that it has the highest bass population. Only 1% of the bass angling effort occurred upstream from Umpqua (RM 4) where access is limited to a few points. Also the density of bass is low in this area.

The intensity of the bass fishery was expressed as the average number of anglers per stream mile (Table 10). Angling intensity showed the same pattern as angler distribution, with Area 3 getting the most pressure followed by Area 1. Angling intensity for the entire river averaged 0.41 bass anglers per stream mile.

Road access to the South Umpqua River is better than on the Umpqua River. However, low flows in late summer and early fall limit boat access during the peak of the bass fishery. As a

TABLE 10
INTENSITY AND DISTRIBUTION OF USE BY SMALLMOUTH BASS ANGLERS ON THE UMPQUA RIVER FROM 15 AERIAL COUNTS MADE BETWEEN JUNE 4 AND SEPTEMBER 24, 1988 *

AREA	DESCRIPTION	TOTAL SB ANGLERS COUNTED	AVERAGE SB ANGLERS PER COUNT	AVERAGE SB ANGLERS PER STREAM MILE	PERCENT OF FISHERY
1	SCOTTSBURG TO ELKTON (RM 27-49)	149.0	9.93	0.45	28%
2	ELKTON TO KELLOGG (RM 49-71)	104.0	6.63	0.32	20%
3	KELLOGG TO UMPQUA (RM 71-103)	269.7	17.98	0.56	51%
4	UMPQUA TO FORKS (RM 103-112)	6.4	0.43	0.05	1%
TOTALS		529.1	35.27	0.41	100%

*NOTE : AERIAL COUNTS WERE MADE ON SATURDAYS FROM 9 AM TO NOON TO COINCIDE WITH PEAK USE. ANGLER INTERVIEWS WERE USED TO DISTINGUISH SMALLMOUTH BASS ANGLERS FROM THOSE WHO WERE ANGLING FOR OTHER SPECIES.

result, approximately two-thirds of the bass angling on the South Umpqua River occurred from the bank. Area 5, from the mouth to Dillard (RM 27), received 46% of the bass angling effort (Table 11). Another 43% of the angler use occurred in Area 6 between Dillard (RM 27) and Myrtle Creek (RM 40), even though this section is less than half the length of Area 5. Only 11% of the fishery occurred upstream from Myrtle Creek where both access and bass populations decrease. The high intensity of use in Area 6 is related to the excellent road access along the entire length.

Timing and Relationship to Other Fisheries

The smallmouth fishery on the Umpqua River began in the Spring as soon as the water temperature approached the 50 degree range. Our survey started on April 23 so would have missed anglers fishing for bass before this date. However, their numbers would have been very low because of low water temperatures and high, turbid flows which interfered with angling. Figure 5 shows the seasonal pattern of the Umpqua River smallmouth bass fishery by area from aerial counts. Peak use occurred in late July and early August. The bass fishery comprised 12% of the total angling effort in late April and remained at a low level through mid-June (Figure 6). It became the most important fishery on the river after the spring chinook and shad fisheries ended in late July and remained so until the fishery for fall-run salmonids increased in September. The bass fishery still accounted for over half of the angler use on the river when the survey ended on September 30.

The bass fishery on the South Umpqua River began in early May as soon as high spring flows receded and water temperatures began to rise. The peak of the fishery occurred from mid-June through mid-July (Figure 7). It was the most important fishery on the river through September, except for a brief period in late May and early June when small fisheries for shad and spring chinook occurred in the lower river (Figure 8). Our survey ended on September 30 before the decline of the fishery.

Catch

During 1988, we interviewed 343 smallmouth bass anglers on the Umpqua River. They fished 1442 hours to catch 1185 smallmouth bass at an average catch rate of 3.5 bass per angler and 0.8 bass per angler hour (Table 12). However, they released 540 (46%) of the bass caught so the harvest rate was only 1.9 bass per angler and 0.4 bass per angler hour. Hourly catch rates for boat and bank anglers were similar (Table 13), but catch per angler was higher for boat anglers because they fished for longer periods of time. The bass catch by area of the river (Table 12) showed that 68% of the bass were taken from Area 3 (Kellogg to Umpqua). Areas 1 and 2 provided 15% and 18% of the harvest, respectively.

TABLE 11
INTENSITY AND DISTRIBUTION OF USE BY SMALLMOUTH BASS ANGLERS ON THE SOUTH UMPQUA RIVER FROM 15 AERIAL COUNTS MADE BETWEEN JUNE 4 AND SEPTEMBER 24, 1988 *

AREA	DESCRIPTION	TOTAL SB ANGLERS COUNTED	AVERAGE SB ANGLERS PER COUNT	AVERAGE SB ANGLERS PER STREAM MILE	PERCENT OF FISHERY
5	MOUTH TO DILLARD (RM 0-27)	80.3	5.35	0.20	46%
6	DILLARD TO MYRTLE CR. (RM 27-40)	75.1	5.01	0.39	43%
7	MYRTLE CR. TO CANYONVILLE (RM 40-51	19.0	1.27	0.12	11%
8	CANYONVILLE TO TILLER (RM 51-75)	0.0	0.00	0.00	0%
TOTALS		174.4	11.63	0.16	100%

*NOTE : AERIAL COUNTS WERE MADE ON SATURDAYS FROM 9 AM TO NOON TO COINCIDE WITH PEAK USE. ANGLER INTERVIEWS WERE USED TO DISTINGUISH SMALLMOUTH BASS ANGLERS FROM THOSE WHO WERE ANGLING FOR OTHER SPECIES.

FIGURE 5. SEASONAL DISTRIBUTION OF SMALLMOUTH BASS ANGLERS, UMPQUA RIVER, 1988

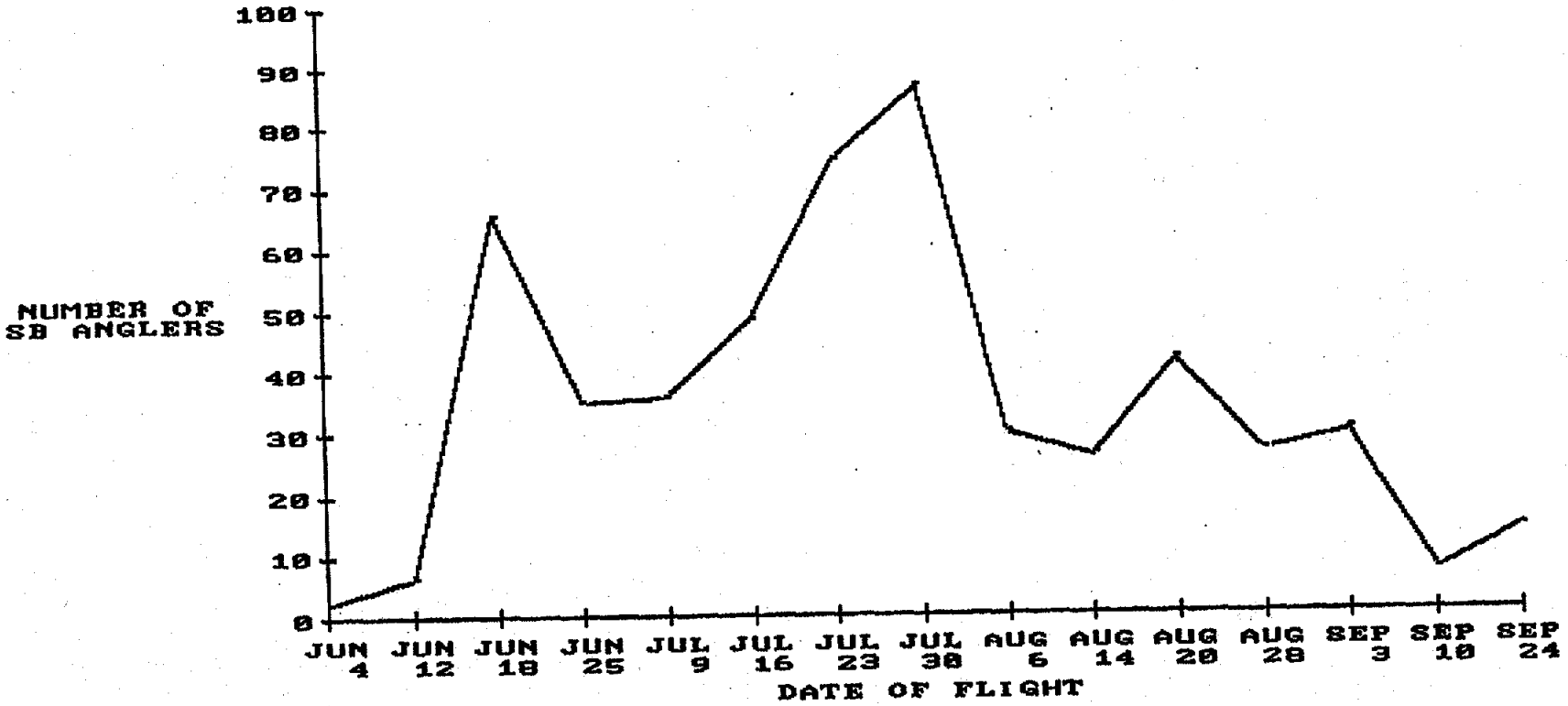


FIGURE 6. PERCENTAGE OF ANGLERS FISHING FOR SMALLMOUTH BASS IN THE UMPQUA RIVER, 1988

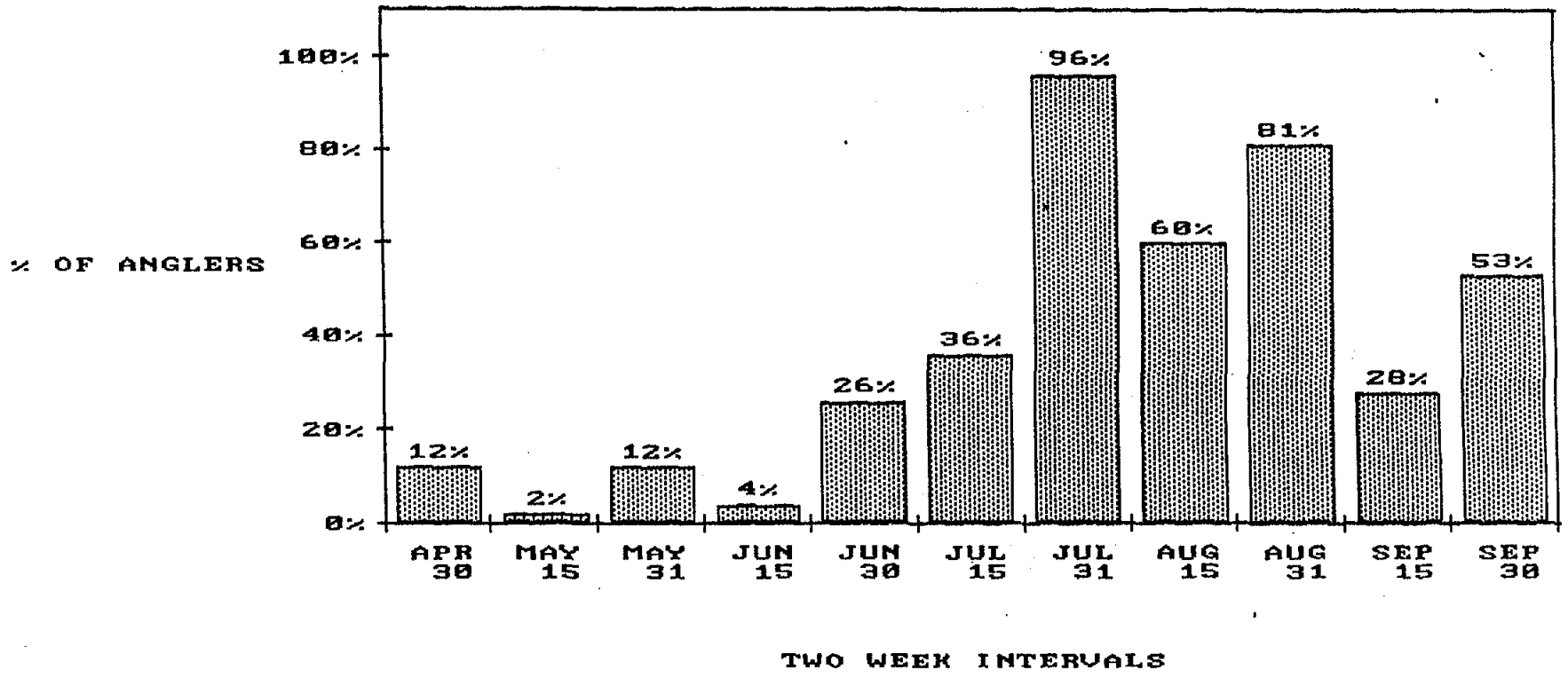


FIGURE 7. SEASONAL DISTRIBUTION OF SMALLMOUTH BASS ANGLERS, SOUTH UMPQUA RIVER, 1988

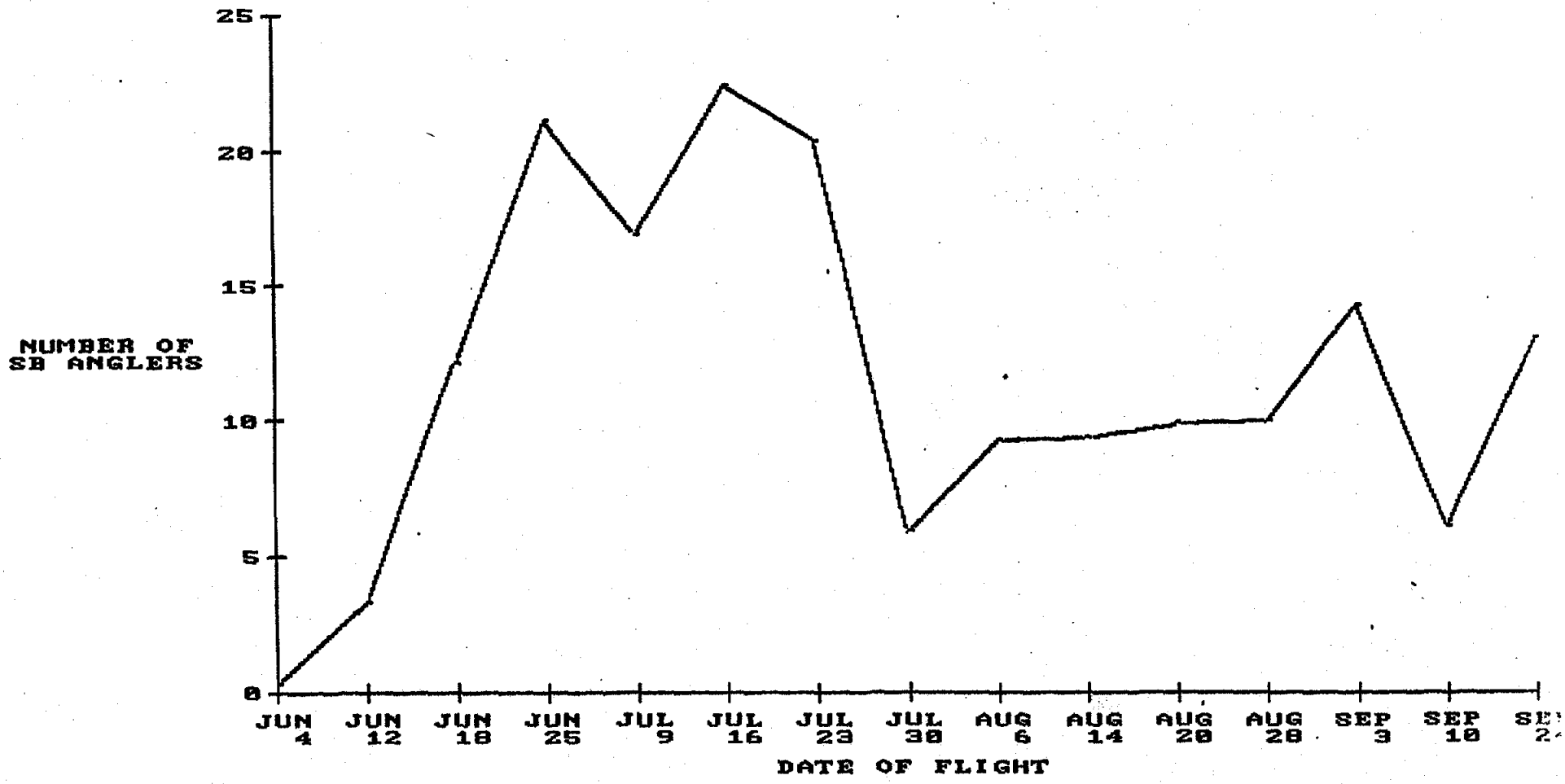


FIGURE 8. PERCENTAGE OF ANGLERS FISHING FOR SMALLMOUTH BASS IN THE SOUTH UMPQUA RIVER, 1988

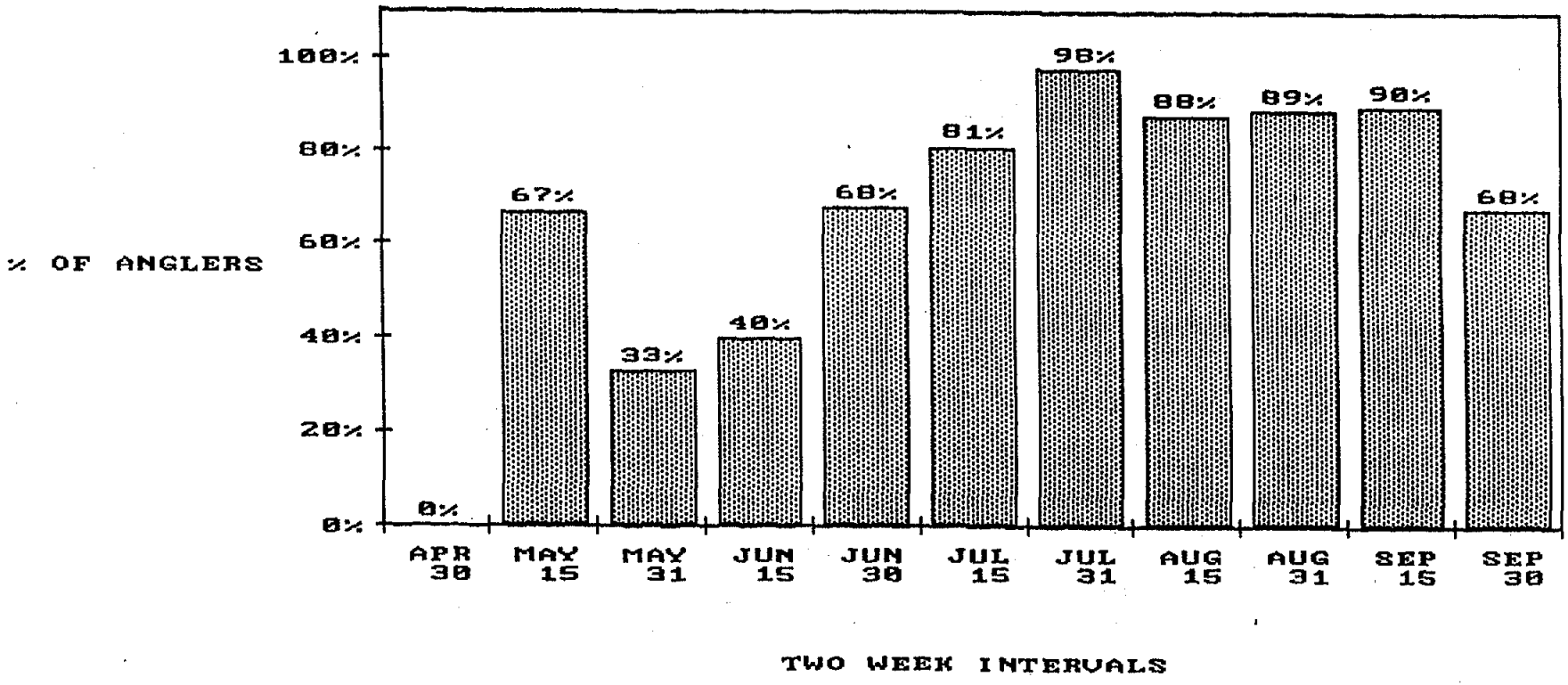


TABLE 12
SUMMARY OF CATCH DATA BROKEN OUT BY AREA FOR BOTH THE UMPQUA AND SOUTH UMPQUA RIVERS

UMPQUA RIVER

AREA	NUMBER ANGLERS	HOURS FISHED	FORK LENGTHS OF KEPT BASS 4-6	6-8	8-10	10-12	12-14	14-16	16-18	NUMBER BASS HARVESTED	NUMBER BASS RELEASED	BASS HARVESTED PER ANGLER	TOTAL BASS PER ANGLER	BASS HARVESTED PER HOUR	AVERAGE FORK LENGTH (INCHES)
1	61	216.4	0	18	42	31	18	1	0	110	66	1.8	2.9	0.5	9.9
2	36	187.6	5	18	17	12	32	0	0	84	19	2.3	2.9	0.4	10.1
3	233	983.1	0	27	132	170	94	5	5	433	375	1.9	3.5	0.4	10.7
4	13	55.1	0	0	4	0	10	4	0	18	80	1.4	7.5	0.3	12.6
TOTALS	343	1442.2	5	63	195	213	154	10	5	645	540	1.9	3.5	0.4	10.5

SOUTH UMPQUA RIVER

5	96	160.0	0	0	15	15	9	3	1	43	191	0.4	2.4	0.3	11.1
6	92	201.2	0	8	13	17	5	0	0	43	202	0.5	2.7	0.2	9.9
7	6	5.7	0	0	0	0	0	0	0	0	1	0	0.2	0	0
8	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	194	366.9	0	8	28	32	14	3	1	86	394	0.4	2.5	0.2	10.5

TABLE 13
CATCH RATES FOR BOAT AND BANK ANGLERS FISHING FOR SMALLMOUTH BASS IN THE UMPQUA RIVER, 1988

	BASS LANDED PER ANGLER	BASS LANDED PER HOUR
BOAT	6.1	0.8
BANK	1.8	0.8
TOTAL	3.5	0.8

The distribution of catch through the season (Table 14) showed that catch increased rapidly in mid-June and remained at a high level through August.

Smallmouth bass checked during angler interviews on the Umpqua River in 1988, ranged from 4 to 18 inches in length but most (86%) were in the 8 to 14 inch size group (Figure 9). The mean length of bass harvested was 10.5 inches and 59% exceeded 10 inches in length (Table 12). Age-length data showed that 44% of the bass harvested were age 1 and 46% were age 2 (Figure 10).

Anglers on the Umpqua River used bait most of the time when angling for smallmouth bass. The largest category of anglers (40%) used bait exclusively. Another 36% used a combination of bait and lures. These two categories of anglers caught 92% of all the bass checked. Bass caught by anglers who used a combination of bait and lures averaged 11.1 inches in length, while bass caught by bait-only anglers averaged 10.2 inches. Bass caught by lure-only anglers averaged 10.4 inches.

On the south Umpqua River, we interviewed 194 smallmouth bass anglers who fished 367 hours to catch 480 bass at an average catch rate of 2.5 bass per angler and 1.3 bass per angler-hour (Table 12). They released 394 (82%) of the bass caught so the harvest rate was only 0.4 bass per angler, and 0.2 bass per angler-hour. As on the Umpqua River, hourly catch rates for boat and bank anglers were similar, but boat anglers stayed out longer and caught more fish (Table 15). The bass harvest by area of the river showed that nearly all bass were taken from the two areas between the mouth and Myrtle Creek. Area 6 between Dillard (RM 27) and Myrtle Creek (RM 40) is only 13 miles in length but produced 51% of the total harvest. The distribution of catch through the season showed that angling picked up quickly in early July and peaked in late July (Table 16). Catch declined but remained steady through the end of the survey on September 30.

Smallmouth bass checked in the South Umpqua River fishery ranged from 6 to 16 inches in length and had a mean length of 10.3 inches (Figure 11). Bass in the 8 to 12 inch size group made up 70% of the harvest and 58% exceeded 10 inches in length (Table 12). Age-length data showed that 52% of the bass harvested were age 1, 32% were age 2, and 15% were age 3 (Figure 12).

The methods used to catch bass in the South Umpqua River were identical to those used in the Umpqua. The percentage of anglers using bait either by itself or in combination with lures made up 78% of the anglers interviewed and caught 90% of the bass. Bass caught by anglers who used a combination of bait and lures averaged the largest at 12.9 inches. Bass taken by bait-only anglers averaged 10.1 inches, and those caught by lure-only anglers averaged 12.0 inches.

TABLE 14
SUMMARY OF SMALLMOUTH BASS CATCH DATA FOR
THE UMPQUA RIVER, 1988

DATE		TOTAL ANGLERS	TOTAL HOURS FISHED	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	AVERAGE FORK LENGTH	TOTAL BASS KEPT	TOTAL BASS RELEASED	BASS KEPT PER ANGLER	BASS LANDED PER ANGLER	BASS LANDED PER HOUR	PERCENT RELEASED
APR 15-30	BOAT	0	0.0									0	0	0	0.0	0.0	0.0	---
	BANK	2	0.6									0	0	0	0.0	0.0	0.0	---
MAY 1-15	BOAT	0	0.0									0	0	0	0.0	0.0	0.0	---
	BANK	2	9.8				2		1			12.3	3	27	1.5	15.0	3.1	90%
MAY 16-31	BOAT	3	25.7					1				13.0	1	10	0.3	3.7	0.4	91%
	BANK	17	36.4			1	2					10.3	3	0	0.2	0.2	0.1	0%
JUN 1-15	BOAT	2	4.0									0.0	0	0	0.0	0.0	0.0	---
	BANK	2	6.6									0.0	0	0	0.0	0.0	0.0	---
JUN 16-30	BOAT	26	166.6		8	4	19	6				10.2	37	123	1.4	6.2	1.0	77%
	BANK	23	60.5		3	11	9	2				9.8	25	8	1.1	1.4	0.5	24%
JUL 1-15	BOAT	27	162.5		4	13	17	39	4	1		11.7	78	34	2.9	4.1	0.7	30%
	BANK	7	24.3			4	2					9.7	6	7	0.9	1.9	0.5	54%
JUL 16-31	BOAT	36	272.3		5	52	57	21	4			10.5	139	43	3.9	5.1	0.7	24%
	BANK	49	120.6	5	10	6	6	6				8.9	33	41	0.7	1.5	0.6	55%
AUG 1-15	BOAT	10	80.0			36	35	47		2		11.3	120	35	12.0	15.5	1.9	23%
	BANK	27	82.9		5	10	3	3	1	2		10.3	24	17	0.9	1.5	0.5	41%
AUG 16-31	BOAT	13	89.2			7	25	7				11.0	39	0	3.0	3.0	0.4	0%
	BANK	56	96.7		22	39	12	1				8.8	74	65	1.3	2.5	1.4	47%
SEP 1-15	BOAT	12	130.3		3	3	6	17				11.6	29	82	2.4	9.3	0.9	74%
	BANK	10	17.6			5	9	3				10.8	17	22	1.7	3.9	2.2	56%
SEP 16-30	BOAT	2	16.6				8	1				11.2	9	10	4.5	9.5	1.1	53%
	BANK	17	39.0		3	4	1					8.5	8	16	0.5	1.4	0.6	67%
SUBTOTAL	BOAT	131	947.2	0	20	115	167	139	8	3	0	11.0	452	337	3.5	6.0	0.8	43%
	BANK	212	495	5	43	80	46	15	2	2	0	9.4	193	203	0.9	1.9	0.8	51%
TOTAL		343	1442.2	5	63	195	213	154	10	5	0	10.5	645	540	1.9	3.5	0.8	46%

FIGURE 9. FORK LENGTHS OF SMALLMOUTH BASS CAUGHT BY ANGLERS FROM THE UMPQUA RIVER, 1988

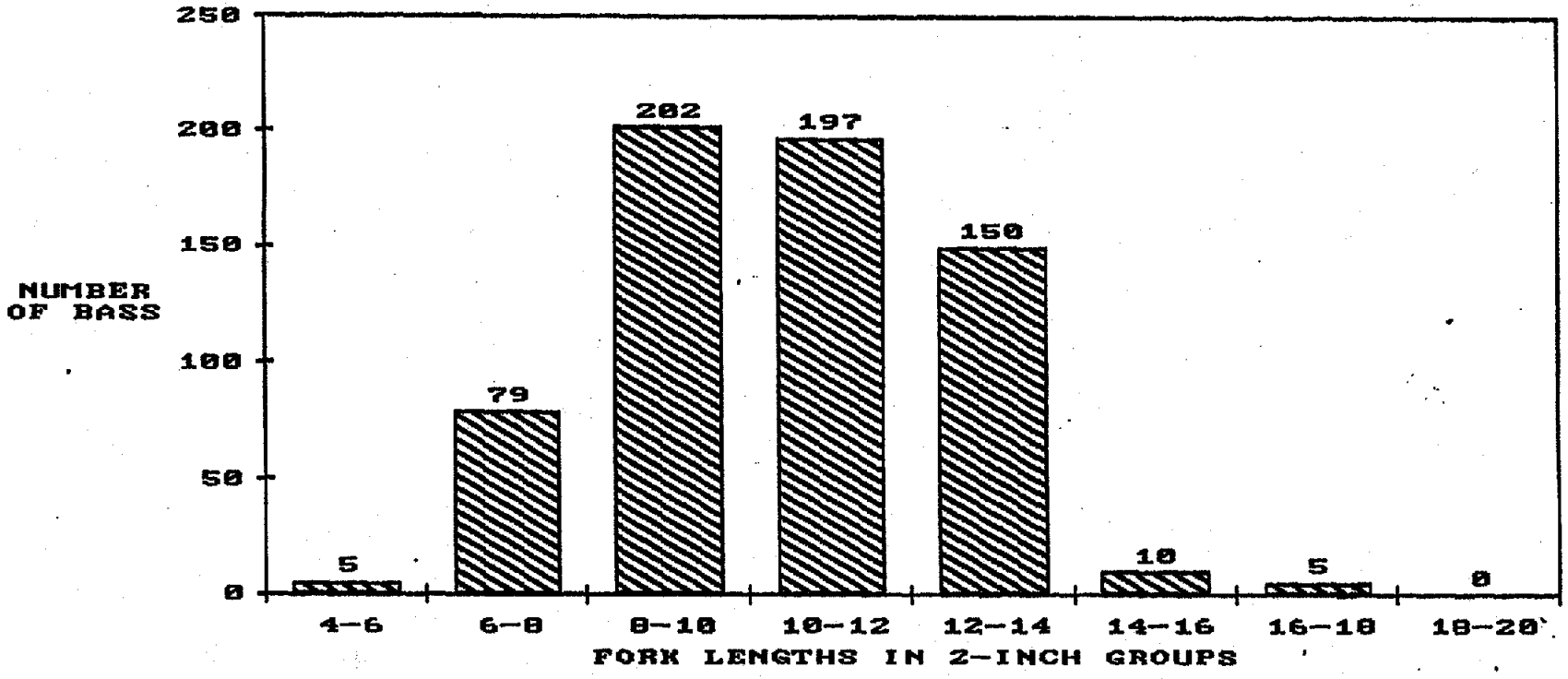


FIGURE 10. AGES OF SMALLMOUTH BASS CAUGHT BY ANGLERS IN THE UMPQUA RIVER, 1988 (N=645)

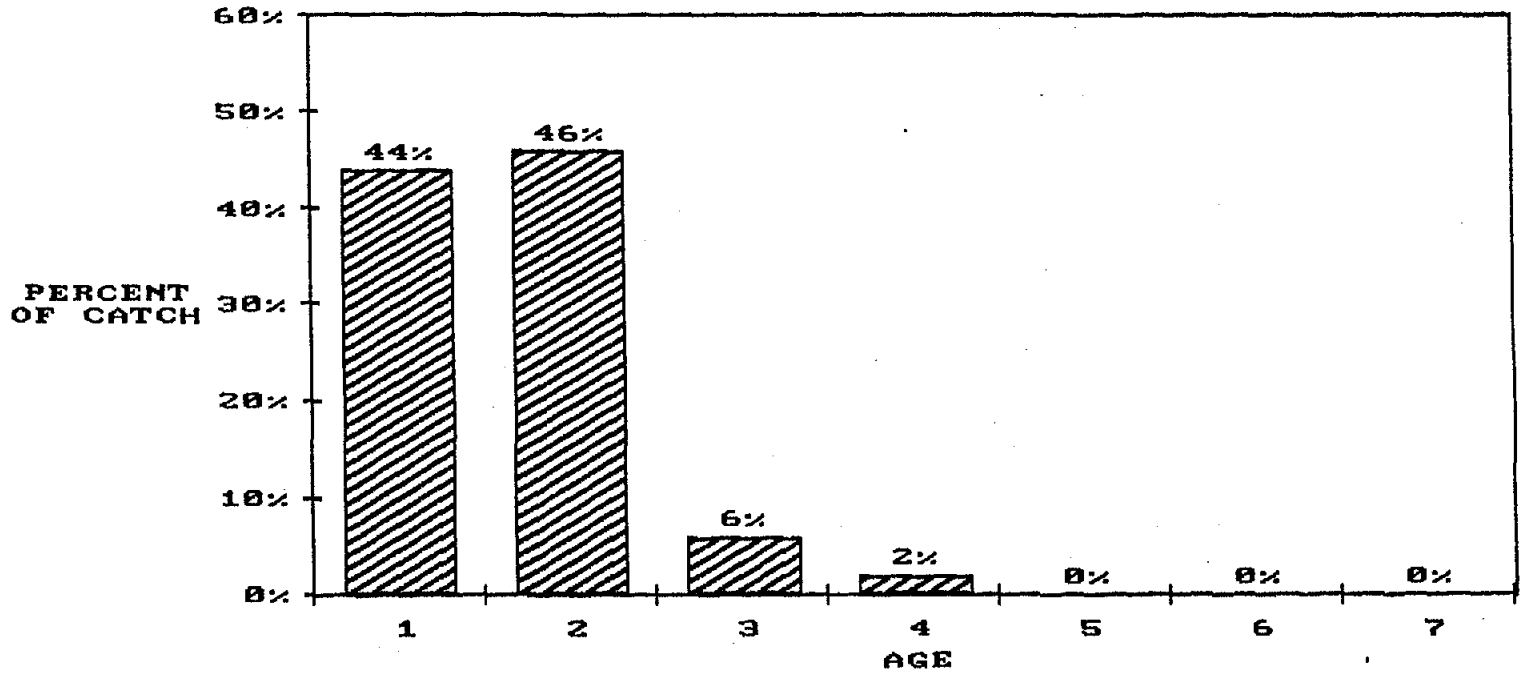


TABLE 15
CATCH RATES FOR BOAT AND BANK ANGLERS FISHING FOR SMALLMOUTH BASS IN THE SOUTH UMPQUA RIVER, 1988

	BASS LANDED PER ANGLER	BASS LANDED PER HOUR
BOAT	4.8	1.2
BANK	1.8	1.2
TOTAL	2.3	1.2

TABLE 16
SUMMARY OF SMALLMOUTH BASS CATCH DATA FOR
THE SOUTH UMPQUA RIVER, 1988

DATE		TOTAL ANGLERS	TOTAL HOURS FISHED	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	TOTAL BASS KEPT	TOTAL BASS RELEASED	BASS KEPT PER ANGLER	BASS LANDED PER ANGLER	BASS LANDED PER HOUR	PERCENT RELEASED
APR 15-30	BOAT	0	0.0									0	0	0.0	0.0	0.0	---
	BANK	0	0.0									0	0	0.0	0.0	0.0	---
MAY 1-15	BOAT	0	0.0									0	0	0.0	0.0	0.0	---
	BANK	2	5.1									0	40	0	20.0	7.8	100%
MAY 16-31	BOAT	0	0.0									0	0	0.0	0.0	0.0	---
	BANK	4	23.6			1						1	1	0.3	0.5	0.1	50%
JUN 1-15	BOAT	0	0.0									0	0	0.0	0.0	0.0	---
	BANK	15	16.1									0	3	0.0	0.2	0.2	100%
JUN 16-30	BOAT	5	19.2					3	1			4	1	0.8	1.0	0.3	20%
	BANK	8	15.5				1	3	1			5	3	0.6	1.0	0.5	38%
JUL 1-15	BOAT	6	18.6									0	33	0.0	5.5	1.8	100%
	BANK	20	22.6			1	1	2				4	6	0.2	0.5	0.4	60%
JUL 16-31	BOAT	19	79.1			8	6	3				17	78	0.9	5.0	1.2	82%
	BANK	20	24.5			2	3					5	45	0.3	2.5	2.0	90%
AUG 1-15	BOAT	2	4.4									0	0	0.0	0.0	0.0	---
	BANK	25	25.3		7	6	1	1	1			16	32	0.6	1.9	1.9	67%
AUG 16-31	BOAT	0	0.0									0	0	0.0	0.0	0.0	---
	BANK	17	17.6		1	4	4	1				10	36	0.6	2.7	2.6	78%
SEP 1-15	BOAT	0	0.0									0	0	0.0	0.0	0.0	---
	BANK	34	55.3					1				1	33	0.0	1.0	0.6	97%
SEP 16-30	BOAT	2	11.2			2	3					5	25	2.5	15.0	2.7	83%
	BANK	15	28.8			3	8	3				14	36	0.9	3.3	1.7	72%
SUBTOTAL	BOAT	34	132.5	0	0	10	9	6	1	0	0	26	137	0.8	4.8	1.2	84%
	BANK	160	234.4	0	8	17	18	11	2	0	0	56	235	0.4	1.8	1.2	81%
TOTAL		194	366.9	0	8	27	27	17	3	0	0	82	372	0.4	2.3	1.2	82%

FIGURE 11. FORK LENGTHS OF SMALLMOUTH BASS CAUGHT BY ANGLERS FROM THE SOUTH UMPQUA RIVER, 1988

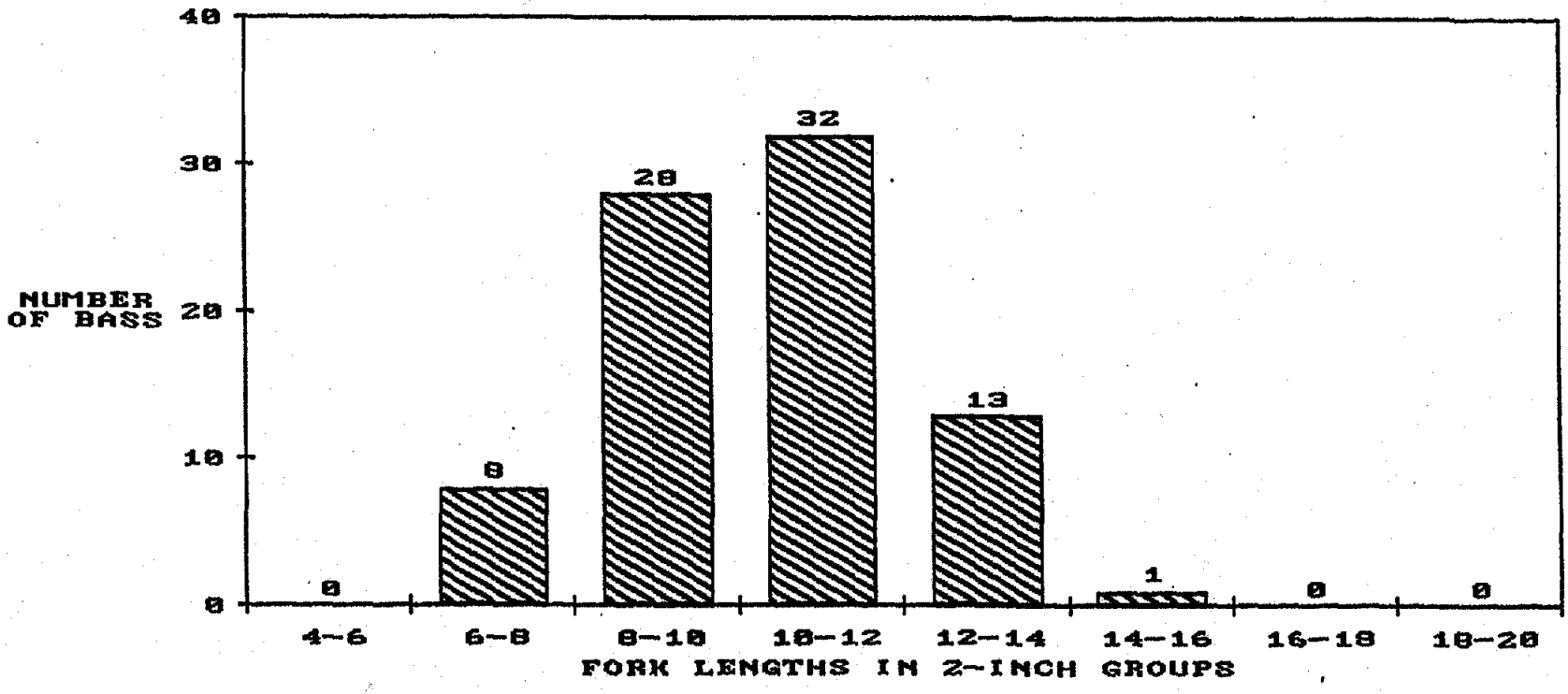
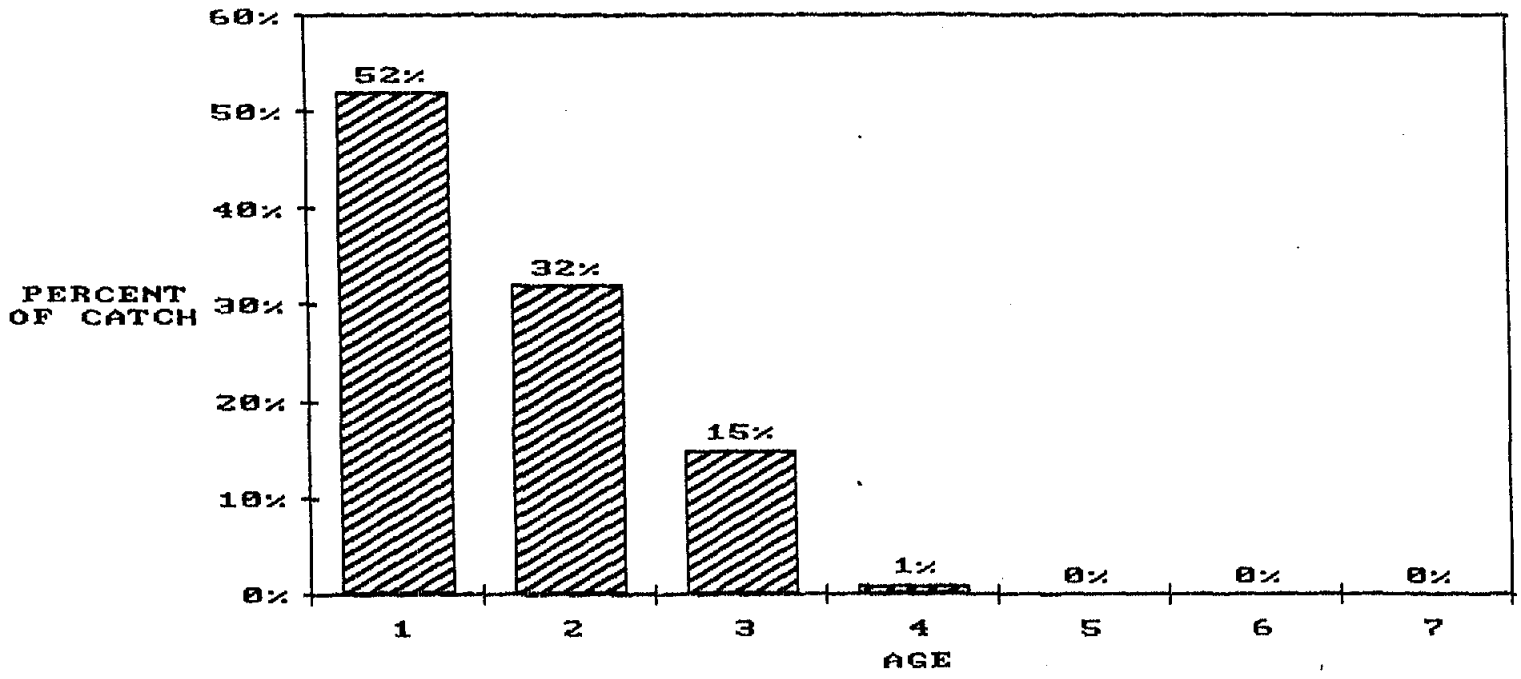


FIGURE 12. AGES OF SMALLMOUTH BASS CAUGHT BY ANGLERS IN THE SOUTH UMPQUA RIVER, 1988 (N=82)



Yeild per Recruit

Figures 13-16 show simulated catch, yield, and proportional stock density (PSD) for smallmouth bass at exploitation rates of 0% to 80% under 7 inch and 12 inch minimum size limits. PSD is an index of population size structure calculated as the percentage of stock size bass (over 7 inches) that exceed 11 inches in length. The 7 inch minimum size limit is considered equivalent to no size limit, since few anglers keep bass less than 7 inches long.

Model outputs for the Umpqua and South Umpqua rivers were identical except for slightly higher yield estimates for the South Umpqua because of the slightly faster growth rate of older bass there.

The outputs indicate that size limits would have little effect on yeild in weight at exploitation rates of less than 40%, but that the number and sizes of fish caught would be greatly affected. For example, at an exploitation rate of 40%, the catch under a 7 inch size limit would be double the catch under a 12 inch limit. However, the PSD, or proportion of stock size bass over 11 inches long, would be 83% greater with the 12 inch limit.

Diet

During 1988 we collected 94 stomachs from smallmouth bass that were harvested by anglers from the Umpqua and South Umpqua rivers. Fifty-two of the stomachs were from Umpqua River fish, with the remainder from the South Umpqua. The fish sampled ranged from 6 to 15 inches in length with 71% in the 9 to 12 inch size group. Half of the stomachs were empty. Contents of the remaining stomachs showed that fish and crayfish were the most common food items, followed by insects (Table 17). Fish were taken throughout the sampling period of May through September. Crayfish were most common in the diet after July. Insects made their greatest contribution to the diet in May and June. We were only able to identify two of the fish found in stomachs--one was a squawfish and the other a salmonid of unknown species.

DISCUSSION

Our first study objective was to develop effective techniques for sampling smallmouth bass in the stream system. The techniques developed provided a great deal of information about the smallmouth bass population but did not allow us to capture a representative sample of the bass present. Electrofishing with a drift boat offers the best potential for obtaining a better sample because it would allow us to sample all sections of the

FIG.13. SIMULATED CATCH

UMPQUA AND SOUTH UMPQUA RIVERS

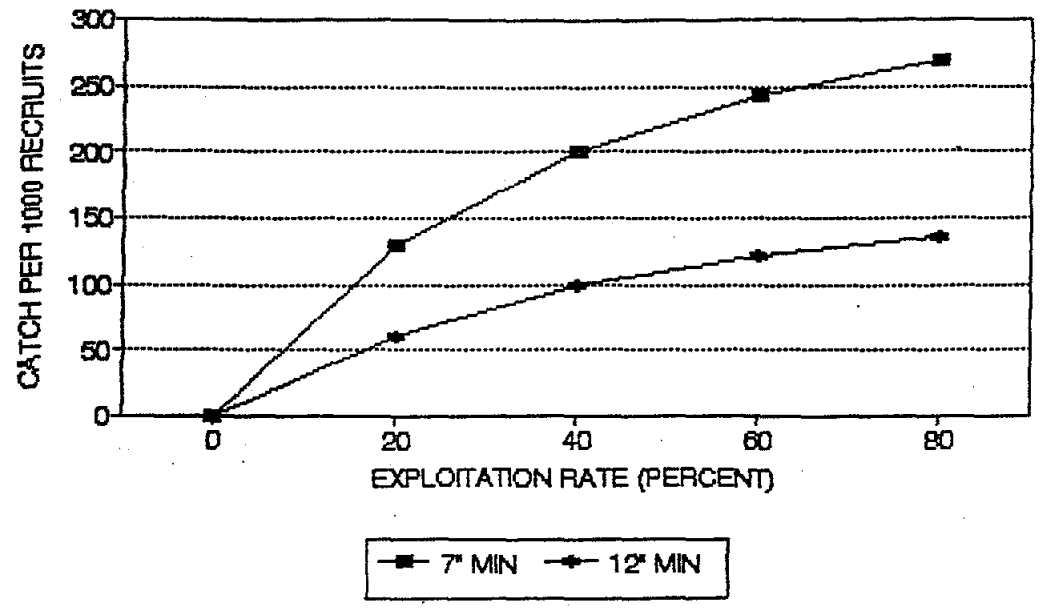


FIG.14. SIMULATED YIELD

UMPQUA RIVER

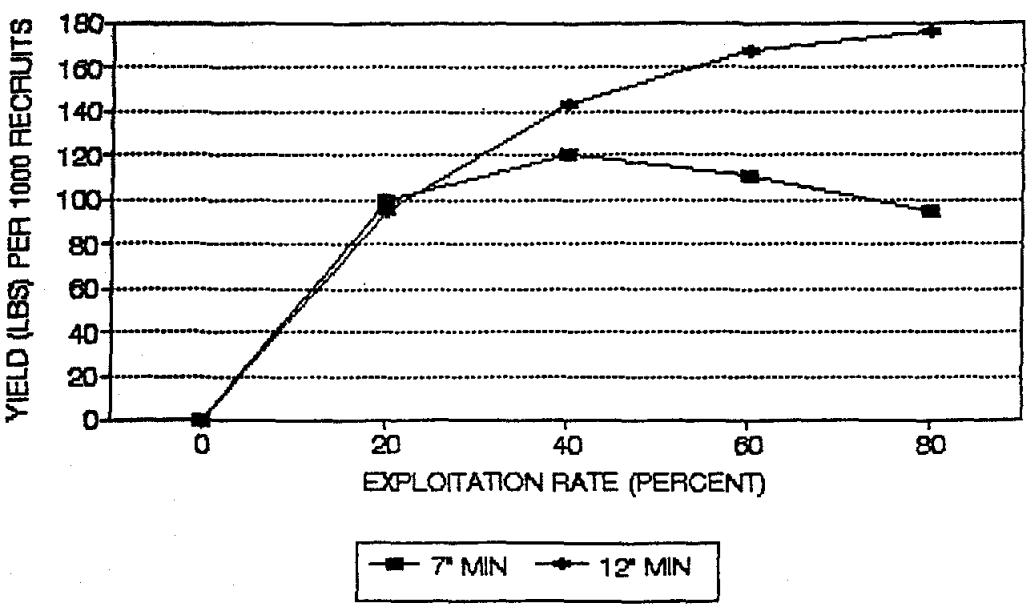


FIG.15. SIMULATED YIELD
SOUTH UMPQUA RIVER

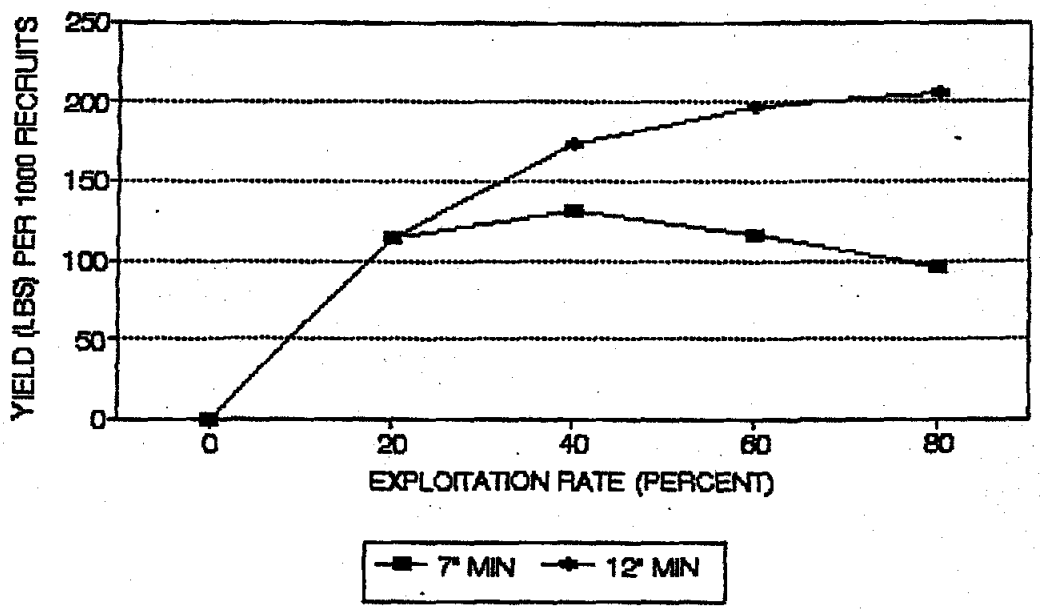


FIG.16. SIMULATED PSD
UMPQUA AND SOUTH UMPQUA RIVERS

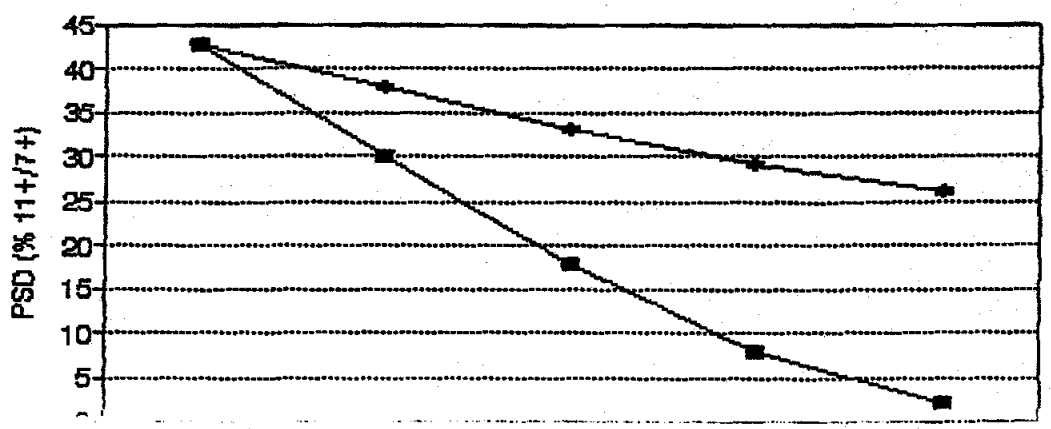


TABLE 17
STOMACH CONTENTS OF SMALLMOUTH BASS COLLECTED FROM
THE UMPQUA AND SOUTH UMPQUA RIVER IN 1988

MONTH	NUMBER COLLECTED	PERCENT EMPTY	PERCENTAGE OF NON-EMPTY STOMACHS CONTAINING: FISH	CRAYFISH	INSECTS	OTHER *
MAY	6	50%	33%	0%	33%	33%
JUNE	16	25%	50%	33%	33%	0%
JULY	34	62%	54%	62%	80%	0%
AUGUST	30	43%	35%	53%	12%	12%
SEPTEMBER	8	75%	50%	50%	0%	50%
TOTALS	94	50%	45%	47%	17%	9%

* INCLUDING PLANT MATERIAL, SNAKES, TADPOLES AND ANGLER BAIT

rivers. Electrofishing should be tried when visibility into the water is between 2 and 4 feet so as to not spook fish, but still allow samplers to see and pick up those that are stunned.

The present distribution and habitat associations of smallmouth bass in the Umpqua River basin indicates that the species now occupies most of the suitable habitat. The low populations or lack of bass in the smaller tributaries indicates that these waters do not provide suitable year-around habitat. The absence of young-of-the-year bass in the area of tidal influence below Scottsburg on the Umpqua River, and near the upstream limits of the species in the South Umpqua River and Cow Creek indicates a lack of reproduction in these areas.

Growth rates of smallmouth bass in the Umpqua and South Umpqua rivers equals or exceeds that in other Oregon streams (Table 18). All of the other streams except Thomas Creek are in Eastern Oregon. Bass growth in Cow Creek is poor compared to other state waters. If we assume that growth rates reflect habitat suitability, this would indicate that the Umpqua and South Umpqua rivers offer good habitat for smallmouth bass, while habitat in Cow Creek is marginal.

The estimated total annual mortality rates of 58% and 50% for the Umpqua and South Umpqua rivers, respectively, are in line with rates reported from other studies. Latta (1975) reported that mortality rates for smallmouth bass in northern latitudes ranged for 33% to 60% with a mean of 52%. Coble (1975) stated that it is characteristic of smallmouth bass populations that about half or more of the population dies each year. In 11 of 12 studies that he reviewed, annual mortality exceeded 50%, with a mean of 57%. He stated that angling is the greatest cause of mortality for bass over about 6 inches in many populations. Rohrer (1984 and 1985) reported annual mortality rates for smallmouth bass in Brownlee Reservoir of 73-82%. Estimates of annual smallmouth bass mortality for John Day Reservoir from catch curves ranged for 36% to 39%, but were apparently low when compared to mortality and exploitation estimates by other methods (Beamesderfer, et al, 1987).

The smallmouth bass fishery is the most important fishery on the Umpqua and South Umpqua rivers through much of the summer and fall. It is the only fishery available for part of that period. The average number of anglers per stream mile is light because the bass fishery occurs over 85 miles of the Umpqua River and 51 miles of the South Umpqua River. However, access concentrates anglers in some areas. The average catch rates on the Umpqua and South Umpqua rivers compare favorably with those on the John Day River which is considered a good smallmouth bass stream (Table 19). Average lengths of bass harvested from the Umpqua and South Umpqua rivers also compare favorably with bass taken from the

TABLE 18
GROWTH RATES OF SMALLMOUTH BASS IN OREGON STREAMS (DAILY 1989)

	MEAN CALCUALTED LENGTH AT EACH AGE							
STREAM	1	2	3	4	5	6	7	8
SOUTH UMPQUA RIVER	3.1	7.5	10.8	13.4	15.2	16.3	16.8	
JOHN DAY RIVER	2.5	7.0	10.8	13.0	14.4	15.3	16.2	
UMPQUA RIVER	3.5	8.0	10.8	12.6	13.9	14.9		
THOMAS CREEK	3.3	6.7	9.3	10.6	11.8	12.9		
OWYHEE RIVER	2.2	5.3	7.7	9.0	9.8	10.8	11.7	12.4
COW CREEK	2.5	4.9	6.2					
SNAKE RIVER	1.9	4.3	6.0	7.2	9.2	10.6	11.5	

TABLE 19
CATCH DATA FROM SMALLMOUTH BASS FISHERIES IN OREGON

STREAM	YEAR	TOTAL BASS PER ANGLER	TOTAL BASS PER HOUR	MEAN LENGTH (INCHES)
UMPQUA RIVER	1988	3.7	0.9	10.4
SOUTH UMPQUA RIVER	1988	2.2	1.3	10.3
JOHN DAY RIVER	1973-87	2.3	0.7	10.7

John Day River. Anglers on the Umpqua and South Umpqua rivers released an exceptionally high percentage of the bass caught. This may indicate dissatisfaction with the size of the fish, or a desire to conserve the bass population and improve angling.

Population modeling indicates that at exploitation rates over 40%, size regulations could have a significant effect on the number and size of bass harvested. A tagging study is planned for 1990 to estimate the exploitation rate of bass in the Umpqua River. Exploitation estimates for smallmouth bass populations in John Day and Brownlee reservoirs have ranged from 26% to 45% (Beamesderfer, et al, 1987, and Rohrer, 1984 and 1985). If exploitation rates on the Umpqua and South Umpqua rivers are similar to the highest of these rates regulations could significantly affect the fishery. For example, larger minimum size limit could reduce the number of fish harvested and consequently the number of people getting to take fish home. However, it might also increase the size of bass harvested and the population available for catch and release. Information is needed on the movement of bass within the stream system to determine how variations in exploitation rates by area will affect the population. The tagging study should also provide this information.

The diet segment of this study was too limited to address the concern about possible predation of smallmouth bass on salmonids. Additional sampling of smallmouth bass stomachs should be done in the spring when juvenile salmonids are migrating through the areas inhabited by bass. Stream temperatures should also be monitored and correlated with bass feeding activity to determine the timing of smolt passage that would minimize predation by bass.

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