

Grizzly bear habitat use on cutthroat trout spawning streams in tributaries of Yellowstone Lake
by Daniel Paul Reinhart

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University
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Abstract:
Grizzly bears (Ursus arctos) and black bears (U. americanus) prey on spawning cutthroat trout (Oncorhynchus clarki) in tributary streams of Yellowstone Lake in Yellowstone National Park. Tributaries were surveyed from 1985 to 1987 to determine the presence and level of trout spawning activity and bear use. Indices were developed to estimate spawner density and levels of bear activity and fishing on streams. Of 126 known tributaries of Yellowstone Lake, 48% had a spawning run. Of these spawning streams, 95% had evidence of associated bear activity, and 61% had associated evidence of bear fishing. Bear use of cutthroat trout spawning streams was largely a positive function of spawner density/m^3 . Bear use was secondarily related to timing of spawning runs, proximity to other spawning streams, and abundance and quality of streamside vegetation. Less bear use of spawning streams than expected from regression analysis occurred near park developments. Scat analysis showed 16.5% scat volume of cutthroat trout remains and translated into 91.8% estimated total ingested volume of trout when fecal correction factors were applied. Vegetation communities along Yellowstone Lake spawning streams were rated overall higher quality habitat for bears than Yellowstone Park at large or the upland communities surrounding Yellowstone Lake. I concluded that spawning cutthroat trout were an important seasonal food for a large number of Yellowstone bears.

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APPROVAL

of a thesis submitted by

Daniel P. Reinhart

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date June 11, 1990

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ABSTRACT

Grizzly bears (Ursus arctos) and black bears (U. americanus) prey on spawning cutthroat trout (Oncorhynchus clarki) in tributary streams of Yellowstone Lake in Yellowstone National Park. Tributaries were surveyed from 1985 to 1987 to determine the presence and level of trout spawning activity and bear use. Indices were developed to estimate spawner density and levels of bear activity and fishing on streams. Of 126 known tributaries of Yellowstone Lake, 48% had a spawning run. Of these spawning streams, 95% had evidence of associated bear activity, and 61% had associated evidence of bear fishing. Bear use of cutthroat trout spawning streams was largely a positive function of spawner density/m^3. Bear use was secondarily related to timing of spawning runs, proximity to other spawning streams, and abundance and quality of streamside vegetation. Less bear use of spawning streams than expected from regression analysis occurred near park developments. Scat analysis showed 16.5% scat volume of cutthroat trout remains and translated into 91.8% estimated total ingested volume of trout when fecal correction factors were applied. Vegetation communities along Yellowstone Lake spawning streams were rated overall higher quality habitat for bears than Yellowstone Park at large or the upland communities surrounding Yellowstone Lake. I concluded that spawning cutthroat trout were an important seasonal food for a large number of Yellowstone bears.

INTRODUCTION

Effective management of grizzly bears (Ursus arctos horribilis) in the Yellowstone Ecosystem relies on understanding their food habits and habitat use. The designation of the grizzly bear as "threatened" under the Endangered Species Act in 1975 requires special protection and management on Federal lands for this species (Interagency Grizzly Bear Guidelines, 1986). Effective control of grizzly bear mortality and maintenance of high quality habitat is critical to their survival.

The grizzly bear in the Yellowstone Ecosystem has been studied extensively. Murie (1944) reported initial findings on grizzly bear food habits. From 1959-70, researchers studied food habits, social behavior, general ecology, and management of Yellowstone grizzly bears (Craighead and Craighead 1971, 1972; F. Craighead 1976; J. Craighead 1980; Craighead et al. 1982; and others). From 1973 to the present, the Interagency Grizzly Bear Study Team (IGBST) studied food habits, habitat use, movements, population status, general ecology and management of grizzly bears in the Yellowstone Ecosystem (Mealey 1975, Blanchard 1978, Graham 1978, Kendall 1983, Schleyer 1983, Knight et al. 1984, Knight and Eberhardt 1985, Harting 1985, Mattson et al. 1987, and others).

Spawning and migrating salmonids are a major food of brown bears (U. arctos) and black bears (U. americanus) worldwide. Anadromous Pacific salmon (Oncorhyncus spp.) comprise a major part of seasonal

bear diets in coastal systems of Alaska (Clark 1959, Frame 1974, Luque and Stokes 1976, Berns et al. 1980, Glenn and Miller 1980), British Columbia (Meehan 1961, Hamilton and Archibald 1985), and the Soviet Union (Bergman 1936, Bromlei 1965, Kistchinski 1972). Bears historically used salmonids in headwaters of the Columbia and Clearwater Rivers in northwest United States (Wright 1909, Russell 1967) and elsewhere. Hydroelectric development and fisheries practices have disrupted spawner numbers and bear movements in these river systems (Butterfield and Almack 1985, Davis et al. 1986), in California (Piekielek and Burton 1975), the Soviet Union (Lazarev 1978), and Japan (Aoi 1985).

In Yellowstone National Park, grizzly and black bears fish for adfluvial cutthroat trout (Oncorhyncus clarki, formerly known as Salmo clarki) in tributaries of Yellowstone Lake (Hoskins 1974, 1975; Mealey 1975, 1980). This has been evident from an abundance of fish carcasses, trail matting of vegetation, bear scats, tracks, and observations of bears along banks of spawning streams around Yellowstone Lake. Bear use of fish is consistent with the fact that bears are morphologically and physiologically adapted to digest protein, and fish are highly digestible (Herrero 1978, Bunnell and Hamilton 1983, Hewitt and Robbins 1990).

In 1974 and 1975, the Interagency Grizzly Bear Study Team (IGBST) conducted a survey of Yellowstone Lake spawning streams and associated bear use (Hoskins 1974, 1975). Mealey (1975, 1980) also investigated bear use of spawning trout as part of his food habits study in

Yellowstone Park. Since 1975, changes in management of the cutthroat trout fishery have resulted in an increase in the population age and size structure of trout in Yellowstone Lake (Gresswell and Varley 1988).

This study was conducted from 1985 through 1987 to further investigate bear use of spawning streams in Yellowstone Park. The first 2 years of this study were a cooperative project by the IGBST and the U. S. Fish and Wildlife Service (USFWS) Fisheries Assistance Program in Yellowstone Park. Jones et al. (1986, 1987) presented information obtained by the USFWS on fish population structure and physical stream attributes related to cutthroat trout spawning runs. This manuscript provides data on seasonal grizzly bear habitat use of spawning streams and provides a framework for management of areas around Yellowstone Lake. Specific objectives of this study were:

1. To appraise the relative value of cutthroat trout as a food source for Yellowstone grizzly bears.
2. To quantify spawning stream attributes that contribute to usability by bears.
3. To appraise the overall food habits and habitat use of bears on spawning streams.
4. To identify changes in bear use of streams since the 1970's.
5. To provide data for park managers to develop guidelines to reduce bear-human conflicts near spawning streams.

STUDY AREA

Yellowstone Lake and Tributaries

The study area included all tributary streams of Yellowstone Lake in east-central Yellowstone National Park (Fig. 1).

Yellowstone Lake is a high elevation (2358 m), oligotrophic lake. It is relatively deep with an average depth of 42 m and a maximum depth of 98 m. Yellowstone Lake has a surface area of 35,391 ha, basin capacity of 14×10^9 m^3 (Benson 1961), and an estimated shoreline of 176 km. The size of tributaries feeding Yellowstone Lake varied considerably. The small, intermittent streams had flows of less than 0.01 m^3/sec. The largest tributary, the Yellowstone River Inlet, had an estimated drainage basin capacity of 43,269 ha (Jones et al. 1986). There are 124 known tributaries that feed Yellowstone Lake (Hoskins 1974, Varley et al. 1976, Jones et al. 1986). Unnamed streams were numbered by Hoskins (1974) and by Yellowstone Park officials using a system of numbering Yellowstone waters (SONYEW) in 1975 (Varley et al. 1976). This system was recently changed to provide stream classification by hierarchical order and geographical location, and provide the ability to add new streams without changing the entire numbering system (Jones et al. 1986). All tributary streams are listed by name, Hoskins number, old, and revised SONYEW number in Appendix Table 14. Revised SONYEW numbers are referenced in the text and presented in Appendix Fig. 1.

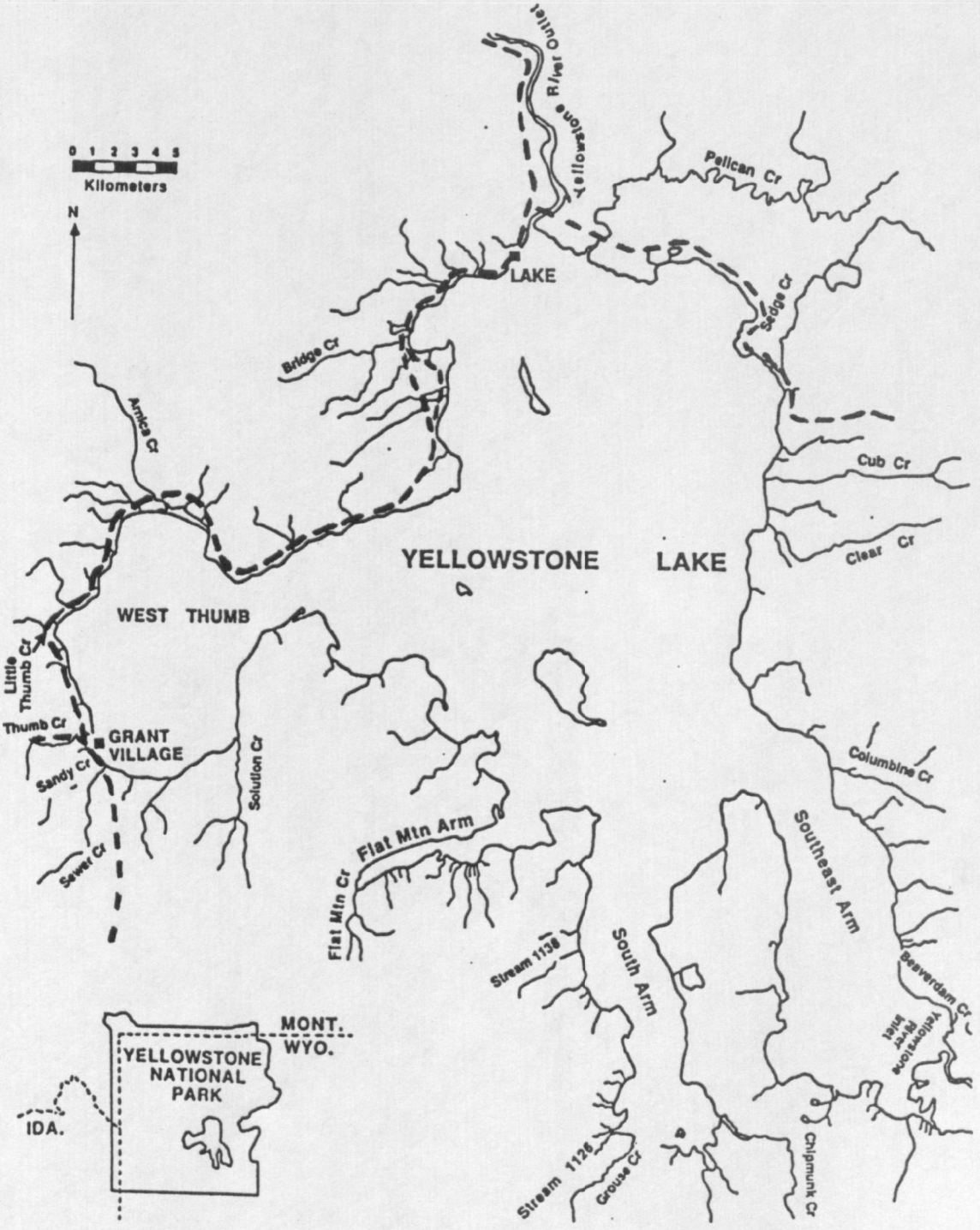

Fig. 1. Map of Yellowstone Lake and tributary streams.

Yellowstone Lake and its tributaries are partitioned into back- and front-country areas. Front-country portions lie on the north and northwest shore including the north half of the West Thumb. This area is characterized by its proximity to major park roads and developments. The Lake and Grant Village concessions lie on the north shore of Yellowstone Lake near the Yellowstone River Outlet and on the West Thumb, respectively, (Fig. 1). Park concessions include hotels, lodges, campgrounds, employee housing, restaurants, gas stations, stores, marinas, and park ranger and visitor stations.

Backcountry portions of Yellowstone Lake, away from roads and developments, include areas along the east shore, Southeast, South and Flat Mountain Arms, and the west shore to Grant Village (Fig. 1). Backcountry streams have horse and hiking trails and primitive campsites in their vicinity and are closed to people during the cutthroat trout spawning season until 15 July. The 3 arms of Yellowstone Lake have power boat restrictions that either eliminate the use of motorized boating or reduce boating speeds to 5 mph.

Yellowstone Lake Watershed

The Yellowstone Lake drainage basin is an estimated 261,590 ha (Benson 1961). Of this, 174,709 ha lies within Yellowstone National Park; the watershed outside the park comprises the south and east tributaries of the Yellowstone River Inlet in the Bridger Teton and Shoshone National Forests.

Geology

The geology of Yellowstone Lake and its drainage basin was created by geologic episodes of volcanic activity and glaciation (Keefer 1972). The drainage basin was formed around 600,000 years ago as part of a 2,595 km^2 caldera created after an immense volcanic eruption. The bedrock of the Yellowstone Lake basin is characterized by Absaroka andesite and basalt on the east and south portions and volcanic rhyolite on the west and north portions of the drainage basin (Keefer 1972).

Climate

Climate of Yellowstone Lake and its drainage is characterized by long, cold winters and short, cool summers. Mean annual temperature at Lake Yellowstone weather station was 0.2 C; summer and winter temperatures averaged 11.5 C and -9.5 C, respectively (Dirks and Martner 1982). Yellowstone Lake remains frozen from December until late May or early June.

Mean annual precipitation in the Yellowstone Lake area is 49.8 cm (Dirks and Martner 1982). Most precipitation falls in the form of snow during the late fall and winter months. Specific snowfall patterns were recorded from Soil Conservation Service (SCS) Snotel data at Canyon and Sylvan Pass north and east of Yellowstone Lake, respectively. Snowpack accumulation for the study years 1985 through 1987 were: 1985 - 80% of normal, 1986 - 107% of normal, and 1987 - 52% of normal.

Landscape Physiography

The overall landscape of the Yellowstone Lake watershed differs between the east and west shores of the lake. The east and southeast drainage is dominated by larger tributaries draining from high relief mountain topography, closed canopy mixed forest, and subalpine meadows. The southwest, west, and north drainage is characterized by smaller streams draining from low relief, plateau topography, lodgepole pine (Pinus contorta) forest, and alluvial meadows.

Vegetation Communities

The study area was located primarily within 2 major subalpine vegetation zones (Despain 1973). The lodgepole pine zone dominated the west and north drainage basin. This zone was characterized by large tracts of even-aged lodgepole pine with some Engelmann spruce (Picea engelmannii) and subalpine fir (Abies lasiocarpa) widely scattered near riparian areas. Alluvial grass-sedge and grass-forb meadows occurred along stream corridors.

The spruce-fir zone dominated the east and south drainage basin of Yellowstone Lake. Mixed stands of Engelmann spruce, subalpine fir, and lodgepole pine occurred throughout with open grass-sedge meadows along riparian areas and subalpine meadows at higher elevations. Whitebark pine (Pinus albicaulis) occurred at higher elevations of this zone and along the southeast shore of Yellowstone Lake.

Streams around Yellowstone Lake were bounded by 6 major habitat types and 7 cover types. Forest and nonforest habitat types follow Steele et al. (1983) and Mattson (1984), respectively, and are described in Table 1. Cover types follow Mattson and Despain (1985) and are described in Table 2.

Fauna

Piscifauna

Yellowstone Lake supports 2 native and 3 non-native fish species. Cutthroat trout is the predominant fish in Yellowstone Lake and the only game species. The longnose dace (Rhinichthys cataractae) is the only other native fish (Simon 1962). Introduced species include redside shiners (Richardsonius balteatus), longnose suckers (Catostomus catostomus), and lake chub (Couesius plumbeus) which occurs in small numbers (Gresswell and Varley 1988).

Avifauna

Yellowstone Lake supports numerous piscivorous avifauna. The most significant predator of cutthroat trout is the white pelican (Pelecanus erythrohhychos) (Ball and Cope 1961, Davenport 1974). These birds fish the lake and larger, more open tributaries and the mouths of streams during the spawning runs. Other birds found fishing tributaries are California gulls (Larus californicus) and common ravens (Corvus corax). Ospreys (Pandion haliaetus) and bald eagles (Haliaetus leacocephalus) fish for cutthroat trout and are found

Table 1. Forest and nonforest habitat types found in Yellowstone Lake tributary study area.*

Scientific Name	Acronym	Common Name
Forest Habitat Types		
Picea engelmannii/ *Equisetum arvense*	PIEN/EQAR	Engelmann Spruce/ Horsetail
Abies lasiocarpa/ *Calamagrostis canadensis*	ABLA/CACA	Subalpine Fir/Bluejoint Reedgrass
Nonforest Habitat Types		
Calamagrostis canadensis/ *Senecio triangularis*	CACA/SETR	Bluejoint Reedgrass/ Arrowleaf Groundsel
Salix wolfii/ *Carex microptera*	SXWO/CXMI	Wolf's Willow/Smallwinged Sedge
Phleum alpinum/ *Agropyron caninum*	PHAL/AGCA	Alpine Timothy/Bearded Wheatgrass
Carex rossii/*Carex rossii*	CXRO/CXRO	Ross Sedge/Ross Sedge

*Habitat types follow the classification of Steele et al. (1983) for forest and Mattson (1984) for nonforest types.

Table 2. Forest and nonforest cover types found in Yellowstone Lake tributary study area.

Cover Type	Site Description*
	Forest Cover Types
SF	Climax stand of Engelmann spruce and subalpine fir.
LP3	Overmature stand of lodgepole pine with mature Engelmann spruce and subalpine fir.
LP2	Mature stand of lodgepole pine with undermature Engelmann spruce and subalpine fir.
	Nonforest Cover Types
Wet Forest Opening	Swale or stream course opening bounded by forest and persistently shaded. Dense graminoid-herbaceous vegetation.
Low Willow Shrubland	Floodplain, peatland, or gently sloping seep. Low lying willows with dense herbaceous vegetation.
Wet Grassland Meadow	Floodplain, basin meadows, and gently sloping seeps. Wet-to-moist sites with dense and diverse graminoid-herbaceous vegetation.
Marsh/Fen	Low lying, concave or gentle slopes with seepage. Persistently saturated site dominated by sedges.

*Site description from Mattson and Despain (1985).

nesting in several areas near the lakeshore (Swenson 1975). Other piscivorous birds on Yellowstone Lake include double-crested cormorants (Phalaerocorax auritus), common mergansers (Mergus manganser), belted kingfishers (Megaceryle alcyon), great blue herons (Ardea herodias), and Caspian terns (Hydroprogne caspia) (Davenport 1974).

Terrestrial Fauna

Populations of mammals are found in the study area around Yellowstone Lake. Mammals that fish tributary streams other than grizzly and black bears include coyotes (Canis latrans), river otters (Lutra canadensis), and mink (Mustella vison). Other mammals associated with stream habitats are muskrats (Ondatra zibethica) and beaver (Castor canadensis). Ungulates found near streams include elk (Cervus elaphus), bison (Bison bison), moose (Alces alces), and mule deer (Odocoileus hemionus). Small mammals associated with bear food habits around Yellowstone Lake include red squirrels (Tamiasciurus hudsonicus), pocket gopher (Thomomys thalpoides), ground squirrels (Spermophilus cilellus), and voles (Microtus spp.).

METHODS

Field Methods

Field work was conducted on lake tributaries during the cutthroat trout spawning runs from May through August 1985, 1986, 1987. Additional data on larger streams were collected in 1988. All tributary streams within the study area were visited at approximately 1- to 2-week intervals to determine the presence and level of trout spawning activity and bear use.

The 1985 study area included all backcountry streams along the east shore, Southeast, South, and Flat Mountain Arms, and the west shore to Grant Village (Fig. 1). Backcountry streams were visited by boat. The 1986 study area included all front-country streams proximal to park roads and developments (Fig 1); selected backcountry streams on the east shore and Flat Mountain Arm were also surveyed in 1986. In 1987, all 1985-86 study area streams were surveyed.

Once a spawning run was observed on a stream, the following data were collected each visit for every 100-m stream section from the mouth to the upstream extent that fish and bear sign were observed:

1. Stream physical parameters, including stream order, mean width, depth, stream gradient, substrate characteristics, and water temperatures.

2. Numbers of spawning fish and upstream extent of spawning runs, estimated by counting spawners while walking upstream from the mouth (Frame 1974).
3. Bear activity and fishing, estimated by:
   a. Counting and collecting all bear scats for analysis.
   b. Counting fish parts equivalent to 1 fish carcass.
   c. Measuring all bear tracks across the pad width and assigning tracks to bear species by the Palmisciano method (Blanchard 1985).
   d. Classifying bear trail use as none where no tracks were found, light where few tracks and light trailing was evident, moderate where increased tracks and discernible vegetative trail matting was apparent, heavy where tracks were common and matting was considerable enough to form a distinctive swath, and very heavy where tracks were abundant and the swath of vegetation matting was wider and evident on both sides of the stream.
4. Streamside vegetation communities, classified by forest and nonforest habitat type (Steele et al. 1983, Mattson 1984) and cover type (Mattson and Despain 1985). Community site analyses were conducted on all streams with spawning and bear activity. Analysis procedures were outlined by Knight et al. (1984) and Harting (1985) and included cover, abundance, and phenology of vegetal bear foods and physiognomic description of the site area.

Analysis Methods

Streams in the Yellowstone Lake study area were stratified into 4 groups for analysis. These groups were the west shore, south arms, east shore, and front country (Appendix Fig. 10).

Streams were classified by the following criteria:

1. Streams with spawning runs (by observations of adult cutthroat trout).
2. Streams with bear activity (by evidence of scats, tracks, bear trails, day beds or bear hair).
3. Streams with conclusive evidence of bear fishing (by presence of fish parts or scats containing fish parts).

Scats were analyzed by a private contractor to determine volumetric representation of major bear foods as described by Mealey (1975), and Mattson et al. (in prep.). Scat analysis results were summarized by diet item percentage frequency, percentage composition, and percentage total volume for all recorded bear foods. Major bear diet items were stratified by time periods, major stream groups, and study years.

Fecal (scat) correction factors (adapted from Hewitt and Robbins [1990]) were used to adjust scat analysis results, to account for differential bear food digestion. The amount of ingested matter per scat for each diet item was calculated by D. Mattson (IGBST unpubl. data, 1989) by multiplying the dry matter mass of scats by the fecal correction factor. The total amount of mass ingested for each diet

item was multiplied by the number of scats and the mean percentage composition for each diet item. This was then standardized to give relative percentage of diet items ingested by bears.

Indices were developed to estimate the relative density of spawning cutthroat trout and level of bear activity and bear fishing for each stream visit:

$$F_i = F_n/S_v$$

Volumetric fish density (F_i), expressed as the mean number of fish per m^3 of stream, was calculated by dividing the mean number of fish observed per 100-m section (F_n) by the mean volume of a 100-m stream section (S_v).

$$S_v = \bar{w} \times \bar{d} \times 100 \text{ m}$$

Stream volume (S_v) was the product of mean stream width ($\bar{w}$) and mean stream depth ($\bar{d}$), in meters, multiplied by 100 m.

$$B_i = (B_s + B_t) \times 0.25$$

Two variables and a scaling factor were used to calculate a relative index of bear activity (B_i): the mean number of scats found per 100-m section (B_s) and estimated level of bear trailing (B_t) expressed by a 5-part code (none = 0, light = 0.5, moderate = 1.0, heavy = 1.5, very heavy = 2.0). These variables were added and multiplied by 0.25 to give B_i.

$$B_f = (B_p + B_{sf}) \times 0.25$$

Bear fishing index (B_f) was calculated in a similar manner using 2 variables and 2 scaling factors: the mean number of fish parts per 100-m stream section (B_p) and the mean percent volume of fish found in bear scats, multiplied by 0.02 (B_{sf}). Both variables were added and then multiplied by 0.25 to give B_f.

Values of B_i and B_f were calculated with scaling factors so as to range from 0 to 1, based on 1985-86 data. These indices were plotted for key streams in each stream group to display temporal changes in spawner density, bear activity, and bear fishing. The upstream extent and duration of spawning runs, associated bear activity, and bear fishing were accounted for on each stream by summing F_i, B_i, and B_f across all steam sections and visits. The result indexed total fish density and bear use for each stream by study year.

The relationship between fish density/m^3 and bear activity and fishing were evaluated using simple linear regression. Fish density constituted the independent variable, and bear activity and bear fishing indices the dependent variables in separate regressions. Regression equations were developed for each stream group and study year. Front-country streams were further stratified into those less than (<) and greater than (>) 1 km from major park developments.

Streamside vegetation communities were classified into forest and nonforest habitat types and cover types to allow evaluation of streamside habitats around Yellowstone Lake in terms of habitat scores (Mattson et al. 1986). Habitat productivity scores, summarizing

quantitative evaluation of grizzly bear habitat, were obtained from summer habitat data for the Cumulative Effects Analysis in the Yellowstone Ecosystem (U.S. For. Serv. et al. 1985). Procedures used to derive productivity scores are described in detail by Mattson et al. (1986). Briefly, scores were calculated by the product of total feed-site density and mean feed-site value for all habitat type-cover type communities. Feed-site density or preference was determined from scat analysis and aerial telemetry locations of radio-collared grizzly bears. Feed-site value was determined by weighting feed-site types based on characteristics of bear foods represented for each type.

Habitat productivity scores were assigned to spawning stream community sites by their habitat type-cover type classification. Scores were derived from habitat values based on available vegetal foods, feeding diversity, and the presence of absence of ungulate concentrations (U.S. For. Serv. et al. 1985). Spawning stream scores were used for nonforest habitats with ungulates; herds of elk and bison were consistently observed in nonforest types and fit the habitat description for summer ungulate high use described by Mattson and Despain (1985). Forest streamside habitats had evidence of ungulate use, but not to the extent as nonforest habitats; habitat scores without ungulates were assigned to forest types. Streamside habitat productivity scores were summarized for the 4 Yellowstone Lake areas.

The proportional distribution of habitat productivity scores for Yellowstone Lake tributaries was then compared to the proportional

area of summer habitat score ranges in Yellowstone National Park (D. Mattson, IGBST unpubl. data, 1987). Observed streamside values were tested for goodness of fit to those expected by parkwide analysis, and individual score categories tested for significant differences (Byers et al. 1984). Ivlev's electivity index (Ivlev 1961) was also used to quantify deviation of observed from expected habitat values.

Track analysis was used to estimate the number of bears using spawning streams. Streams were allotted to 8 groups around Yellowstone Lake defined by proximity to each other. These groups included the north and south portion of the east shore, the Southeast and South Arms, Flat Mountain Arm and the remaining west shore to Grant Village, and the West Thumb and Lake areas in the front-country (Appendix Fig. 1). Free interchange of bears within each group was assumed.

All track measurements for each stream group were plotted for each survey visit. Individuals were determined based on clustering of track measurements, bear species, and the concurrence of large tracks with smaller ones, inferring the presence of a female with young.

Estimated track sizes within each stream group were then compared across time periods. Tracks of similar size for different time periods were considered to be of the same individual. Track sizes were finally compared between proximal stream groups. Again, individuals were consolidated based on similar track sizes. When a clear pattern of track size clusters was not evident, a range of 1-2 bears was usually given.

From this method, the total number of bears estimated was probably less than the actual number. Thus, the number of bears using spawning streams around Yellowstone Lake should be considered a conservative estimate.

Statistical tests used in analysis followed procedures described by Zar (1984). The log-likelihood ratio or G statistic was used for analysis of frequency data employing contingency table and goodness of fit tests. The Yates correction for continuity was also performed when degrees of freedom = 1. Spearman's rank correlation procedure was used for nonparametric tests of data with nonnormal distributions. Analysis of covariance was used to test for differences of regression coefficients and intercepts for significant regressions between fish density and bear activity.

RESULTS

Most tributary streams (81%) were surveyed at least 2 of the 3 study years from 1985 through 1987. Streams judged to not possibly support a cutthroat trout spawning run because of their physical attributes were surveyed 1 year (Appendix Table 16). Large stream systems (Pelican Creek, Beaverdam Creek, the Yellowstone River Inlet and Outlet) and their drainages were only surveyed in 1988 because of their large size and time constraints. Additional spawning and bear use information for Pelican Creek was obtained from IGBST telemetry locations of instrumented grizzly bears and from observations from Pelican Cone Lookout (Gunther 1986). Bear fishing observations near the Lake development area were also obtained from French and French (1990).

Yellowstone Lake Tributaries, Physical Attributes

Of 124 previously recorded and numbered tributary streams, 4 streams were not located in this study. These were streams 1112 and 1117 in the Southeast Arm and streams 1171 and 1172 in the West Thumb. Two streams were located during this study that had not been previously recorded. These 2 streams were designated 115102 in Flat Mountain Arm and stream 110902 in the Southeast Arm (Table 3).

Tributaries that flow into Yellowstone Lake varied from small, intermittent, first-order streams to a fifth-order Yellowstone River

Table 3. Survey results for spawning cutthroat trout and associated bear use on tributary streams of Yellowstone Lake.

Lake area	Stream name or old number	New SONYEW number	Survey summary results[a] 1985	1986	1987	Hoskins (1974,1975)
West Shore	Solution Cr	1163	S,B	-	S,B	S
	211	1162	N	-	N	S
	206	1161	N	-	-	
	205	1160	S	-	N	
	204	1159	N	-	N	
	203	1158	S,B	-	S,B,F	S,B
	202	1157	S	-	S,B,F	S,B
	201	1156	N	-	N	
	Flat Mountain Stream	1155	S,B,F	S,B,F	S,B,F	S,B,F
	199	1154	N	-	-	
	198	1153	N	-	-	
	197	1152	N	-	-	
	196-W	115101	N	-	-	S
	196-E	115102	N	-	-	
	195	1150	S,B,F	S,B,F	S,B,F	S,B,F
	194	1149	N[d]	-	N	
	193	1148	N,B	N,B	N,B	S,B
	192	1147	N	S,B	N,B	S
	191	1146	S,B,F	S,B,F	S,B,F	S,B,F
	190	1145	N,B	N,B	N,B	
	189	1144	S,B	S,B	S,B	S
	188	1143	S,B	S,B	N,B	S,B
	187	1142	N	N,B	N	
	186	1141	S,B	-	S,B,F	S
South Arms	182	1140	N	-	-	
	181	1139	N[d]	-	S,B	S
	180	1138	S,B,F	S,B,F	S,B,F	S,B,F
	179	1137	S	-	S,B	S,B
	178	1136	N	-	-	
	177	1135	N	-	-	
	176	1134	S,B	-	NB	S
	175	1133	N	-	N	
	174	1132	S	-	S,B	S
	173	1131	S,B	-	S,B	S
	172	1130	N	-	-	S
	171	1129	N	-	-	
	170	1128	N	-	-	
	169	1127	S,B,F	-	S,B,F	S,B
	168	1126	S,B,F	-	S,B,F	S,B,F
	Grouse Cr	1125	S,B	-	S,B	S
	162	1124	N	-	-	
	161	1123	S,B	-	S,B,F	S
	160	1122	S,B	-	S,B,F	S
	Chipmunk Cr	1121	S	-	S,B	S
	152	1120	N	-	N	
	Alder Lake Outlet	1119	N	-	S	
	145	1118	S,B	-	S,B	
	144	1117	N[d]	-	N[d]	
	143	1116	N[d]	-	N	
	142	1115	S	-	S	
	141	1114	S,B	-	S,B	
	138	1113	S,B,F	-	S,B,F	S,B,F
	137	1112	N[d]	-	N[d]	
	136	1111	S,B,F	-	S,B,F	S,B,F

Table 3. Continued.

Lake area	Stream name or old number	New SONYEW number	Survey summary results[a] 1985	1986	1987	Hoskins (1974,1975)
	135	111001	N	-	N	
	134.5	111002	-	-	N	
	134	1109	N	-	N	S
	133	110801	N	-	N	
	132	110802	N,B	-	N,B	
	131	110803	S,B	-	S,B	S
	Trail Cr	1108	S,B	-	S,B	S
	Yellowstone R Inlet	0040	-	-	-	S
East Shore	Beaverdam Cr	1107	S	-	S,B,F	S
	124	1106	N	-	N	S
	123	1105	N	-	N	
	122	1104	N	-	N	
	121	1103	S	-	S,B,F	S
	120	1102	N	-	N	
	119	1101	N	-	N	
	Alluvium Cr	1100	N,B	-	N	
	Columbine Cr	1099	S,B	-	S,B	S
	114	1098	N	-	-	
	Meadow Cr	1097	S	-	S,B,F	S
	112	1096	N	-	-	
	Clear Cr	1095	S,B,F	S,B,F	S,B,F	S
	103	1094	S	S,B	N	S
	Cub Cr	1093	S,B,F	S,B,F	S,B,F	S
	099	1092	N	-	-	
	098	1091	S,B,F	S,B,F	S,B,F	S
	097	1090	-	N	-	
Front-country	Sedge Cr	1089	-	N	-	
	Indian Pond Outlet	1087	-	N	-	
	088	1086	-	N	-	
	Pelican Cr[b]	1005	S,B	S,B,F	S,B,F	S,B,F
	Yellowstone R Outlet	1000	-	-	-	
	272	1204	-	N	N	
	Lodge Cr	1203	-	S,B	S,B,F	S
	Hotel Cr[c]	1202	-	N	S,B,F	
	Hatchery Cr	1201	-	S,B	S,B,F	S
	268[c]	1200	-	S	S,B,F	S
	267	1199	-	S	S,B,F	S
	266	1198	-	S	S,B,F	S
	265	119701	-	N	-	
	Bridge Cr	1197	-	S,B	S,B,F	S
	259	1196	-	N	-	
	258	1195	-	N	-	
	257	1194	-	N	-	
	256	1193	-	N	N	
	Weasel Cr	1192	-	S,B	S,B,F	S
	252	1191	-	N	N	
	251	1190	-	N	N	
	250	1189	-	N	N	S
	249	1188	-	N	N	
	248	1187	-	N	N	S
	247	1186	-	N	N	
	239	1185	-	N	-	
	238	1184	N	N	-	
	Arnica Cr	1183	-	S,B,F	S,B	S
	Little Arnica Cr	1182	-	S,B	S,B,F	S

Table 3. Concluded.

Lake area	Stream name or old number	New SONYEW number	Survey summary results[a] 1985	1986	1987	Hoskins (1974,1975)
	233	1181	-	N	N	
	232	1180	-	S	S,B,F	S
	231	1179	S,B,F	S,B	S,B,F	S
	230	1178	-	N	N,B	
	229	1177	S,B,F	S,B,F	S,B,F	S,B,F
	Little Thumb Cr	1176	S,B,F	S,B,F	S,B,F	S,B,F
	227	1175	-	N	N	
	226	1174	-	N	N	
	225	1173	-	N	N	
	222	1172	-	N[d]	N[d]	
	221	1171	-	N[d]	N[d]	
	220	1170	-	N	N	
	219	1169	-	S,B,F	S,B,F	S
	Thumb Cr	1168	-	S,B	S,B	S
	217	1167	-	S	S,B,F	S
	Sandy Cr	1166	-	S	S,B,F	S
	215	1165	-	N	N	S
	Sewer Cr	1164	S,B	S,B,F	S,B,F	S,B,F

[a]Survey results: - = No survey that year
N = No spawning run observed
S = Spawning run
B = Bear sign
F = Bear fishing

[b]Observations from Gunther (1986).

[c]Observations from French and French (1990).

[d]Stream not found.

Inlet. Physical attributes of tributaries including location, stream order, cross-sectional dimensions, percent gradient, substrate characteristics, and temperature are given in Appendix Table 15. Of the tributaries found in this study, 85 were first-order streams. Of these, 49 or 58% were designated intermittent either from Hoskins (1974) or this study. Twenty-eight were second-order streams; 4 or 14% were considered intermittent. Five third-order, 2 fourth-order, and 1 fifth-order tributaries were found. All third- through fifth-order streams were permanent (Appendix Table 15).

Cutthroat Trout Spawning Streams

Of 126 identified tributaries of Yellowstone Lake, 60 streams or 48% had evidence of a cutthroat trout spawning run (Table 3). Data on the timing, duration, and upstream extent of all spawning streams are given in Appendix Tables 16 and 18. The number of spawners observed in a stream varied from 2 to 6,499 adult trout. Upstream extent of spawning runs ranged from 20 to 5,000 m from the mouth.

There was no significant difference between the 60 spawning streams found in this and the 63 found earlier by Hoskins (1974, 1975) ($G_c = 0.25$, $df = 1$, $P > 0.75$). However, some differences were evident in specific spawning streams between the 2 studies. Hoskins recorded 9 streams with spawning runs that were not found in this study; I found 6 spawning streams that Hoskins did not record (Table 3).

Some variation in the occurrence of streams with spawning runs was evident among study years. Eight streams did not have evidence of a cutthroat trout spawning run all 2 or 3 survey years (Table 3).

Variation in the observed occurrence of spawning runs among study years or between this and Hoskins' 1974-75 study was the result of several factors. Spawning cutthroat trout may have been missed because of the 1- to 2-week intervals between stream visits. Spawning runs on some streams were blocked at the mouth from berms formed by high wave action. Blocks also occurred at road culverts of some front-country streams when lake water levels were low causing impassable drops (Appendix Table 16). Most (71%) annual variation of spawning runs were smaller, first-order streams with cross-sectional dimensions of 1.5 m wide by 0.1 m deep or smaller ($G_c = 21.36$, df = 1, $P < 0.001$). The remaining (29%) streams with spawning variation were second-order streams.

Sixty-two tributaries did not have evidence of a cutthroat trout spawning run. Attributes of those streams (Appendix Table 16) included:

1. Streams were small: Cross-sectional dimensions were less than 0.7 m wide by 0.05 m deep.
2. Natural blocks: Sand spits near mouth from wave action or natural drops.
3. Manmade blocks: Road culverts near mouth.
4. Steep gradient: Streams greater than 10% slope.

5. Unsuitable spawning substrate: Substrate with boulders, cobbles, or silt.
6. Chemical barrier: pH less than 5 (Hoskins 1974) or obvious geothermal influence.

Spawning streams without spawning runs were not independent of stream order (G_c = 29.76, df = 1, $P < 0.001$). Of the 62 streams without spawners, 59 or 95% were first-order and 3 or 5% were second-order streams. All third- or higher order streams had a spawning run.

Cutthroat trout spawning runs began from mid-May to early June and lasted until mid-June to mid-August (Appendix Table 16, Figs. 2, 3, and 4). Spawning runs usually began at the time of ice melt on Yellowstone Lake on smaller streams and soon after snowmelt at the drainage basin of larger tributaries. The 840 spot stream temperatures taken during stream surveys ranged from 3 to 13 C when cutthroat trout were first observed ($\bar{X}$ = 8.5 C, SD = 2.7 C) and from 9 to 18 C when last observed ($\bar{X}$ = 12.5 C, SD = 3.0 C).

Timing in onset and duration of spawning runs varied among study years and stream groups. Comparisons of spawning activity showed that the beginning, peak, and end of spawning runs in 1986 were 1-2 weeks later than 1985, and 1-3 weeks later than 1987 (Figs. 2, 3, and 4). Onset and duration of spawning runs were also 1-3 weeks later on east shore tributaries than in other areas around Yellowstone Lake (Appendix Table 16, Figs. 2, 3, and 4).

Other fish species observed in tributary streams included longnose suckers in 8 streams and redside shiners in 13 streams

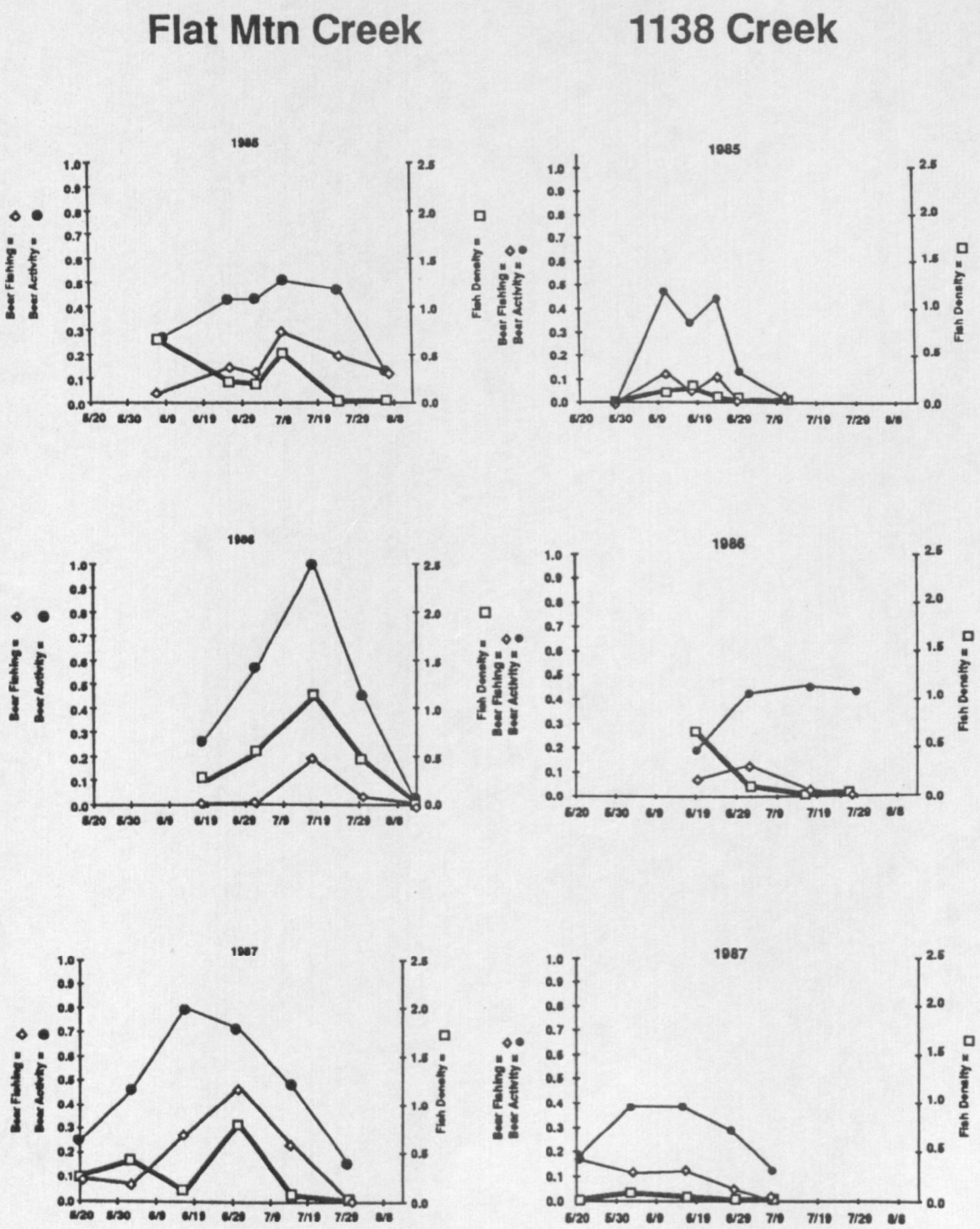

Fig. 2. Indices of bear fishing, bear activity, and fish density by date for 2 west shore streams in 1985, 1986, and 1987.

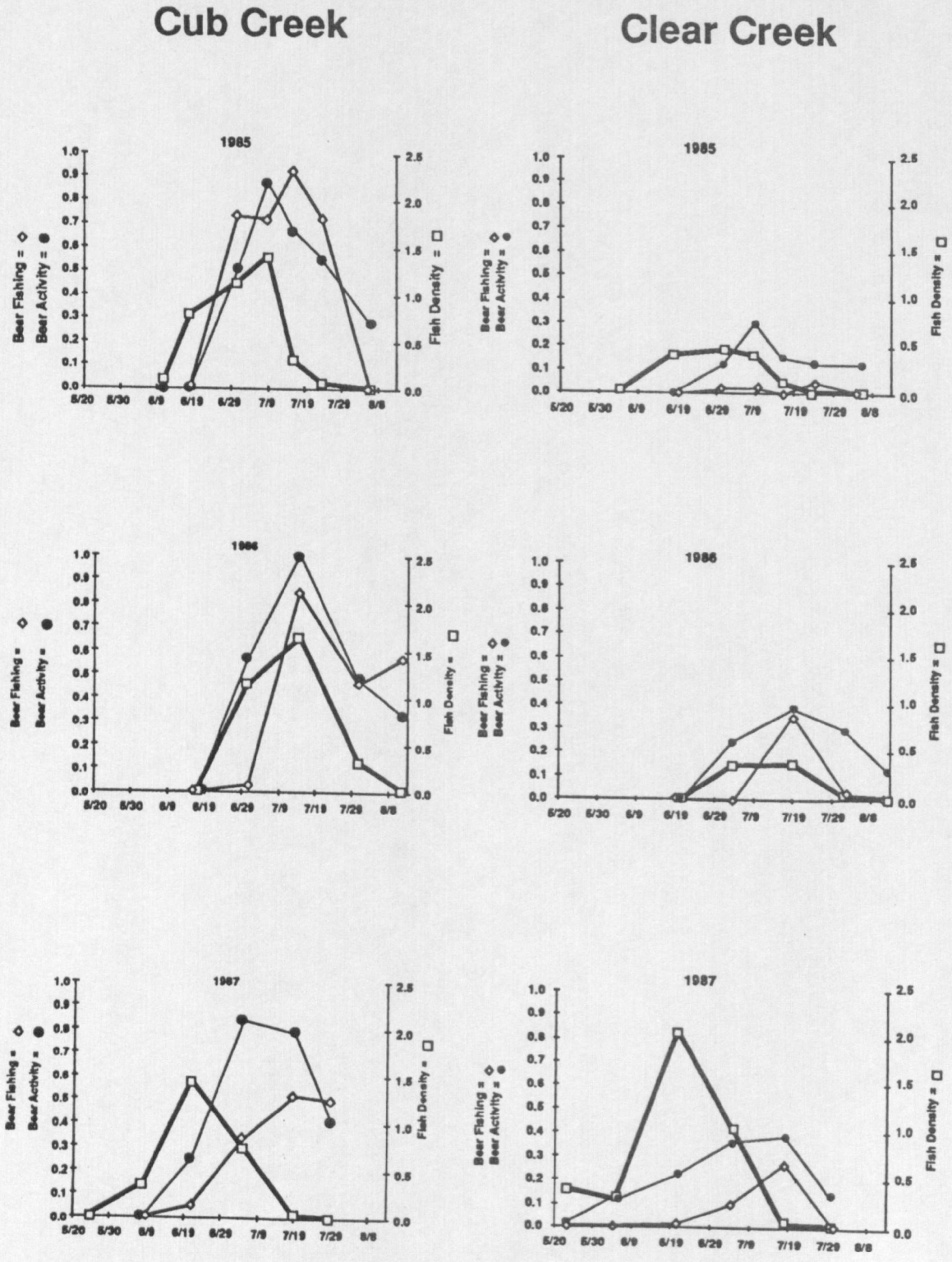

Fig. 3. Indices of bear fishing, bear activity, and fish density by date for 2 east shore streams in 1985, 1986, and 1987.

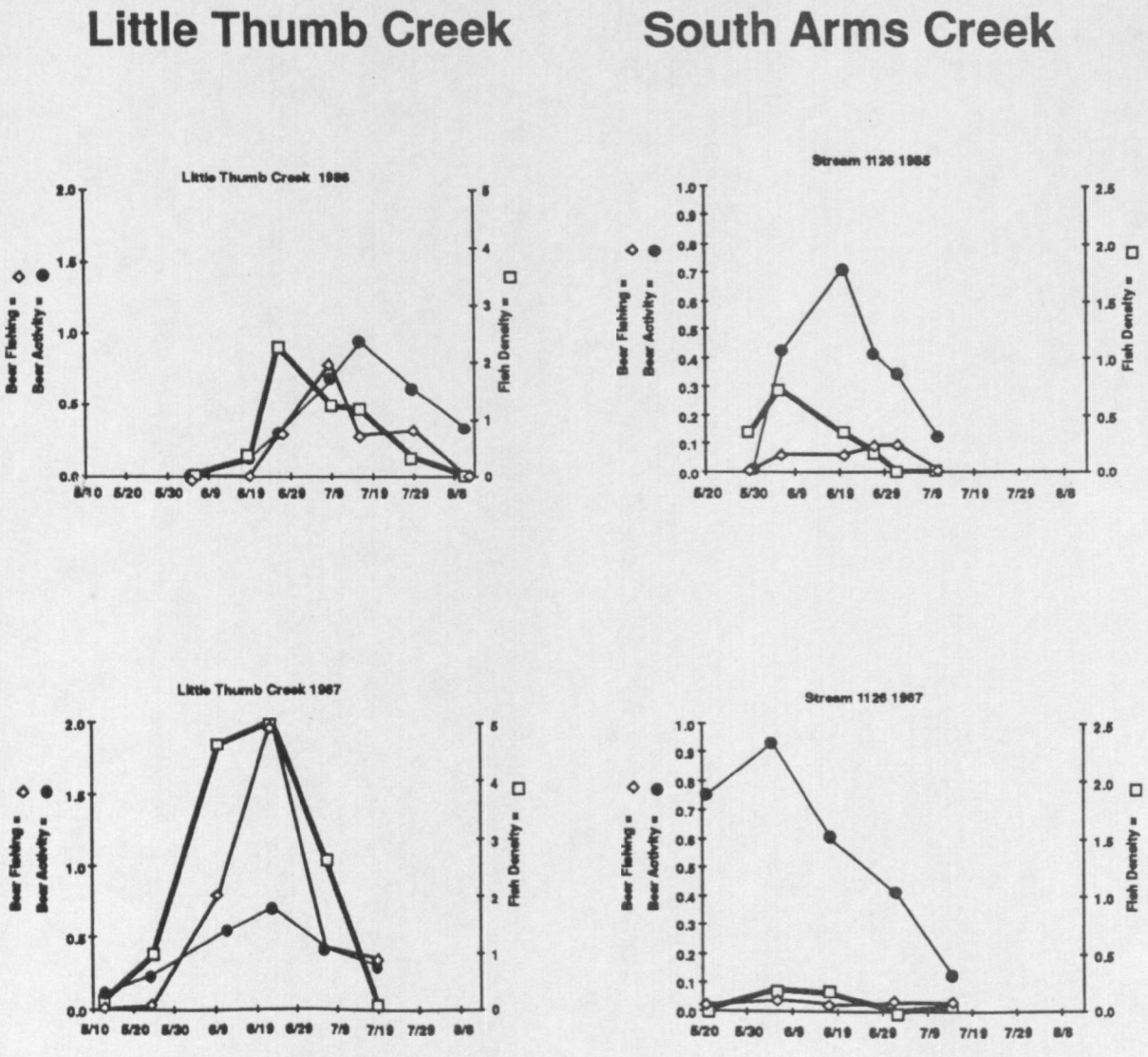

Fig. 4. Indices of bear fishing, bear activity, and fish density by date for front-country stream in 1986 and 1987, and south arm stream in 1985 and 1986

(Appendix Table 16). Both species were observed in streams near the end or after cutthroat trout spawning runs when water temperatures exceeded 10 C.

Bear Use of Spawning Streams

Of the 60 tributaries with observed cutthroat trout spawning runs, 56 or 95% had evidence of associated bear activity. Evidence of bear activity ranged from incidental tracks of a single bear to heavy sign of stream use by several bears. Five other streams had incidental bear activity sign but no evidence of a cutthroat trout spawn. Thirty-six spawning streams or 61% had conclusive evidence of bear fishing (Table 3).

There was a greater occurrence in bear use of spawning streams during this study than Hoskins found 10 years prior ($G_c = 58.57$, df = 1, $P < 0.001$). Hoskins (1974, 1975) recorded 17 streams (28%) with bear activity and 11 streams (18%) with conclusive evidence of bear fishing in 1974 and 1975 (Table 3).

Bear use of spawning streams varied among study years and lake areas ($G_c = 4.22$, df = 1, $P < 0.05$). Fifty-eight percent of backcountry spawning streams were fished by bears all 2 or 3 years surveyed, whereas only 22% of front-country streams were fished by bear all years surveyed (Table 3).

Streams with the highest overall values of bear use (bear activity and bear fishing) per unit length of stream and cumulative over time in a year included Flat Mountain Creek in the west shore,

stream 1126 in the South Arm, Cub Creek in the east shore, and stream 1177 and Little Thumb Creek in the West Thumb. These streams had consistent bear use index values over 2.0 (Table 4).

Temporal levels of bear use on spawning streams corresponded with cutthroat trout spawning activity. Bear activity generally began with the onset of the spawning run, was highest near the time of peak spawner numbers or soon after, and continued 1-2 weeks after spawning runs had diminished or ceased. Bear fishing began at or before the peak run, was highest within 1-2 weeks after peak spawner numbers, and declined when spawning activity diminished or ceased (Figs. 2, 3, and 4).

Temporal levels of bear use on spawning streams varied among study years and lake areas. Both bear activity and spawner levels, were consistently later in 1986 than other study years and later on the east shore than in other lake areas. Overall bear activity levels were highest and bear fishing levels lowest on streams in the south arms and west shore compared to activity levels on east shore and front-country streams (Figs. 2, 3, and 4).

Fish Density and Bear Use

Bear use of spawning streams was related more to volumetric fish density than absolute numbers or linear density of fish. This was exemplified by 2 proximal streams on the east shore (Fig. 2). Peak spawner density on Cub Creek in 1985 was 1.40 fish/m^3 of stream. At that visit, indices of bear activity and bear fishing were 0.87 and

Table 4. Yellowstone Lake fish density and bear use summary scores.

Lake area	Year	Stream	Fish density[a]	Bear activity[b]	Bear fishing[c]	Bear score[d]
West Shore	1985	1163	0.02	0.125	0	0.025
		1158	0.14	0.175	0	0.175
		1157	0.06	0	0	0
		1155	1.56	2.345	0.765	3.11
		1150	0.244	1.35	0.27	1.62
		1146	0.154	1.2	0.766	1.97
		1144	0.026	0.475	0	0.475
		1143	0.06	0.125	0	0.125
		1141	0.057	0.028	0	0.28
	1986	1155	2.39	1.816	0.21	2.026
		1150	0.396	1.3	0.275	1.55
		1146	0.739	1.02	0.108	1.005
		1144	0	0.512	0	0.512
		1143	0.83	0.562	0	0.56
	1987	1163	0.022	0.125	0	0.125
		1158	0.52	1.64	0.68	2.32
		1157	0.06	0.89	0.07	0.96
		1155	2.11	3.22	1.14	4.36
		1150	0.12	0.96	0.365	1.327
		1146	0.733	1.29	0.731	2.02
		1144	0	0.187	0	0.18
		1143	0	0.375	0	0.375
		1141	0.08	0.5	0.525	1.025
South Arms	1985	1138	0.317	1.337	0.265	1.602
		1137	0.114	0	0	0
		1132	0.495	0	0	0
		1131	0.1	0.062	0	0.062
		1127	0.47	0.625	0.0125	0.637
		1126	1.537	1.999	0.318	2.16
		1125	0.065	0.25	0	0.25
		1123	0.562	0.783	0.218	1.064
		1122	0.054	0.25	0	0.25
		1118	0.05	0.5	0	0.5
		1114	0.666	0.125	0	0.125
		1113	0.498	0.562	0.01	0.572
		1111	0.302	1.065	0.01	1.06
	1986	1138	0.743	1.48	0.2175	1.26
	1987	1139	0.2	1.062	0.275	1.137
		1138	0.105	1.35	0.454	1.805
		1137	0.15	0.583	0	0.583
		1132	0.66	0.187	0	0.187

Table 4. Continued.

Lake area	Year	Stream	Fish density[a]	Bear activity[b]	Bear fishing[c]	Bear score[d]
		1131	0.38	0.312	0.125	0.437
		1127	0.121	1.337	0.362	1.695
		1126	0.396	2.819	0.141	2.96
		1125	0.098	0.25	0	0.025
		1123	0.22	0.681	0.276	0.957
		1122	0.258	0.708	0.083	0.791
		1118	0	1	0.071	1.07
		1114	0.221	0.937	0.05	0.987
		1113	0.48	0.888	0.028	0.916
		1111	0.608	1.207	0.418	1.642
East Shore	1985	1103	0.755	0.125	0	0.125
		1099	1.424	0.701	0.05	0.751
		1097	0.017	0	0	0
		1095	1.397	0.825	0.1	0.92
		1094	0.148	0	0	0
		1093	3.76	2.88	2.407	5.287
		1092	2.367	0.81	0.606	1.416
	1986	1095	0.81	1.065	0.3925	1.457
		1094	1.043	0.406	0	0.0406
		1093	3.096	2.36	1.897	4.257
		1092	0.658	1.719	0.124	1.843
	1987	1103	0.28	1.375	0.875	2.25
		1099	0.366	0.704	0.016	0.72
		1097	0.278	0.649	0.512	1.161
		1095	3.992	1.536	0.43	1.966
		1093	2.543	2.286	1.383	3.668
		1092	0.23	0.921	0.616	1.538
Front-country	1986	1203	1.079	0.125	0	0.125
		1201	3.17	0.125	0	0.125
		1199	0.085	0	0	0
		1198	1.462	0	0	0
		1197	0.494	0.3125	0	0.3125
		1192	0.6	0.125	0	0.125
		1183	0.12	0.125	0.025	0.15
		1182	0.245	0	0	0
		1180	0.044	0	0	0
		1179	0.552	0.125	0	0.125
		1177	4.13	1.5	2.05	3.55
		1176	5.24	2.995	3.41	6.407
		1169	0.315	0.4375	0.125	0.5625
		1168	0.087	0.0625	0	0.0625

Table 4. Concluded.

Lake area	Year	Stream	Fish density[a]	Bear activity[b]	Bear fishing[c]	Bear score[d]
		1167	3.142	0	0	0
		1166	0.85	0	0	0
		1164	3.126	0.54	0.102	0.5
	1987	1203	0.944	0.583	0.066	0.649
		1201	5.453	0.993	0.976	1.969
		1199	1.975	0.5	0.75	1.25
		1198	0.533	0.125	0.062	0.187
		1197	1.502	1.021	0.279	1.3
		1192	1.6	0.125	0	0.125
		1183	0.117	0.4	0	0.4
		1182	0.761	0.588	0	0.558
		1180	0.799	0.125	0.165	0.29
		1179	4.66	0.875	1.475	2.35
		1177	6.945	1.641	7.99	8.78
		1176	13.85	2.325	10.4	12.74
		1169	0.583	0.25	0.437	0.687
		1168	0.09	0.125	0	0.125
		1167	9.84	0.3	0.35	0.65
		1166	1.728	0.263	0.066	0.33
		1164	3.06	1.06	0.852	1.937

[a]Fish density: number trout/m^3 of stream.

[b]Bear activity: number scats/100 m + bear trailing level.

[c]Bear fishing: number fish parts/100 m + % fish in scats.

[d]Bear score: bear activity + bear fishing.

0.72, respectively. Peak fish density on Clear Creek in 1985 was 0.47 fish/m^3 and associated levels of bear activity and bear fishing were 0.30 and 0.25, respectively. At peak densities, 1,165 fish were counted in Clear Creek and 948 counted in Cub Creek. This translated into 116 fish per 100 m on Clear Creek and 126 fish per 100 m on Cub Creek. Although fish numbers and linear densities were comparable for the 2 streams, Cub Creek had substantially higher fish density/m^3 and associated bear use values because of its smaller cross-sectional area.

A positive relationship ($r^2 = 0.52$, $P < 0.001$) between fish density/m^3 and overall bear use of spawning streams was determined by regression analysis.

Backcountry Streams

Relationships between bear activity and fish density varied with backcountry streams when regression equations were stratified among lake areas and study years (Table 5). Steep slopes and high coefficient of determination (r^2) values characterized regressions of bear activity on fish density for west shore streams in 1985 and 1987 and on the east shore and south arms in 1985. A moderate slope and lower r^2 value was evident for the 1986 west shore regression. Weak or nonsignificant relationships were evident on the south arms in 1987 and east shore in 1986 and 1987. Analysis of covariance showed that regression equation slopes for all backcountry streams were not significantly different ($P < 0.05$) within years. Intercepts of significant regressions were highest during all 3 study years on the

Table 5. Regression equation parameters (B_i = a x b(F_i)) for the relationship between fish density (F_i) and bear activity (B_i) for individual study years and areas around Yellowstone Lake. Areas are designated: WS - west shore; SA - south arms; ES - east shore; FC - front country. Front-country streams were divided into those >1 km of developments and <1 km of developments.

Year	Area	n	a (intercept)	b (slope)	r^2	P
1985	WS	8	0.482 A[a]	1.291 A	0.681	0.012
	SA	8	0.246 A	0.952 A	0.581	0.028
	ES	6	-0.312 B	0.742 A	0.873	0.006
1986	WS	6	0.734 A	0.448 A	0.500	0.116
	ES	6	0.689	0.498	0.456	0.325
	FC	17	-0.128 B	0.349 A	0.562	0.001
	>1 km	11	0.010	0.439	0.827	0.000
	<1 km	6	0.019	0.014	0.074	0.603
1987	WS	9	0.713	1.190 A	0.858	0.000
	SA	8	0.964	0.808	0.053	0.584
	ES	6	0.907	0.264	0.464	0.136
	FC	17	0.290	0.116 B	0.548	0.000
	>1 km	11	0.288	0.157	0.846	0.000
	<1 km	6	0.408	0.015	0.032	0.735

[a]Slopes and intercepts with unlike letters are significantly different ($P < 0.05$) within years.

west shore compared to other lake areas and were consistently lower for all stream groups during 1985.

Patterns of regressions between bear fishing and fish density among backcountry stream areas and study years (Table 6) were comparable to relationships between bear activity and fish density. Significant east shore regressions were also characterized by steeper slopes and higher r^2 values compared to other backcountry areas. However, regressions of fish density and bear fishing differed by lower, often negative intercepts.

Front-country Streams

A moderate relationship of bear activity and fish density was evident for front-country streams in 1986 and 1987 (Table 5). Moderate slopes and r^2 values characterized the regressions of all front-country streams. The relationship between bear activity and fish density for spawning streams >1 km from tourist facilities and campgrounds differed substantially compared to streams <1 km from park developments where no statistical relationship was found. In 1986, indices of bear activity were 90% less on spawning streams <1 km from developments than expected by the regression equation between fish density and bear activity on streams >1 km from developments. This translated into 46% less bear use on front-country streams than expected from the regression on all spawning streams. In 1987, bear activity levels on streams <1 km from developments was 30% less than expected, and overall bear use of front-country streams was 13% less than expected.

Table 6. Regression equation parameters ($B_2 = a \times b(F_1)$) for the relationship between fish density (F_1) and bear fishing (B_2) for individual study years and areas around Yellowstone Lake. Areas are designated: WS - west shore; SA - south arms; ES - east shore; FC - front country. Front-country streams were divided into those >1 km of developments and <1 km of developments.

Year	Area	n	a (intercept)	b (slope)	r^2	P
1985	WS	8	0.118	0.438	0.449	0.069
	SA	8	-0.042	0.215	0.653	0.015
	ES	6	-0.529	0.652	0.806	0.015
1986	WS	6	0.093	0.049	0.116	0.508
	ES	6	-0.434	0.740	0.925	0.038
	FC	17	-0.281	0.424	0.560	0.001
	>1 km	11	-0.208	0.539	0.794	0.000
	<1 km	6	(no regression: dependent variable = 0)			
1987	WS	9	0.274	0.452	0.744	0.003
	SA	8	0.127	0.180	0.054	0.578
	ES	6	0.533	0.066	0.054	0.658
	FC	17	-0.533	0.604	0.607	0.002
	>1 km	11	-0.596	0.829	0.893	0.000
	<1 km	6	0.235	0.042	0.143	0.459

Relationships between bear fishing indices and fish density for front-country streams (Table 6) were again similar to relationships of bear activity and fish density. Regression intercepts were consistently lower for front-country streams than for backcountry stream regressions. Steeper slopes and higher r^2 values were evident on front-country streams >1 km from park developments compared to those <1 km away. No regression was calculated for streams <1 km from developments in 1986; no sign of bear fishing was found on those streams that year.

Bear Scat Analysis

A total of 671 bear scats were collected during the study years 1985-87. Fecal analysis was conducted on scats found within 20 m of tributary streams. The number of scats collected each study year was 143 in 1985, 124 in 1986, and 404 in 1987.

Scat Content

A list of diet items found in bear scats including percentage frequency of occurrence, percentage composition in scats, and percentage volume content is given in Table 7. Scat volume, averaged over all study years, varied among diet items. Cutthroat trout remains were present in 38% of all scats and comprised 16.5% total scat volume. No other fish species were identified in scats. Mammal remains comprised 10.3% scat frequency and 4.8% scat content. Mammals identified from fecal analysis included in descending order of content: elk, bison, grizzly bear, black bear, moose, deer, ground squirrel,

Table 7. Contents of scats collected in the Yellowstone Lake tributary study area, 1985-87.

Diet item	1985		1986		1987		Total, 1985-87			
	n	% Content	n	% Content	n	% Content	n	% Freq.	% Composition	% Content
Trout	63	18.95	47	25.81	145	12.85	255	38.00	43.50	16.54
Mammals	11	3.67	13	4.60	45	5.32	69	10.28	47.03	4.84
Grizzly bear	4	1.68	-	-	1	0.06	5	0.74	53.00	0.39
Black bear	-	-	-	-	2	0.44	2	0.30	90.00	0.20
Ungulates	7	1.99	12	4.19	36	4.22	55	8.20	45.64	3.74
Elk	3	1.05	5	1.98	16	2.00	24	3.58	50.21	1.80
Bison	3	0.91	6	1.81	16	1.99	25	3.72	46.40	1.73
Moose	-	-	-	-	3	0.19	3	0.45	25.00	0.11
Deer	-	-	1	0.40	1	0.004	2	0.30	32.50	0.10
Rodents	-	-	-	-	6	0.59	6	0.89	40.00	0.36
Ground squirrel	-	-	-	-	2	0.28	2	0.30	57.50	0.17
Microtus spp.	-	-	-	-	1	0.07	1	0.15	30.00	0.04
Muskrat	-	-	-	-	1	0.15	1	0.15	60.00	0.09
Birds	-	-	1	0.81	3	0.10	4	0.60	35.00	0.21
Grouse	-	-	1	0.81	3	0.10	4	0.60	35.00	0.21
Ants	15	1.47	26	4.19	26	0.89	67	9.99	16.27	1.62
Forbs	49	13.32	35	14.84	103	14.79	187	27.87	51.98	14.49
Thistle	20	7.62	8	4.23	55	8.45	83	12.37	60.60	7.50
Dandelion	15	3.36	17	8.27	18	4.24	50	7.45	64.40	4.80
Clover	7	0.91	4	1.21	21	1.36	32	4.77	25.94	1.24
Angelica	3	0.56	2	0.64	-	-	5	0.74	32.00	0.24
Cow parsnip	1	0.42	1	0.08	1	0.05	3	0.45	30.00	0.13

Table 7. Continued.

Diet item	1985 n	1985 % Content	1986 n	1986 % Content	1987 n	1987 % Content	Total, 1985-87 n	Total, 1985-87 % Freq.	Total, 1985-87 % Composition	Total, 1985-87 % Content
Spring beauty	1	0.24	-	-	5	0.50	6	0.89	40.83	0.36
Fireweed	1	0.14	-	-	2	0.09	3	0.45	18.33	0.08
Ranunculus	-	-	2	0.32	-	-	2	0.30	20.00	0.06
Senecio	1	0.07	-	-	-	-	1	0.15	10.00	0.01
Roots	1	0.70	-	-	1	0.25	2	0.30	100.00	0.30
Biscuitroot	1	0.70	-	-	1	0.25	2	0.30	100.00	0.30
Graminoids	106	43.23	77	32.42	328	56.45	511	76.15	66.27	50.47
Grass-sedge	92	44.54	66	28.59	288	51.65	446	66.47	69.01	45.87
Sedge	6	2.41	2	0.81	5	0.59	13	1.94	52.69	1.02
Bluegrass	5	1.57	8	2.70	32	3.96	45	6.71	48.00	3.22
Brome	1	0.14	1	0.32	-	-	2	0.30	30.00	0.09
Bluejoint	1	0.21	-	-	1	0.06	2	0.30	27.50	0.08
Timothy	1	0.35	-	-	-	-	1	0.15	50.00	0.07
Agrostis	-	-	-	-	1	0.07	1	0.15	30.00	0.04
Wheatgrass	-	-	-	-	1	0.05	1	0.15	20.00	0.03
Sporophytes	18	8.67	17	6.57	54	5.85	89	13.26	49.66	6.59
Horsetail	18	8.67	17	6.57	51	5.52	51	12.82	49.82	6.3
Club moss	-	-	-	-	3	0.33	3	0.45	45.00	0.20
Berries	3	0.80	1	0.81	2	0.07	6	0.89	40.83	0.36
Grouse whortleberry	1	0.56	1	0.81	-	-	2	0.30	90.00	0.27
Buffaloberry	-	-	-	-	2	0.07	2	0.30	15.00	0.04
Strawberry	2	0.25	0	0	0	0	2	0.30	17.50	0.05

Table 7. Concluded.

Diet item	1985 n	1985 % Content	1986 n	1986 % Content	1987 n	1987 % Content	Total, 1985-87 n	Total, 1985-87 % Freq.	Total, 1985-87 % Composition	Total, 1985-87 % Content
Whitebark pine	-	-	2	0.40	-	-	2	0.30	25.00	0.07
Debris	16	3.25	36	9.56	63	3.38	115	17.14	26.22	4.49
Garbage	-	-	-	-	3	0.11	3	0.45	15.00	0.07
TOTAL NO. SCATS	143		124		404		671			

muskrat, and voles (Table 7). Most bear remains were identified as cubs.

Foliferous vegetation was the most abundant food group evident in scats and represented 88% frequency and 71.5% scat volume (Table 7). Graminoids were the dominant vegetation grazed with a 76% frequency and 50.5% scat volume. Most graminoids were only characterized as grass-sedge. Graminoids that were identified included bluegrass (Poa spp.), sedges (Carex spp.), brome (Bromus spp.), reedgrass (Calamagrostis spp.), timothy (Phleum spp.), wheatgrass (Agropyron spp.) and bentgrass (Agrostis spp.). Forbs comprised 27.9% frequency and 7.5% content. Forbs were easily identified and included, in order of content: elk thistle (Cirsium scariosum), dandelion (Taraxacum officinale), clover (Trifolium repens and T. longipes), cow parsnip (Heracleum lanatum), angelica (Angelica spp.), spring beauty (Claytonia lanceolata), fireweed (Epilobium angustifolium), groundsel (Senecio spp.), and buttercup (Ranunculus spp.). Sporophytes were also grazed and comprised 13.3% frequency and 6.6% volume. Horsetail (Equisetum arvense) was the dominant sporophyte represented in scats with a minor component of club moss (Lycopodium spp.).

Other items were represented in scats by minor amounts. Ants (Formica spp. and Camponotus spp.) comprised 10% frequency and 1.6% volume. Debris (dirt, rock, wood, needles) comprised 17.1% frequency and 4.5% volume. Other diet items with less than 1% frequency and scat volume included grouse (Tetraonidae), biscuitroot (Lomatium cous), berries (Vaccinium scoparium, Fragaria virginia, and Sheperdia

canadensis), whitebark pine (Pinus albicaulis) seeds, and human garbage.

Temporal Variation in Scat Content

Diet item representation in scats varied among study years (Table 7). Overall content of cutthroat trout was highest in 1986 with 25.8% volume and lowest in 1987 with 12.8% volume. Conversely, foliferous vegetation represented in bear scats was highest in 1987 and lowest in 1986. Diet item representation of trout and vegetation was intermediate in 1985.

Scat content varied among dates within each study year (Fig. 5). Temporal scat analysis showed scats were found along streams later in 1986 and earlier in 1987 than in 1985. Trout remains were found in scats from 1 June to 27 July 1985, 15 June to 10 August 1986, and 20 May to 27 July 1987. Overall use of graminoids was highest early in the spawning season in May and June and declined thereafter. Horsetail and forbs comprised a substantial portion of scat volume from mid-June through July; thistle use occurred somewhat later through July and August. Use of other diet items, mostly ants and associated debris, was more evident near the end of the spawning season.

Area Variation in Scat Content

Percent scat volume of diet items in scats averaged over study years varied among the 4 lake areas (Figs. 6 and 7). Scats were found along streams later on the east shore and earlier on the south arms

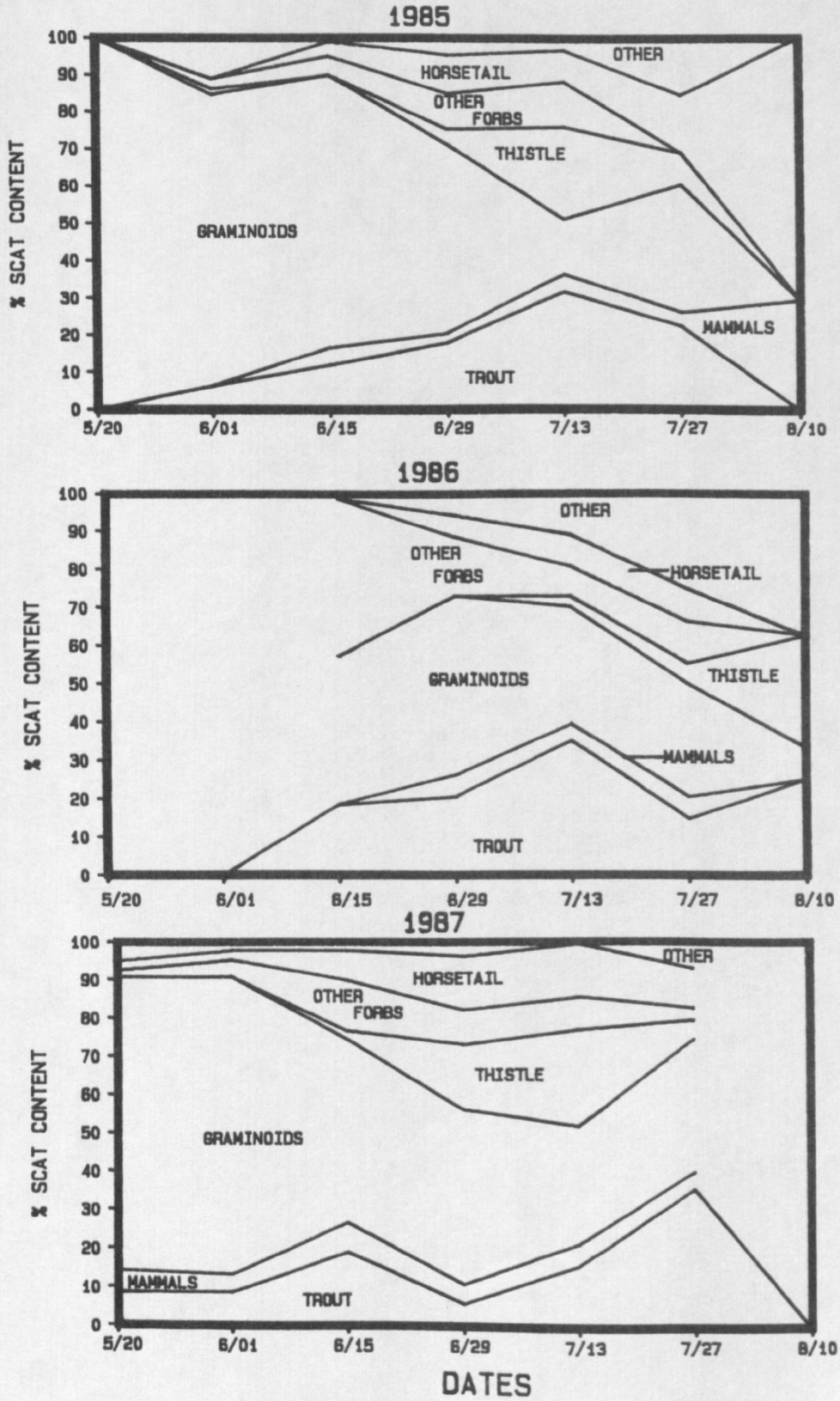

Fig. 5. Scat contents by date for study years 1985, 1986, 1987.

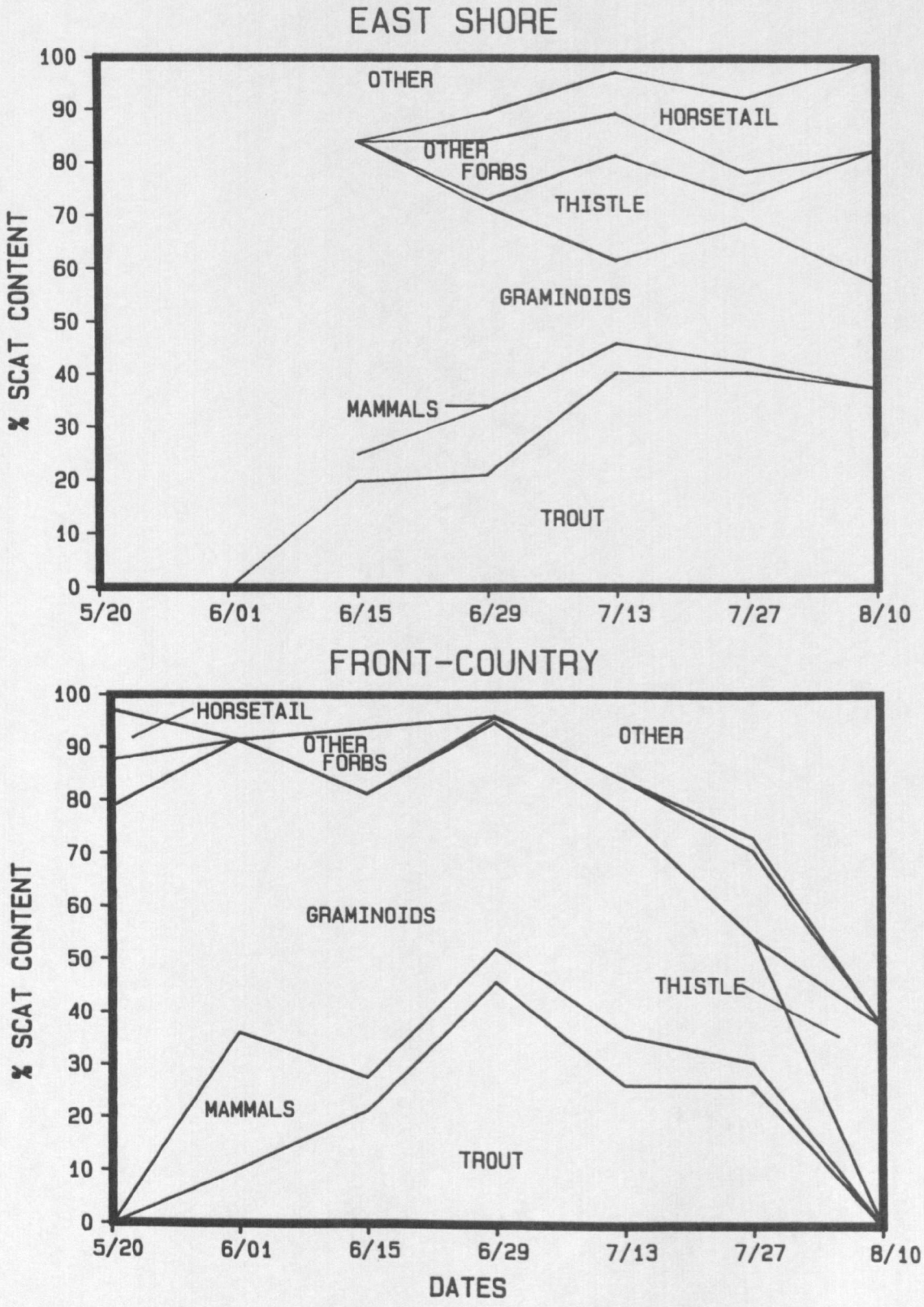

Fig. 6. Scat contents by date for west shore and south arms.

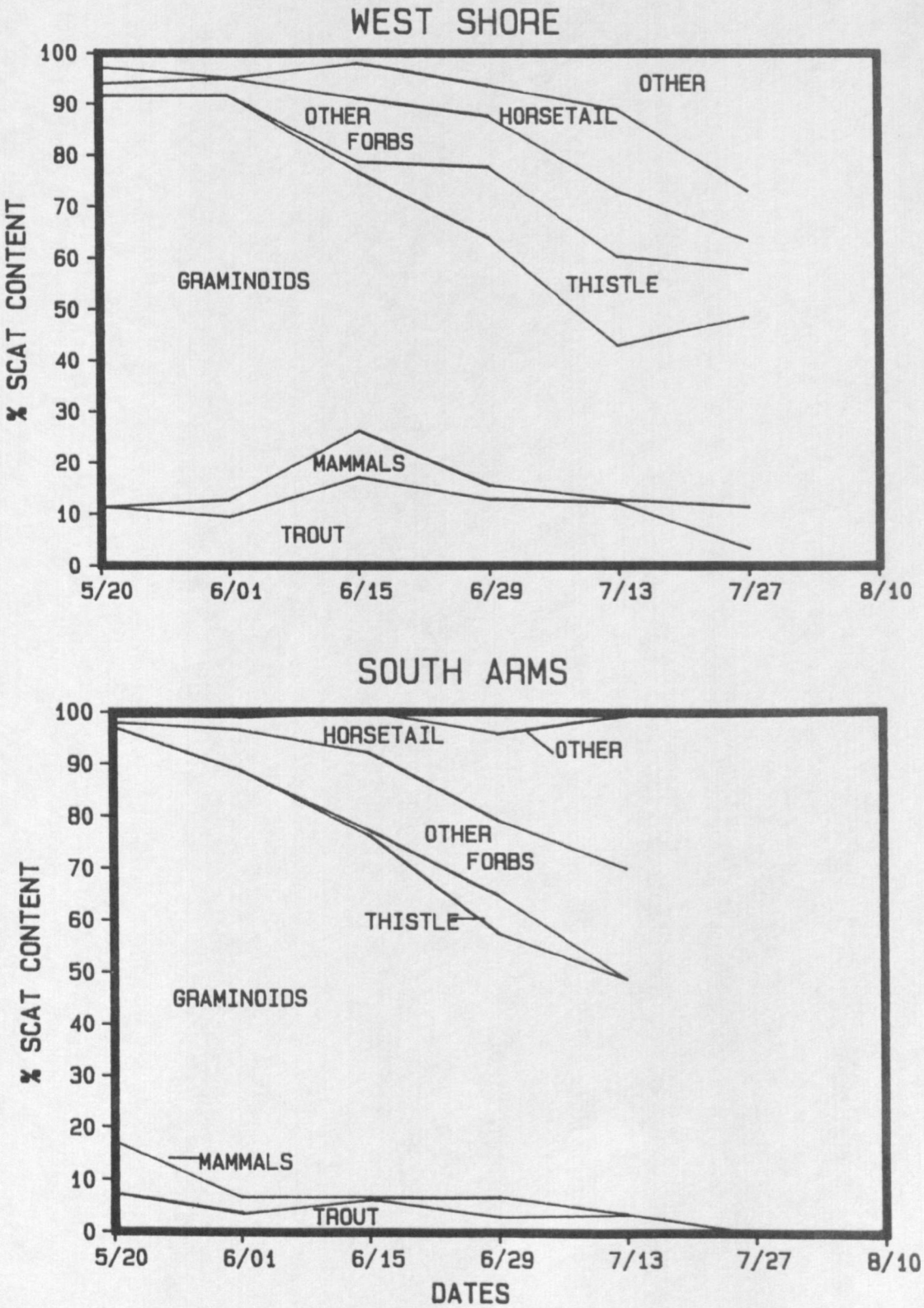

Fig. 7. Scat contents by date for east shore and front-country.

compared to west shore and front-country streams. Similarly, peak trout content was found in scats much later on east shore streams compared to other lake areas. Overall use of cutthroat trout was highest on east shore and front-country streams (Fig. 7) and lowest on the south arms (Fig. 6). Use of foliferous vegetation appeared highest on the south arms and west shore, intermediate on the front country, and lowest on the east shore.

Diet Item Digestibility

Scat analysis of percent diet item content does not adequately reflect food ingestion by bears. This is primarily due to differences in digestibilities of various food items. Foods high in fats and protein such as fish and mammals are under-represented in bear scats relative to foliferous vegetation (Mealey 1975, Bunnell and Hamilton 1983, Hewitt and Robbins 1990).

Fecal correction factors were derived for various bear foods found in study area scats. Correction factors that relate volume of feces residue to matter ingested were 0.16 to 0.35 for vegetation, 0.91 to 1.25 for insects, 1.55 to 12.50 for mammals, and 40.82 for trout (Hewitt and Robbins 1990). Cutthroat trout comprised 16.5% scat volume in this study and translated into 91.8% of estimated total ingested volume when fecal correction factors were applied. Foliferous vegetation (graminoids, forbs, and horsetail) comprised 71.3% of scat volume and translated into 4.3% of estimated ingested material (Table 8).

Table 8. Grizzly bear scat summary and digestibility rates.

Diet item	Parts used	% Vol.	% Freq.	% Composition	% Digestibility	Digest energy (kcal/g)[b]	Fecal correction factor[d]	Est. % ingestion[e]
Trout	Entire Tissue, bone	16.54	38.00	43.53	71.9[a]	4.1	40.82	91.79
Mammals	Tissue, hair bone	4.84	10.28	47.03	79.5[b]	4.2	2.00-12.50	3.47
Ants	Entire	1.62	9.99	16.27	55.7[b]	2.7	0.90	0.34
Horsetail	Stem	6.39	12.82	49.82	12.8[a]	0.5	0.16	0.22
Graminoids	Leaf, stem flower, fruit	50.47	76.15	66.27	15.8[a]	0.5	0.18- 0.28	3.01
Forbs (foliage)	Leaf, stem flower, fruit	14.49	27.87	51.98	17.7[b]	0.6	0.24- 0.34	1.03
Biscuitroot	Roots	0.30	0.30	100.00	41.1[a]	1.3	0.65	0.06
Berries	Fruit, leaves	0.36	0.89	40.83	89.1[c]	3.0	0.54- 1.75	___
Whitebark pine	Seeds	0.07	0.30	25.00	48.7[a]	1.9	1.48	0.04

[a]Mealey (1975).
[b]Knight et al. (1984).
[c]Bunnell and Hamilton (1983).
[d]Hewitt and Robbins (In press).
[e]Estimated % ingested = (number scats x % composition x ingested gram/scat)/total ingested gram.

Plant Community Site Analysis

Streamside communities along Yellowstone Lake tributaries were characterized by forest and nonforest, moist to wet sites (Appendix Table 17). Stream communities, classified by habitat type and cover type, were stratified for the 4 lake areas (Tables 9 and 10). The west shore and front-country streams were dominated by lodgepole forests, the east shore by spruce-fir forest, and the south arms characterized by nonforest communities.

Vegetation communities along Yellowstone Lake spawning streams were assigned grizzly bear habitat productivity scores (hps) and compared with habitat values for Yellowstone Park at large (Tables 11 and 12). Distribution of streamside hps differed significantly from that expected for Yellowstone Park as a whole ($G = 32.48$, $df = 5$, $P < 0.001$). Mean hps for Yellowstone Lake spawning streams was 0.250 and was higher than mean summer values for Yellowstone Park (hps = 0.214) or those in the upland communities surrounding Yellowstone Lake (hps = 0.208). Similarly, Ivlev's (1961) electivity analysis showed that Yellowstone Lake stream scores were disproportionately more represented in the higher range of Yellowstone Park hps and less represented in the lower end of Yellowstone Park values (Table 12).

Average distance from streambanks to forest cover ranged from 5 to 300 m. Cover distance for forest ht-ct communities ranged from 5 to 20 m and showed little variation among types. Nonforest cover distance ranged from 15 to 300 m and varied among community types (Table 11).

Table 9. Habitat types represented along spawning streams by lake areas.

Habitat type	West Shore	South Arms	East Shore	Front-country
PIEN/EQAR	0	3	2	0
ABLA/CACA	7	2	4	9
CACA/SETR	1	1	0	8
SXWO/CXMI	0	5	0	0
PHAL/AGCA	2	4	1	0
CXRO/CXRO	0	1	1	0

Table 10. Cover types represented along spawning streams by lake areas.

Cover type	West Shore	South Arms	East Shore	Front-country
SF	0	3	3	1
LP3	5	2	3	2
LP2	2	0	0	6
Wet Forest Opening	1	1	0	8
Low Willow Shrub	0	5	0	0
Wet Grass-land Meadow	2	4	1	0
Marsh/Fen	0	1	1	0

Table 11. Summer habitat productivity scores (hps)* and distance to cover for habitat type-cover type communities on Yellowstone Lake tributary streams.

Habitat type-cover type communities	hps	Number streams	Percent representation	Average distance to cover (m)
Forest Types				
SF-PIEN/EQAR	0.389	5	10	8
SF-ABLA/CACA	0.329	2	4	10
LP3-ABLA/CACA	0.262	12	23	8
LP2-ABLA/CACA	0.215	8	16	12
Nonforest Types				
Wet Forest Opening-CACA/SETR	0.320	10	20	18
Low Willow-SXWO/CXMI	0.164	5	10	33
Wet Grassland-PHAL/AGCA	0.144	7	14	31
Marsh/Fen-CXRO/CXRO	0.128	2	4	200

*Summer hps obtained from U.S. For. Serv. et al. (1985). Forest type hps without ungulate, nonforest hps with ungulate.

Table 12. Grizzly bear habitat scores on spawning streams versus Yellowstone Park summer values.

Habitat productivity scores	Observed occurrence (spawning streams)	Expected occurrence (Yellowstone Park)	95% significance class	Proportion observed	Proportion expected	Electivity index
0.00 - 0.15	9	9.1	0.04 - 0.32	0.18	0.18	0
0.16 - 0.20	5	8.2	0.00 - 0.21	0.10	0.16	-0.06
0.21 - 0.25	8	20.4	0.02 - 0.30	0.16	0.40	-0.43*
0.26 - 0.30	12	7.6	0.08 - 0.40	0.24	0.15	0.23
0.31 - 0.35	12	3.1	0.08 - 0.40	0.24	0.06	0.60*
0.36 - 0.40	5	2.0	0.00 - 0.21	0.10	0.04	0.43

*Values at 0.05 significance level.

Track Measurements

Track measurements were used to determine the number, species, and association of family groups for all spawning streams on each survey visit (Appendix Table 18). A maximum of 6 autonomous bears (lone bears and family groups) were estimated to use an individual spawning stream at 1 time. A Spearman rank correlation showed that the number of bears using a stream was associated with the bear use index values in Table 4 ($r_s = 0.762$, $P < 0.001$). This association was somewhat more obvious with bear activity scores ($r_s = 0.804$, $P < 0.001$) than with bear fishing scores ($r_s = 0.604$, $P < 0.001$). Thus, the indices used to determine levels of bear use on a spawning stream were strongly correlated with the number of bears using a stream.

From track analysis, I estimated that between 42 and 61 autonomous bears used backcountry streams in 1985; between 37 and 55 bears used these same streams in 1987. Between 8 and 12 and between 7 and 9 bears were estimated to use front-country streams in 1986 and 1987, respectively. Between 68 and 72% of these bears were grizzlies.

Large Stream Systems, 1988 Results

The larger tributaries of Yellowstone Lake and the Yellowstone River Outlet were surveyed separately during the cutthroat trout spawning run in 1988. The tributaries included the Yellowstone River Inlet, Pelican Creek, and Beaverdam Creek. Because of their length, size, and number of tributary branches, these systems were not

completely surveyed during the study years 1985-87. These 4 streams and their tributaries are presented in Figs. 8 and 9. Survey results from 1988 are given in Table 13.

Yellowstone River Outlet

Although the Yellowstone River is not a tributary of Yellowstone Lake, portions of it from the mouth of the lake to the Buffalo Ford were surveyed (Fig. 8). Spawning cutthroat trout were observed at LeHardy Rapids and Buffalo Ford near the shoreline of the river. Substrate and stream depths appeared suitable at these sites. Tributaries of the Yellowstone River Outlet with evidence of spawning runs included stream 1083 and Thistle Creek (Table 13).

Bear use of the Yellowstone River Outlet was observed by French and French (1990). They reported bear fishing in shallow portions of the river at LeHardy Rapids and near the mouths of Thistle Creek and stream 1076. I found evidence of bear activity on stream 1083 (Table 13).

Pelican Creek

Migrating cutthroat trout were observed in Pelican Creek from near the mouth to the upper end of Pelican Valley. Low fish densities, or from 2 to 5 fish per 100 m, were observed on this stream. Five tributaries of Pelican Creek had spawning cutthroat trout (Table 13). Stream 108513 had the highest relative abundance of spawners with 248 fish for 400 m or 1.24 trout/m^3 of stream. Raven Creek had 20 fish from its confluence with Pelican Creek to 500 m

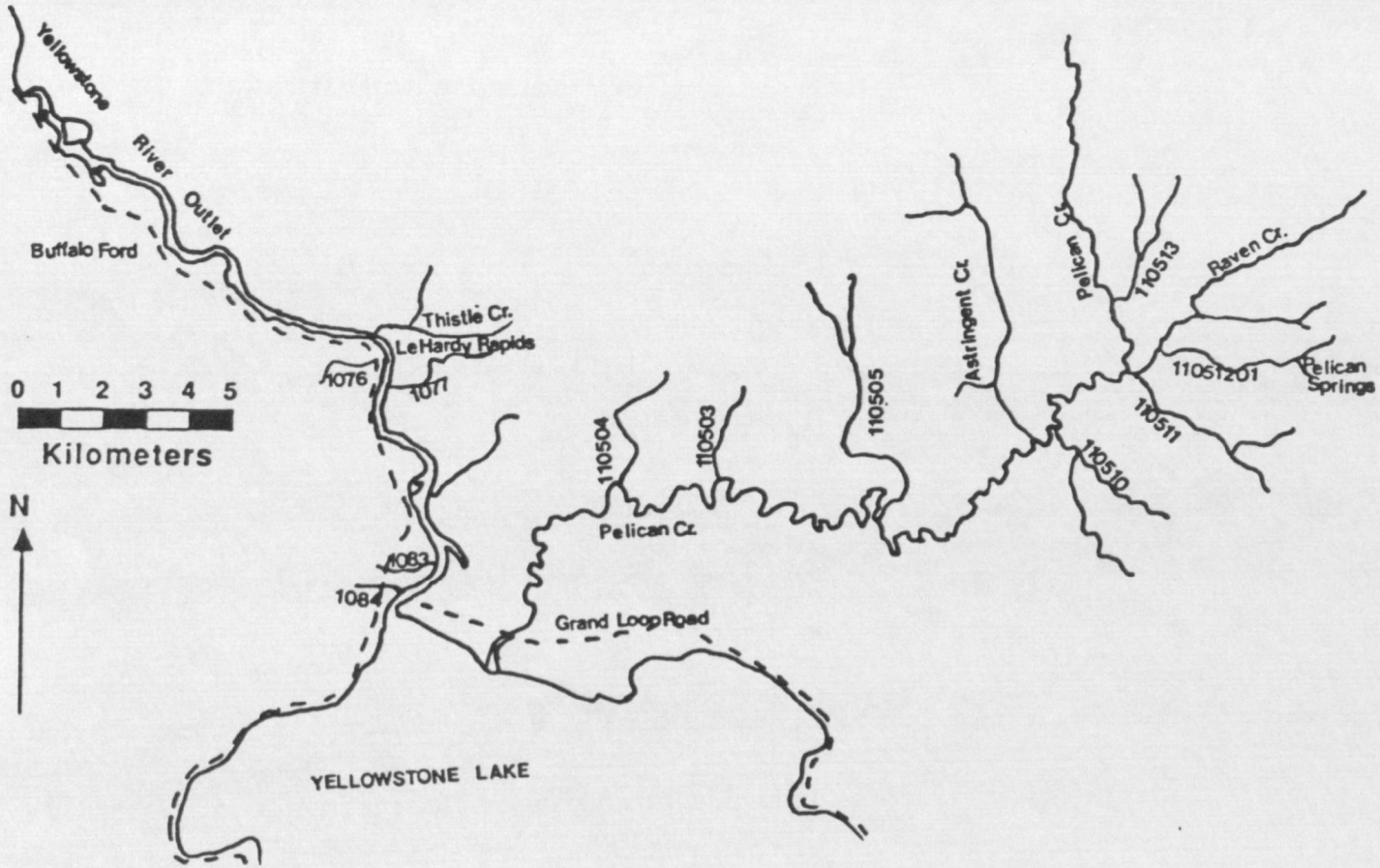

Fig. 8. Map of Yellowstone River Outlet and Pelican Creek on north shore of Yellowstone Lake.

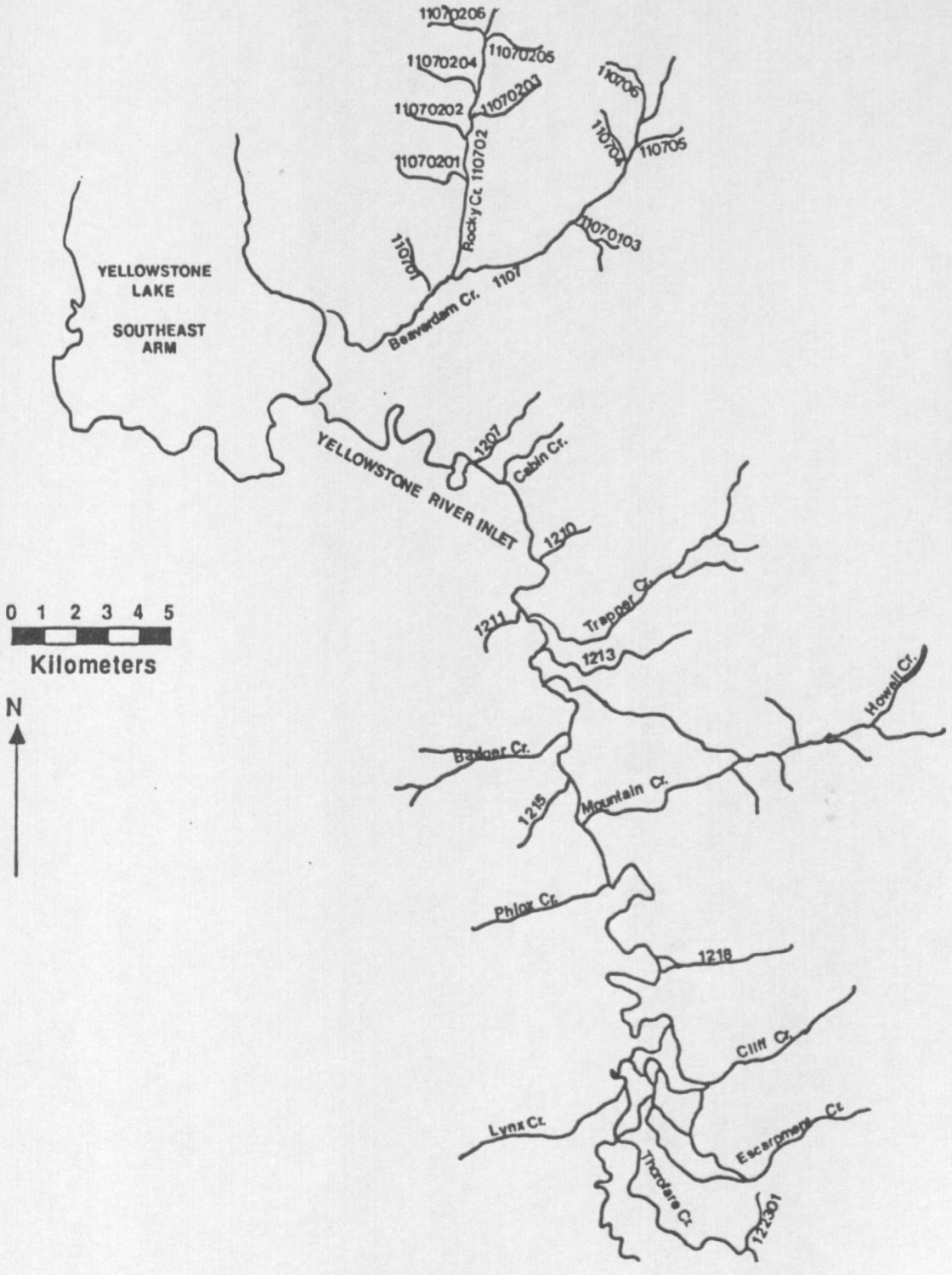

Fig. 9. Map of Yellowstone River Inlet and Beaverdam Creek on south shore of Yellowstone Lake.

Table 13. Survey results from 1988 on large stream systems.

Stream name branch	SONYEW number	Survey results: (Yes,No) spawning run	bear activity	bear fishing
Yellowstone Outlet	1000	Y	Y	Y
	1084	N	N	N
	1083	Y	Y	N
Thistle Cr	1078	Y	Y	Y
	1077	Y	Y	Y
	1076	Y	Y	Y
Pelican Cr	1085	Y	Y	N
	108503	N	Y	N
	108505	N	Y	N
Astringent Cr	108509	N	N	N
	108510	Y	Y	N
	108511	Y	Y	N
Raven Cr	108512	Y	Y	Y
Pelican Spgs Cr	10851201	Y	Y	N
	108513	Y	Y	Y
Beaverdam Cr	1107	Y	Y	Y
	110701	Y	Y	Y
Rocky Cr	110702	Y	Y	N
	11070201	Y	Y	N
	11070202	Y	Y	N
	11070203	N	N	N
	11070204	N	N	N
	11070205	N	N	N
	11070206	N	N	N
	110703	N	N	N
	110704	N	N	N
Yellowstone Inlet	1200	Y	Y	N
	1207	N	N	N
	1208	N	N	N
Cabin Cr	1209	N	Y	N
	1210	N	N	N
	1211	N	N	N
Trappers Cr	1212	Y	Y	N
	1213	N	N	N
	1214	Y	Y	N
Badger Cr	1215	Y	Y	N
Mountain Cr	1216	Y	Y	N
Phlox Cr	1217	Y	N	N
	1218	Y	N	N
Cliff Cr	1219	Y	N	N
	1220	N	N	N
Escarpment Cr	1221	Y	N	N
Lynx Cr	1222	N	N	N
Thorofare Cr	1223	Y	N	N

upstream; this translated into 0.02 fish per m^3. Other Pelican Creek tributaries had light evidence of spawning runs. Longnose suckers were also observed in Pelican Creek.

Stream 108513 was the only tributary in the Pelican Valley with evidence of bear fishing activity. Bear fishing activity on this stream was reported by Gunther (1986) and from IGBST feed-site investigations of radio-instrumented grizzly bears. Light bear activity was found along Raven Creek and stream 11851201. Although substantial bear activity near other tributaries of Pelican Creek were recorded by Gunther (1986) and others, no evidence exists that bears fished these streams.

Beaverdam Creek

Spawning cutthroat trout were observed in Beaverdam Creek from 17 June to 10 July 1988. Beaverdam Creek had a maximum fish abundance of 25 fish per 100 m or 0.01 fish/m^3; upstream extent of the run was approximately 5,000 m from its mouth. The first tributary of Beaverdam Creek (stream 110701) had 26 adult trout for 200 m or 0.832 fish per m^3 of stream. Rocky Creek, a second tributary, had a maximum of 12 fish per 100 m or 0.008 fish/m^3 for 1,000 m upstream from its confluence with Beaverdam Creek. Two small tributaries of Rocky Creek had light evidence of cutthroat trout spawning (Table 13).

Evidence of bear activity was found along portions of Beaverdam Creek and its tributaries in 1988. Stream 110701 was the only stream with evidence of bear fishing. Bear fishing on this stream was also found in 1987 by IGBST personnel.

Yellowstone River Inlet

The Yellowstone River Inlet and its tributaries were surveyed in 1988. Although few cutthroat trout were observed spawning in the inlet, more spawners were found in tributaries of the river. These tributaries included Trappers Creek, Badger Creek, Mountain Creek, Phlox Creek, Cliff Creek, Escarpment Creek, and streams 1214 and 1218 (Table 13). No Yellowstone River Inlet tributaries had high spawner numbers.

Although bear sign was found along banks of the Yellowstone River Inlet and some of its tributaries (Table 13), no evidence of bear fishing was found in this area.

DISCUSSION

Survey Methods

The methods used to determine cutthroat trout abundance and associated bear use on spawning streams were effective to determine relative levels for all Yellowstone Lake tributaries. These survey methods were imperfect indicators of spawner abundance and bear use because of the time intervals between surveys and the ephemerality of sign measured. Although polarized sunglasses facilitated fish counts, all trout were not counted because of stream cover, water turbidity, and fish movements. Similarly, rains and scavenger activity frequently dissipated bear use sign such as tracks and fish parts. Because of these factors, I could not estimate the precise number of spawners or bears on streams or fish eaten by bears. However, the objective of this study was to evaluate spawning stream use on a larger scale. This required a means of repeatedly surveying all Yellowstone Lake tributaries in a comparable, systematic manner. This necessitated the use of indirect measures and synthetic indices.

Track Analysis

Tracks have been used to census or index bear populations elsewhere (Edwards and Green 1959, Klein 1959, Valkenburg 1976, Pulliainen 1983). Although accurate track measurements in these coastal studies were facilitated by the presence of mudbanks and

sandbars associated with salmon spawning streams, use of track measurements as a population index was limited because frequent rains, variable substrates and track ages, and high bear densities made it difficult to differentiate individuals by track size. Valkenburg (1976) concluded that track measurements could be used to estimate the relative numbers and species of bears using streams. Klein (1959) also suggested that track measurements were of value for determining relative or seasonal bear abundance when less than 6 or 7 bears were using a stream.

Conditions in the Yellowstone Lake study were more favorable than in coastal areas for using track measurements as a relative census technique. No more than 4 to 6 autonomous bears were estimated to use an individual stream at a given time; enough tracks were usually present to allow differentiation but not so many as to generate confusion. Trackable substrate was abundant on spawning streams, and rains were less frequent in Yellowstone Park than in coastal Alaska.

From the methods used to estimate bear abundance in this study, the number of bears using Yellowstone Lake spawning streams probably under-estimated the actual number of bears. The time intervals between survey visits and the consolidation of bears with similar track sizes among time periods and stream groups thus make this census estimate inherently conservative. More accurate estimates of the number of bears on spawning streams were derived for individual streams and visits compared to estimates on stream groups over time periods.

Accurate estimates of the Yellowstone grizzly bear population have eluded researchers (Blanchard and Knight 1980; Knight and Eberhardt 1984, 1985). Track measurements were used to estimate bears on Yellowstone Lake tributaries to determine the relative value of these spawning streams as high quality bear habitat. Because of the indirect methods used to tally bears and the wide range of bear estimates from this study, I do not recommend using these numbers as an index of the Yellowstone grizzly bear population. These numbers can be used as a relative index of bear use on spawning streams and possibly as a measurable indicator of grizzly bear trends using these streams.

Yellowstone Lake Cutthroat Trout

Yellowstone Lake has the largest inland population of cutthroat trout in the world (Varley and Gresswell 1988). Yellowstone cutthroat trout are lacustrine-adfluvial spawners and have shown strong homing tendencies to specific spawning streams (Ball 1955, McCleave 1967, Jahn 1969).

I have found that most streams not suitable for cutthroat trout spawning runs were more apparent in smaller, first-order streams compared to larger tributaries. Although this and other studies have shown a wide variety of spawning stream attributes, most spawning migration takes place in the larger, third-order and higher tributaries of Yellowstone Lake (Cope 1957; Bulkley and Benson 1962; Jones et al. 1986, 1987).

The fluvial nature of salmon and trout leads to increased vulnerability to predators (McFadden 1969, Feder and Lauder 1986). Previous studies have shown Yellowstone Lake spawning mortality to range from 12.9% (Jones et al. 1985) to 48.1% (Ball and Cope 1961).

The white pelican is considered the most significant cutthroat trout predator on Yellowstone Lake (Ball and Cope 1961, Davenport 1974), while bears and other predators were less important. During this survey, pelicans were found fishing the larger, more open tributaries or at the mouths of spawning streams. Bears were apparently more successful fishing on smaller streams. Spawner densities were substantially less on larger tributaries than smaller streams because of their cross-sectional dimensions. Because bear fishing was more evident on smaller tributaries, the proportion of spawner mortality from bears was probably higher on smaller streams than on larger ones.

The use of restrictive regulations has apparently helped the Yellowstone Lake cutthroat trout population. Human activities such as hatchery operations, commercial fishery, and sport angling had an adverse effect on the cutthroat trout population (Gresswell 1980, Varley 1983). In response to a declining cutthroat trout population, hatchery and commercial operations were stopped, and restrictive angling regulations were implemented in 1969. Initial use of a 356-mm minimum size limit resulted in a declining age-size class structure of trout. In 1975, a 330-mm maximum size restriction and 2 fish per day creel limit were implemented. The use of these restrictions on the

cutthroat trout fishery resulted in increasing the proportion of older and larger fish in Yellowstone Lake (Gresswell and Varley 1988).

Bear Fishing

Bear predation on Yellowstone Lake cutthroat trout is unique compared to bear fishing elsewhere. In coastal systems of Alaska, British Columbia, and the Soviet Union, bears fed on Pacific salmon. Unlike anadromous coastal salmon that spawned once and died, cutthroat trout were adfluvial repeat spawners. Post-spawn trout were consequently more likely to be active and alive than post-spawn coastal salmon. Yellowstone bears made much less use of fish carcasses than did coastal bears (Clark 1959, Meehan 1961, Frame 1974). Cutthroat trout were on the average much smaller, ca. 0.45 kg (Jones et al. 1985), than most coastal salmon species. For these reasons, Yellowstone Park bears were probably more reliant on high fish densities for successful fishing than were bears fishing for coastal salmon.

Overall bear use of streams was strongly related to fish density. Hoskins (1975) and Mealey (1975, 1980) both concluded that bear use of spawning cutthroat trout on Yellowstone Lake depended on stream characteristics and linear density of fish. My results suggested that bear fishing success depended on fish density/m^3. Streams with the same absolute numbers or number of fish per 100 m, but with smaller cross-sectional area, typically received greater bear fishing use. Linear density or absolute numbers of spawners were thus weaker indicators of bear use.

Peak bear fishing typically occurred at the time of or soon after peak trout abundance. Two explanations for this pattern in bear fishing are possible: (1) Post-spawn trout were fatigued from spawning activity (e.g., digging redds), swam slower, and were thus more vulnerable to predators; and (2) as stream depths decreased in the summer months toward the end of the spawning season, trout densities and stream fishability would effectively increase. Although bear activity was highest on spawning streams with trout present, bear activity was also evident after fish abundance declined or ceased, and on streams with low or no spawner density. This suggested that bears also used spawning streams for other reasons (e.g., grazing on riparian habitats).

I found no evidence that bears fished longnose sucker spawning runs. Sucker remains were not found along streambanks nor identified in bear scats. Longnose suckers migrated in tributaries near the end of the cutthroat trout spawn; fish densities were typically low at that time and fish availability was effectively diminished. Previous studies (Hoskins 1975, Graham 1978) reported bears fishing sucker runs on Pelican Creek, usually at a USFWS fish trap near the mouth. Reports from IGBST feed-site data also showed conclusive evidence of bears fishing suckers on Witch Creek, a tributary of Heart Lake located approximately 12 km southwest of Yellowstone Lake.

Bear Use of Spawning Streams

The data suggest that a number of factors influenced bear use of spawning streams. Fish density explained some but not all bear use of

Yellowstone Lake tributaries. Overall bear activity and bear fishing were strongly related to fish density/m^3 on the west and east shores 2 out of 3 years, and on front-country streams >1 km from park developments. Other factors explained most bear use on the South and Southeast Arms, on streams with typically low fish densities, and on front-country streams near developments, on streams with often high fish densities. These factors included the overall habitat complex, presence of humans, timing of spawning runs, and proximity of spawning streams.

Habitat Complex

Grizzly bear habitat productivity models for the Yellowstone Ecosystem have been used to predict management actions, bear movements, population parameters, and habitat quality (Knight et al. 1984, Harting 1985, Picton et al. 1986, Weaver et al. 1986). Vegetation communities along Yellowstone Lake spawning streams were rated overall higher quality grizzly bear habitat than Yellowstone Park as a whole or the upland communities surrounding Yellowstone Lake. Summer habitat productivity was characterized as more evenly distributed among geographical areas and less varied among years than spring and fall habitats. Streamside habitat scores were significantly higher than found parkwide even though fish availability was not included in productivity score analysis (Mattson et al. 1986).

Habitat productivity scores developed for the Yellowstone area ranged from 0 to 1 and were typically highest during spring and fall

because of seasonal availability of ungulates and whitebark pine seeds, respectively. Habitat productivity scores were adjusted to account for cutthroat trout spawning streams in the Cumulative Effects Analysis for the Yellowstone Ecosystem (Mattson and Despain 1985). Higher value spawning streams were assigned a habitat score coefficient of 3.75, and lower value spawning streams a coefficient of 1.90 (U.S. For. Serv. et al. 1985). These factors give spawning streams some of the highest habitat productivity scores found in the Yellowstone area.

Another value of streamside habitats to bears was the high interspersion of forest cover and nonforest openings. Most habitat-cover types classified on spawning streams were typically open riparian corridors or meadows bounded by timber or forest galleries within 5 to 50 m from streams. Grizzly bears in the Yellowstone area prefer habitats close to timber and nontimber ecotones (Graham 1978, Blanchard 1983). Open habitats offer substantial foraging opportunities, especially during spring and early summer. Forest areas near streams provide late summer forage and may serve as escape cover (Graham 1978).

Differences in bear use of spawning streams among major stream groups were explained largely by variations in spawning stream characteristics and the overall habitat complex. This was evident by variation in regression equations and scat analysis for the areas around Yellowstone Lake.

West Shore. The west shore was characterized by numerous small tributaries with open riparian corridors or alluvial meadows surrounded by upland lodgepole pine forest. Some west shore streams had high fish densities and were fished heavily. Other streams had substantial bear use, even when fish were absent or present in low densities. This was reflected in high regression intercepts for this area. The lush riparian vegetation of meadows and gallery forest was apparently used by bears. This was especially likely given the paucity of bear food in surrounding upland forest. The large amounts of graminoids and forbs found in west shore scats support this interpretation. The proximity of numerous smaller streams to primary spawning tributaries, especially on Flat Mountain Arm, may also explain high bear use along streams with no or low spawners.

South Arms. The South and Southeast Arms offered the least fishing opportunities for bears. Many streams were too small to support spawners; others were large enough but had lower fish densities. Spawning streams that provided bear fishing occurred at the south end of both arms. The habitat complex of the south arms offered a higher diversity of vegetation community types and received substantial bear use even though heavy fishing was not apparent. Surrounding upland forests were similar to those found along the west shore. Scat results showed the highest use of foliferous vegetation and the least use of trout.

East Shore. The east shore habitat complex differed considerably from the other areas around Yellowstone Lake. Tributaries from surrounding high relief mountains were typically fewer, larger, and bounded by forest. Spawners occurred in these streams in high densities, offering substantial fishing despite their larger size. Bears using the east shore had other foraging options in nearby upland communities at that time of year including over-wintered whitebark pine seeds at higher elevations (Kendall 1983), biscuitroot on high subalpine ridges, and graminoids in lush mountain meadows. Bears on the east shore were probably not as dependent on the riparian habitat complex associated with spawning streams as on the west shore and south arms. The lower regression intercepts and strong relationship between bear fishing and fish density during 1985 and 1986 reflect a strong attraction of bears toward fish on these streams. The proportionate increase of fish and decrease of vegetation in scats also support the interpretation that bears were using east shore streams primarily for fishing and were apparently foraging elsewhere when not.

Front Country. The habitat complex containing front-country streams was similar to that containing west shore backcountry streams, that is, riparian corridors surrounded by upland lodgepole forest. However, bear use of front-country streams differed from the west shore by consistently lower regression equation intercepts, a substantially stronger attraction of bears towards fish on streams

>1 km from developments, and an overall increase in the proportion of fish in scats. Unlike west shore streams, bears were typically using front-country streams primarily for fishing and less for the overall riparian habitat associated with these streams.

Human Presence

Bear use of front-country spawning streams was significantly affected by the presence of humans and park developments. This interpretation is supported by the strong attraction of bears toward fish density, by very little use of streams without spawners, and by the substantial difference in bear use of streams >1 km from developments compared to those <1 km from park concessions. Bears were apparently avoiding streams in closest proximity to humans and human facilities.

Timing of Spawning Runs

Annual variation in bear use of spawning streams was related to physical and other behavioral factors. In general, the relationship between fish density and bear use was strongest in 1985, weakest in 1986, and intermediate in 1987. Differences in timing and magnitude of the spring runoff in streams may explain variation among years in bear use. In 1986 the snowpack was much deeper than in 1985 or 1987; spring snowmelt began late and occurred fast, especially on the west shore and front country. Streamflows were higher and cutthroat trout spawning runs were characterized as late, more intense, with typically high densities and generally shorter durations. Also, during 1986

over-wintered whitebark pine nuts were abundant and used by bears at higher elevation habitats during June and July. The 1987 snowpack was half of normal. Because of this, spawning runs began much earlier than in 1985 and 1986. The availability of trout to bears began and ended earlier than in other study years. Overall bear use of fish was less in 1987 in the south arms and east shore. The 1985 spawning run appeared intermediate in timing among study years; snowpack conditions were close to normal. Although front-country streams were not sufficiently surveyed in 1985, overall bear use of spawning streams appeared strongest and for the longest duration when snowmelt conditions approached normal regimes.

Very little use of streams <1 km from park developments was recorded, despite sometimes high spawner densities. This pattern varied between 1986 and 1987, probably as a consequence of differences in timing of spawning runs relative to the opening of the Lake and Grant Village developments. Park concessions opened mid-May to early June in 1986 and 1987. The 1986 spawning run began in mid-June because of above normal snowmelt conditions, and overlapped entirely with the period of heavy human use. Bear use of spawning streams <1 km from developments was 90% less than expected by fish densities during 1986 because of this concurrence. During 1987, snowpack was less and snowmelt earlier; cutthroat trout spawning runs began in early to mid-May before the opening of major park concessions. Consequently, bear use of streams closest to developments was only 30% less than expected. Timing of spawning runs relative to opening of

developments had substantial impacts on bear use of streams near human facilities.

Proximity of Spawning Streams

Track analysis showed that bear tracks with similar sizes and family group associations were evident on a series of proximal streams. The use of proximal streams by a single bear was confirmed from observations of a radio-collared grizzly utilizing a set of streams near the Lake development. She was found to fish the same 5 to 7 streams on a daily basis (French and French 1990).

Bear use of adjacent streams may explain evidence of bear use with low or no spawner densities. This was particularly evident on Flat Mountain Arm and the east shore where bears were using streams with no spawning trout but were adjacent to other high density spawning streams.

Travel corridors were associated with use of proximal stream groups. Corridors with evidence of use by bears around Yellowstone Lake included park trails, old service roads, power line cuts, and lake shore beaches.

Grizzly Bear Food Habits

Bears using Yellowstone Lake spawning tributaries were foraging primarily for cutthroat trout. This was evident by the high ingestion rate of trout (91% of total diet) estimated after fecal correction factors were applied in scat analysis. This is not surprising given

the high lipid and protein content and digestibility of fish compared to other diet items available to bears at that time of year (Knight et al. 1984).

Grazing foliferous vegetation (graminoids, forbs, and horsetail) was another foraging pattern bears used on spawning streams. Estimated ingestion rates of vegetation were substantially less than scat volume content after fecal correction factors were applied. However, vegetation still occurred in 88% of all study area scats suggesting that grazing lush vegetation associated with riparian habitats was continually employed. Bear activity sign on streams with low or no spawner abundance also suggests use of streamside vegetation.

Temporal use of vegetation reflected seasonal variation in phenology and diet item quality. Graminoids were used throughout the spawning season, but peak use occurred in May and June. Forbs were more heavily used later in June and July. This pattern probably reflected changes in plant succulence; graminoids contain higher digestibility and protein content associated with early pre-flower phenology, whereas forbs have a higher protein content later in the growing season (Graham 1978, Mattson et al., in prep.). Later use of thistle and horsetail was probably more related to emergence of flowering and sporophyte stems.

Bear use of other diet items was found on tributary streams and conforms with other Yellowstone food habit studies. Remains of mammals were found in scats and were more prevalent early in the

spawning season. Knight et al. (1984) and Mattson et al. (in prep.) reported most bear use of ungulates in April and May. This resulted from feeding on winter-killed or weakened animals (Harting 1985, Green 1989) or from preying on newborn calves (Schleyer 1983, Gunther 1986). The consistently high sightings of ungulates on Yellowstone Lake tributaries reflect their availability to bears. Ants were evident in scats in small amounts and reflect their widespread availability, especially as a backup food source (Mattson et al., in prep.).

Other diet items prominent in Yellowstone grizzly bear food habits were not abundant in scats from along Yellowstone Lake. Use of fleshy roots was apparent in minor amounts. Biscuitroot was found in small amounts on east shore streams. This was used on higher elevation meadows associated with east shore drainage headwaters. Yampa (Perideridia gairdneri) was abundant in subalpine meadows along some streams, but absent in scats. This may be due to typical use of yampa in August and September, after the spawning run, and firmer soil characteristics associated with riparian habitats (Graham 1978). Whitebark pine seeds are a predominant fall and spring food for bears (Kendall 1983) but were almost absent from study area scats. Whitebark pine use typically varied with annual cone crops and was usually found at higher elevations than near Yellowstone Lake. An exception occurred on the east shore of the Southeast Arm where whitebark pine occurred. There was a notable lack of spawning streams in this area, and no evidence of bear use of whitebark pine during the study years. However, bear use of whitebark pine was found in this

area during the late summer of 1989, an exceptionally abundant cone crop year.

Bears are apparently using more spawning streams and fish now than 10 years ago. This is most likely due to changes in the Yellowstone Lake fisheries management which has resulted in a larger age- and size-class structure of the cutthroat trout population. The increase in mean lengths of cutthroat trout from 350 mm in 1969 to 392 mm in 1985 (Gresswell and Varley 1988) may be sufficient to effectively increase energetic efficiency per fish for bears. Moreover, more older and larger fish effectively have increased the overall biomass of spawning cutthroat trout from an estimated low of 710 tons in 1966 to approximately 920 tons of fish entering tributaries in 1985 (Servheen et al. 1986). Because of restrictive angling regulations on the fishery, there are now several age classes of trout using spawning streams each year. This may have resulted not only in more fish in tributaries but fish may also be more widely distributed in spawning streams for longer periods than previously estimated.

Another reason for increased bear use of spawning streams is changes in grizzly bear food habits in Yellowstone National Park since the 1970's. Before 1970, many Yellowstone Park bears used human garbage dumps for part of their food supply (Craighead and Craighead 1971, J. Craighead 1980, Craighead and Mitchell 1982). Murie (1944) did not report bear use of fish in his 1-year food habits study. Bear use of spawning cutthroat trout was not reported during the 1959-70

studies of Yellowstone grizzly bears (cf. Craighead and Craighead 1971, Craighead 1976, Craighead and Mitchell 1982, Craighead et al. 1982, and others). Similarly, Mealey (1975) and Hoskins (1975) were also very likely dealing with a bear population in transition from using human foods to now using habitats and foraging patterns in a way much less affected by humans.

Recent food habit studies (Mealey 1975; Knight 1984; Mattson et al., in prep.) in Yellowstone National Park have not demonstrated a high overall level of trout use by bears. This is attributable to under-representation of fish in scats due to their high digestibility (Bunnell and Hamilton 1983, Hewitt and Robbins 1990), and under-sampling associated with the remoteness of backcountry streams and the difficulty in detecting scats composed mainly of fish that were typically smaller and more ephemeral than scats high in vegetation (Mattson et al., in prep.).

Because of their high digestibility, protein and lipid content, spawning cutthroat trout is an important component of the natural food habits of Yellowstone grizzly bears. High energy items such as fish during early summer may provide bears the opportunity to increase body mass and help reproducing females regain nutritional status loss from parturition and lactation of young. Spawning stream use by bears is especially important because of changes in bear feeding behavior and movements since the close of Yellowstone Park garbage dumps in 1970.

MANAGEMENT IMPLICATIONS

The close association between bears and cutthroat trout merits the attention of resource managers. Yellowstone Lake cutthroat trout is a high quality, seasonal food source for numerous grizzly and black bears in Yellowstone National Park; a minimum of 44 autonomous bears were estimated to use spawning streams in 1987. Because of the availability of fish and riparian vegetation associated with spawning streams, Yellowstone Lake tributaries constitute high quality bear habitat from May through August each year.

The following management actions are recommended:

1. Current angling restrictions of the cutthroat trout fishery should be maintained.

Management efforts to improve the Yellowstone Lake cutthroat trout population have been successful. Recent data have shown the cutthroat trout population increasing in age and size classes. This has effectively increased the overall fish biomass and possibly spawning stream use by trout. The higher abundance of spawning trout has been increasingly exploited by bears.

2. Current backcountry restrictions on Yellowstone Lake tributaries should be maintained and possibly improved.

The backcountry portion of Yellowstone Lake contains 62% of tributary streams, 65% spawning streams, and 67% of streams used by

bears. Management concerns for backcountry streams are small compared to front-country areas. However, there have been some reported incidents of bear-human confrontations near backcountry spawning streams. Human influence on backcountry streams includes pack trails along the east and south shores and numerous campsites situated throughout the lake shore. Many areas around Yellowstone Lake are reached only by boat; power boat restrictions apply in the 3 arms.

Human use around the Yellowstone Lake backcountry is currently prohibited for most of the duration of the cutthroat trout spawning run from 15 May through 14 July. However, some campsites on the south shore of Flat Mountain Arm, southwest bay of the South Arm, and east shore lie near the mouths of key spawning streams. I have found spawning and bear activity on streams until 29 July on the west shore and south arms, and until 12 August on the east shore, typically later than the opening of human use.

Current management regulations closing backcountry areas around Yellowstone Lake appear to be effective, allowing bears to forage on cutthroat trout spawning streams and reducing the potential for bear-human conflicts. Further efforts to reduce possible bear-human interaction include eliminating backcountry campsites that are proximal to important spawning streams and extending the opening dates of human backcountry use to the end of July. This is especially critical near east shore tributaries that typically have later spawning runs and have had evidence of bear-human problems.

3. The temporal overlap between human use of park developments and the cutthroat trout spawning and bear activity on front-country streams should be eliminated.

The front-country tributaries of Yellowstone Lake comprise a sizable portion (35%) of cutthroat trout spawning streams. Moreover, 18% of spawning streams occur within 1 km of park concessions. Seven spawning streams lie within the Lake development, and 4 spawning streams are within the Grant Village area.

Humans unequivocally affected bear use of front-country spawning streams. Bear use of spawning streams <1 km from park developments was most dramatically affected. Human effects were greatest when cutthroat trout spawning runs coincided with human use and occupancy. Cutthroat trout spawners and associated bear use was evident on front-country streams as late as 28 July, while concession opening dates occurred from 15 May to 16 June. It was during this time of temporal overlap that most bear-human confrontations occurred.

The predominant management concerns on Yellowstone Lake spawning streams are increased bear use of front-country streams and the potential for bear-human conflicts near park developments. Both the Lake and Grant Village concessions are located among proximal stream groups. Bears were found fishing Lake area spawning streams from 1986 through 1989 and around Grant Village from 1987 through 1989. Bear management problems resulted in both areas when bears fished near developments in the presence of humans. This problem was particularly evident at the Lake area where a female grizzly annually fished

streams from 1987-89 near tourist facilities in front of crowds numbering sometimes in the hundreds. Attempts to trap and relocate her appeared futile. She was moved to other areas including backcountry spawning streams in 1987, 1988, and 1989 but returned to Lake spawning streams within days. She was finally caught and removed from the ecosystem in April 1990 (K. Gunther, Natl. Park Serv., pers. commun., 1990).

Bears using spawning streams near park developments may affect segments of the grizzly bear population. Security-conscious or subordinate bears, typically adult females with young and subadult males, were displaced into habitats closer to human facilities and roads (Mattson et al. 1987). This was demonstrated by the presence of an adult female at Lake and a subadult grizzly bear at Grant Village in 1989. Both fished front-country spawning streams during daylight hours. These cohorts were management-trapped and removed more often than other, more dominant cohorts. Avoidance of humans by grizzlies, or removal of bears by humans may result in poorer condition in females and possibly higher mortality and lower fecundity rates for the population (Knight and Eberhardt 1985, Mattson et al. 1987). Removing bears, especially female grizzly bears, from the Yellowstone population could contribute to the projected decline of the population (Knight and Eberhardt 1984, 1985).

While eliminating bears from spawning streams near developments may lessen the risk of bear-human conflicts, this policy appears contrary to Yellowstone National Park and interagency grizzly bear

guidelines. Moreover, removing front-country bears is a response to a symptom of a deeper problem; other bears were shown to fish spawning streams near developments and will most likely cause future bear management problems. Mitigation of impacts on grizzly bears from facilities remaining at the Fishing Bridge development near the Lake area included "closure to human use during the spawning season of areas surrounding all spawning streams tributary to Yellowstone Lake that are used by grizzly bears" (Final Environmental Impact Statement and Development Concept Plan for the Fishing Bridge Developed Area of Yellowstone National Park 1988). Similarly, Yellowstone Park Service grizzly bear policy proposes that management be implemented to "restore and maintain the natural integrity, distribution, and behavior of bears. . ." and to "provide for visitor safety by minimizing bear/human conflicts by reducing human-generated foods and by regulating visitor distribution" (Interagency Grizzly Bear Guidelines 1986).

Bear-human conflicts could be reduced by eliminating the temporal overlap of cutthroat trout spawning runs and human use near spawning streams. Given that bears are better able to adapt to predictable human behavior, a fixed but late opening date of no earlier than 30 June for lakeshore developments would be required for effective mitigation.

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APPENDICES

APPENDIX A

FIELD FORM FOR YELLOWSTONE LAKE STUDY

Reinhart - 87

YELLOWSTONE TRIBUTARY STUDY

Tributary Name_____ Sonyew No._____ Section_____

Date_____ Time_____ Observers_____ UTM_____

Stream Features

% Slope Gradient_____ Substrate _____ Temp._____

Stream Width_____ Stream Depth_____

No. Meanders_____ Riffles _____ No. Pools_____

Stream Description_____

_____

Vegetation

Habitat Type_____ Cover Type_____ Distance to Cover_____

Area Physiognomy_____

_____

Spawning Activity

Est. Fish Density_____ No. Fish Seen_____ Spawning Phase_____

Bear Sign

No. Fish Parts_____ No. Bear Scats_____ Trails_____

Bear Tracks_____ No. Bears_____

Bear Fishing Activity_____

_____

Site Disturbance

Campsites_____ Trails_____ Distance to Disturbance_____

Fig. 10. Yellowstone Lake study field form.

APPENDIX B

YELLOWSTONE LAKE TRIBUTARY NUMBERS

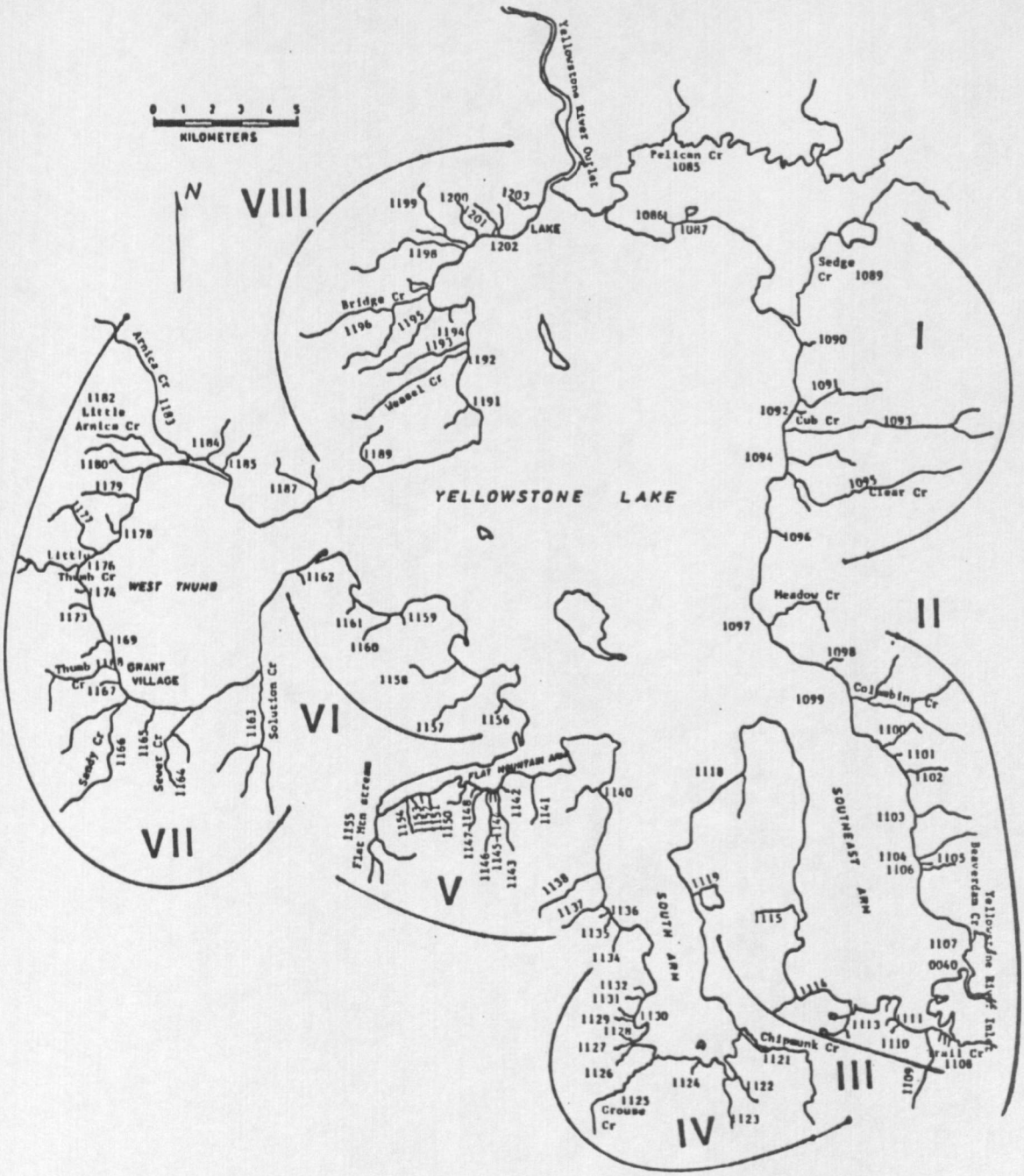

Fig. 11. Map of Yellowstone Lake and tributary streams. Streams are designated by SONYEW numbers. Study areas are grouped as follows: east shore - groups I and II; south arms - groups III and IV; west shore - group V and VI; front-country - groups VII and VIII.

Table 14. Yellowstone Lake tributary streams and year surveyed by IGBST.

Name or Hoskins No.	Old SONYEW number	New SONYEW number	Year surveyed by IGBST
Solution Cr	0212	1163-	1985-87
41	0211	1162-	1985, 1987
--	0206	1161-	1985
109	0205	1160-	1985, 1987
--	0204	1159-	1985, 1987
108	0203	1158-	1985, 1987
107	0202	1157-	1985, 1987
--	0201	1156-	1985, 1987
Flat Mountain Cr	0200	1155-	1985-87
105	0199	1154-	1985
104	0198	1153-	1985
103	0197	1152-	1985
102	0196	1151-	1985
101	0195	1150-	1985-87
100	0194	1149-	1985, 1987
99	0193	1148-	1985-87
98	0192	1147-	1985-87
97	0191	1146-	1985-87
96	0190	1145-	1985-87
95	0189	1144-	1985-87
94	0188	1143-	1985-87
93	0187	1142-	1985-87
92	0186	1141-	1985, 1987
91	0182	1140-	1985, 1987
89	0181	1139-	1985, 1987
88	0180	1138-	1985-87
87	0179	1137-	1985, 1987
86	0178	1136-	1985
85	0177	1135-	1985
84	0176	1134-	1985, 1987
83	0175	1133-	1985, 1987
82	0174	1132-	1985, 1987
81	0173	1131-	1985, 1987
80	0172	1130-	1985
79	0171	1129-	1985
78	0170	1128-	1985
77	0169	1127-	1985, 1987
76	0168	1126-	1985, 1987
Grouse Cr	0165	1125-	1985, 1987
75	0162	1124-	1985
74	0161	1123-	1985, 1987
73	0160	1122-	1985, 1987

Table 14. Continued.

Name or Hoskins No.	Old SONYEW number	New SONYEW number	Year surveyed by IGBST
Chipmunk Cr	0153	1121-	1985, 1987-88
72	0152	1120-	1985, 1987
Alder Lk outlet	0146	1119-	1985, 1987
71	0145	1118-	1985, 1987
69	0144	1117-	1985, 1987
68	0143	1116-	1985, 1987
67	0142	1115-	1985, 1987
66	0141	1114-	1985, 1987
65	0138	1113-	1985, 1987
70	0137	1112-	1985, 1987
64	0136	1111-	1985, 1987
63	0135	111001-	1985, 1987
--	134.5	111002-	1987
62	0134	1109-	1985, 1987
61	0133	110801-	1985, 1987
60	0132	110802-	1985, 1987
59	0131	110803-	1985, 1987
Trail Cr	0129	1108-	1985, 1987
Yellowstone R I.	--	0040-	1988
Beaverdam Cr	0125	1107-	1985, 1987-88
58	0124	1106-	1985, 1987
57	0123	1105-	1985, 1987
56	0122	1104-	1985, 1987
55	0121	1103-	1985, 1987
54	0120	1102-	1985, 1987
53	0119	1101-	1985, 1987
Alluvium Cr	0118	1100-	1985, 1987
Columbine Cr	0115	1099-	1985, 1987
8	0114	1098-	1985
Meadow Cr	0113	1097-	1985, 1987
9	0112	1096-	1985
Clear Cr	0104	1095-	1985-87
6	0103	1094-	1985-87
Cub Cr	0100	1093-	1985-87
5	0099	1092-	1985
2	0098	1091-	1985-87
1	0097	1090-	1986
Sedge Cr	0092	1089-	1986
Indian Pond O.	0089	1087-	1986
10	0088	1086-	1986
Pelican Cr	0070	1005-	1988
Yellowstone R O.			1987, 1988
--	0272	1204-	1986, 1987
111	0271	1203-	1986, 1987

Table 14. Concluded.

Name or Hoskins No.	Old SONYEW number	New SONYEW number	Year surveyed by IGBST
Hotel Cr	0270	1202-	1986, 1987
Hatchery Cr	0269	1201-	1986, 1987
12	0268	1200-	1986, 1987
13	0267	1199-	1986, 1987
14	0266	1198-	1986, 1987
15	0265	119701-	1986
Bridge Cr	0260	1197-	1986, 1987
17	0259	1196-	1986
16	0258	1195-	1986
18	0257	1194-	1986
19	0256	1193-	1986, 1987
Weasel Cr	0255	1192-	1986, 1987
42	0252	1191-	1986, 1987
20	0251	1190-	1986, 1987
21	0250	1189-	1986, 1987
22	0249	1188-	1986, 1987
23	0248	1187-	1986, 1987
24	0247	1186-	1986, 1987
26	0239	1185-	1986
25	0238	1184-	1986, 1987
Arnica Cr	0235	1183-	1985-87
Little Arnica Cr	0234	1182-	1985-87
28	0233	1181-	1985-87
29	0232	1180-	1985-87
30	0231	1179-	1985-87
31	0230	1178-	1985-87
32	0229	1177-	1985-87
Little Thumb Cr	0228	1176-	1985-87
--	0227	1175-	1986, 1987
33	0226	1174-	1986, 1987
34	0227	1173-	1986, 1987
--	0222	1172-	1986, 1987
--	0221	1171-	1986, 1987
35	0220	1170-	1986, 1987
36	0219	1169-	1986, 1987
Thumb Cr	0218	1168-	1985-87
37	0217	1167-	1985-87
Sandy Cr	0216	1166-	1985-87
39	0215	1165-	1986, 1987
Sewer Cr	0214	1164-	1985-87

APPENDIX C

DATA ON YELLOWSTONE LAKE TRIBUTARY STUDY

Table 15. Selected stream physical parameters of tributaries to Yellowstone Lake.

Stream	Mouth location UTM coordinates	Stream order	Gradient (%) (ave.)	Substrate (codes[a])	Temp. (range, ave.) (C)	Width X depth (m)	#Pools\ riffles\ meanders (per 100m)	Stream Status[b]
SOLUTION	5399 X 49165	III	2	S,G	43-64, 44			P
1162	5407 X 49202	I	3	S,C	49	1.0X0.01		I
1161	5430 x 49193	I	2	C,B	46			I,L
1160	5441 X 49189	II	7	S,St	48-59, 53	0.7X0.22	6\4\2	I
1159	5443 x 49190	I	6	S	52	0.7X0.3		I
1158	5464 X 49173	I	3	G,C	43-58 ,52	1.1X0.23	7\6\3	P
1157	5472 X 49168	II	2	S,G	43-60, 51	1.2X0.21		P,L
1156	5479 x 49159	I	2	St,S	58	2.0X0.1		I,L
FLAT MTN.	5438 X 49118	II	2	G,C	39-63, 50	1.7X0.25	3\2\3	P
1154	5447 X 49123	I	26	B,C		0.7X0.2		I
1153	5448 X 49124	I	26	B,C		0.7X0.2		I
1152	5448 X 49124	I	25	B		1.0X0.2		I
115101	5455 X 49127	I	25	B	44-51, 47	1.0X0.1		P
115102	5455 X 49127	I	25	B	44-51, 47	1.0X0.1		P
1150	5467 X 49121	I	7	C,G	44-64, 52	1.8X0.1	4\1\1	P
1149	5470 X 49128	I	20	C		0.3X0.1		P
1148	5471 X 49128	I	11	C,B	36-55, 47			P
1147	5472 X 49128	II	8	C,B	37-50, 45	0.7X0.08		P
1146	5476 X 49128	II	7	C,G	43-53, 45	1.6X0.1	4\1\1	P
1145	5476 X 49127	I	17	S,C	43-53, 51	0.4X0.1	1\1\0	I
1144	5476 X 49127	I	11	C,G	48-51, 49	1.4X0.1	1\0\1	P
1143	5478 X 49128	I	10	C,B,G	37-51, 47	1.3X0.09	3\2\2	P
1142	5478 X 49128	I	9	C	42-50, 47	0.5X0.03	0\1\0	P
1141	5489 X 49123	II	7	G,C	44-51, 46	1.1X0.13	4\2\1	P
1140	5512 X 49129	I	5	C	40	1.0X0.2		I
1139	5512 X 49105	I	5	C,G	44-52, 49	0.9X.09	3\2\1	P
1138	5513 X 49100	II	5	G,C	39-53, 46	1.3X0.15	3\2\1	P

Table 15. Continued.

Stream	Mouth location UTM coordinates	Stream order	Gradient (%) (ave.)	Substrate (codes[a])	Temp. (range, ave.) (C)	Width X depth (m)	#Pools\ riffles\ meanders (per 100m)	Stream Status[b]
1137	5513 X 49089	I	10	C	39-42, 41	1.5X0.13	2\2\1	P,L
1136	5517 X 49085	I	10	C		0.5X0.05		P
1135	5517 X 49084	I	7	C	38	1.0X0.05		I,L
1134	5523 X 49080	I	4	S,G	44-49, 46	1.0X0.13	3\3\2	I,L
1133	5527 X 49070	I	3	S,G	40-47, 42	0.3X0.06	1\1\1	I,L
1132	5528 X 49055	I	8	G,S	43-55, 49	0.7X0.13	7\3\7	P
1131	5527 X 49054	I	6	G,S	39-55, 47	0.7X0.05	4\3\3	P
1130	5525 X 49084	I	10	S	50	0.5X0.05		I
1129	5525 X 49047	I	10	S	46	0.5X0.0		I
1128	5523 X 49039	I	10	S	42	0.5X0.1		I
1127	5523 X 49039	I	4	G,S	38-57, 47	1.0X0.2	5\5\5	P
1126	5524 X 49038	I	2	G,S	37-57, 48	1.0X0.2	4\4\5	P,L
GROUSE	5531 X 49034	II	1	G	36-54, 46	5.5X0.42	1\2\1	P
1124	5546 X 49033	I	10	C,S	33	0.5X0.05		I
1123	5555 X 49028	I	4	G,C	34-53, 47	1.0X0.16	5\5\5	P
1122	5558 X 49027	II	3	C,S	38-62, 53	0.8X0.17	4\4\3	P
CHIPMUNK	5566 X 49039	III	2	G,C	35-57, 45	8.0X0.5	3\3\3	P,L
1120	5547 X 49069	I	11	B,C	44	0.5X0.07	0\0\0	I
ALDER LK O	5543 X 49093	I	2	S,B	55-65, 60	3.5X0.25	1\1\0	P
1118	5559 X 49136	I	3	C,G.S	37-59, 49	1.0X0.09	2\2\2	P,L
1117	NOT FOUND							
1116	5578 x 49111	I	20	C,S		0.2X0.02		I
1115	5578 X 49086	I	3	S,St	47-62, 55	1.4X0.11	2\2\1	P,L
1114	5578 X 49057	II	3	C,S	47-61, 57	0.7X0.08	1\0\1	P,L
1113	5596 X 49053	II	3	G,C	44-61, 52	1.1X0.13	3\2\4	P,L
1112	NOT FOUND							
1111	5612 X 49049	II	6	G,C	46-61, 51	1.5X0.1	3\3\1	P
1110	5613 X 49048	I	10	C	43	0.7X0.1		I
110901	5617 x 49056	I	7	C,G	44	0.2X0.05		I

Table 15. Continued.

Stream	Mouth location UTM coordinates	Stream order	Gradient (%) (ave.)	Substrate (codes[a])	Temp. (range, ave.) (C)	Width X depth (m)	#Pools\ riffles\ meanders (per 100m)	Stream Status[b]
1109	5621 X 49047	II	5	C,G	37-48, 41	1.0X0.08	1\1\0	I
110801	5628 X 49044	I	9	C,B	36-42, 40	2.0X0.15		P,L
110802	5629 X 49045	I	4	C,G	39-44, 40	0.7X0.08		P,L
110803	5631 X 49045	I	8	G,C	38-43, 41	0.8X0.15		P,L
TRAIL	5631 X 49046	II	1	S,C	49-58, 54	4.0X0.35	1\1\1	P,L
YEL.R.INLET	5634 X 49064	V						
BEAVERDAM	5638 X 49083	IV	1	G,C	49-53, 52	8.2X0.62	1\1\0.5	P
1106	5619 X 49104	I	10	C,G	37-42, 39	0.5X0.2	3\1\1	I
1105	5619 X 49106	I	10	C		0.5X.02		I
1104	5618 X 49109	I	7	C,G	38-47, 43	1.5X0.14	3\2\0	P
1103	5616 X 49125	I	5	G,C	39-48, 44	2.0X0.17	2\2\0	P
1102	5614 X 49137	I	3	G,C	45-46, 46	0.7X0.07	0\0\0	I,G
1101	5608 X 49144	I	4	C,G		1.0X0.05		I,G
ALLUVIUM	5605 X 49174	I	3	G,C	52-56, 55	1.5X0.07		P,G
COLUMBINE	5594 X 49164	III	2	G,C	43-53, 49	5.7X0.44	3\3\2	P,G
1098	5591 X 49172	I	20	B,C	43	0.2X0.02		I
MEADOW	5568 X 49191	II	1	G	43-53, 46	2.4X0.35		P,L
1096	5567 X 49222	I	12	C,G	43	0.7X0.02		I
CLEAR	5571 X 49248	III	3	G,C	41-55, 49	6.0X0.4		P
1094	4472 X 49252	I	2	G,C	39-52, 49	1.3X0.1		P,L
CUB	5570 X 49264	II	2	C,G	39-59, 50	4.4X0.3	4\4\4	P,G
1092	5574 X 49271	I	3	C,B	45	0.4X0.03		I
1091	5575 X 49275	I	5	G,C	42-58 49	1.7X0.09	4\4\2	P,L
1090	5575 X 49293	I	14	C		0.5X.07		I
SEDGE	5567 X 49304	II	2	S	48	9.5X0.7		P,G
INDPOND OUT	5534 X 49335	I	6	S,G	55	1.0X0.1	2\2\1	P
1086	5532 X 49334	I	4	C,G	45	4.0X0.3		P
PELICAN	5508 X 49336	IV	1	S,C,G	39			P
YEL.R. O	5490 x 49345							P

Table 15. Continued.

Stream	Mouth location UTM coordinates	Stream order	Gradient (%) (ave.)	Substrate (codes[a])	Temp. (range, ave.) (C)	Width X depth (m)	#Pools\ riffles\ meanders (per 100m)	Stream Status[b]
1204	5489 x 49345	I	4	S,G	46	0.5X0.03		I
LODGE	5486 X 49336	II	3	G,C	43-58, 50	1.2X0.17	3\3\2	P,C
HOTEL	5476 X 49322	I	4	G,S	42	1.2X0.12	1\1\0	P,C
HATCHERY	5473 X 49322	I	5	C,G	41-58, 52	1.0X0.13	3\2\0	P,B
1200	5466 X 49324	I	9	B,C	48-55, 52	1.0X0.15	3\0\0	P,C
1199	5463 X 49324	I	5	G,C	42-63, 52	1.1X0.17	3\2\3	P,C
1198	5462 X 49321	I	5	G,C	46-59, 51	0.8X0.14	4\2\4	P,C
119701	5445 X 49311	I	5	S,C		0.5X0.02		I,L
BRIDGE	5451 X 49307	II	2	G,C	39-67, 55	1.5X0.14	5\5\5	P,B
1196	5450 X 49320	I	3	S		0.5X0.05		I,L
1195	5450 X 49301	I	3	S,C		0.7X0.05		I,C
1194	5456 X 49302	I	3	S		0.3X0.03		I,C
1193	5464 X 49291	I	3	S		0.3X0.03		I,C
WEASEL	5464 X 49289	I	2	G,S	32-49, 47	0.7X0.09	5\3\5	P,C
1191	5464 X 49270	I	5	G,S	40-57, 51	0.5X0.05	2\1\2	I,C,L
1190	5448 X 49247	I	5	S		0.2X0.01		P
1189	5434 X 49242	I	3	C	52	0.7X0.05	2\1\2	I,C
1188	5424 X 49327	I	30	B,C		1.5X0.1		I,C
1187	5415 X 49231	I	3	C,B	47	1.5X0.1		I,C
1186	5408 X 49224	I	5	C,B		0.5X0.03		I,C
1185	5381 X 49241	I	8	S,C	47-49, 48	0.5X0.05		I,C,L
1184	5376 X 49224	II	4	C	41-66, 58	1.0X0.08		I,L,C
ARNICA	5370 X 49245	III	2	G,C	39-66, 56	3.9X0.25	4\4\4	P,B,L
L.ARNICA	5362 X 49243	II	2	G	41-68, 56	1.6X0.13	5\5\6	P,B
1181	5356 X 49241	I	5	S,C	44	0.5X0.05		I,C
1180	5355 X 49236	I	5	S,G	37-50, 47	0.9X0.16	4\3\2	I,B,L
1179	5354 X 49228	I	6	S,G	39-49, 46	1.0X0.1	6\3\3	P,B
1178	5347 X 49212	I	13	C,G	36-45, 41	1.5X0.15	1\1\2	P,B
1177	5340 X 49207	II	2	G	36-63, 46	1.3X0.14	8\7\8	P,B,L

Table 15. Concluded.

Stream	Mouth location UTM coordinates	Stream order	Gradient (%) (ave.)	Substrate (codes[a])	Temp. (range, ave.) (C)	Width X depth (m)	#Pools\ riffles\ meanders (per 100m)	Stream Status[b]
L.THUMB	5335 X 49203	II	3	G	37-63, 46	1.8X0.17	4\4\3	P,B
1175	5334 x 49199	I	10	S,G		0.2X0.02		I,C,G
1174	5337 X 49195	I	10	S,G		0.2X0.02		I,C,G
1173	5338 X 49191	I	8	S		0.2X0.02		I,G
1172	NOT FOUND							
1171	NOT FOUND							
1170	5344 X 49179	I	7	S,G		0.5X0.04		I
1169	5345 X 49177	II	3	C,G,S	32-60, 49	1.4X0.21	4\3\2	P,B
THUMB	5349 X 49162	II	2	B,C	32-68, 50	4.3X0.3	1\1\1	P,B.L
1167	5348 X 49159	I	3	G,S	32-59, 45	1.6X0.1	4\3\2	P,B,L
SANDY	5352 X 49115	II	2	G,S	32-61, 48	2.4X0.22	5\4\2	P,B,L
1165	5362 X 49153	I	5	S	32-47, 40	0.7X0.05		I,C
SEWER	5376 X 49152	II	4	G,C	32-61, 46	1.2X0.12	3\3\3	P

[a] Substrate codes: St-silt; S-sand; G-gravel; C-cobble; B-boulders.

[b] Status codes: P-permenant; I-intermittant; L-lagoon; G-geothermal; C-culvert; B-bridge.

Table 16. Survey results for spawning runs on Yellowstone Lake tributaries.

Stream	Reason for no spawn[a]	Spawning results 1985 B-P-E[b]	1986 B-P-E	1987 B-P-E	Maximum number spawners (m)	Maximum upstream length	Other fish species observed[c]
SOLUTION		5/29-5/29-6/14	-	5/19-5/19-6/04	102	800	S
1162	1,2	N.R.	-	N.R			
1161	1,2	N.R.	-	-			R
1160	1,2	5\29	-	N.R.	8	100	R
1159	5	N.R.	-	N.R.			
1158		5/29-6/07-6/26	-	5/19-5/19-6/03	54	800	
1157		5/29	-	5/19-5/19-6/04	6	500	R
1156	1,5	N.R.	-	N.R.			
FLAT MTN.		5/31-6/07-8/06	6/18-7/17-7/30	5/20-7/01-7/15	671	2000	
1154	4,5	N.R.	-	-			
1153	4,5	N.R	-	-			
1152	4,5	N.R.	-	-			
115101	4,5	N.R.	-	-			
115102	4,5	N.R.	-	-			
1150		6/14-6/14-7/25	6/18-6/18-7/30	6/17	64	500	
1149	1,2	N.R.	-	N.R.			
1148	4,5	N.R.	N.R.	N.R.			
1147		N.R.	6/18	N.R.	6	100	
1146		6/27-6/27-7/03	6/18-6/18-7/03	6/04-6/04-6/19	82	600	
1145	1,4,5	N.R.	N.R.	N.R.			
1144		7\03	6/18	6/04-6/04-7/01	20	100	
1143		7/03	6/18	N.R.	50	200	
1142	1	N.R.	N.R.	N.R.			
1141		6/14-6/14-7/10	-	5/19-6/04-6/19	50	1000	
1140	1,5	N.R.	-	-			
1139		N.R.	-	6/04-6/04-6/19	2	100	
1138		6/13-6/20-7/11	6/18-6/18-7/30	5/20-6/04-6/19	62	1500	
1137		7/02	-	6/04-6/04-6/19	2	100	

Table 16. Continued.

Stream	Reason for no spawn[a]	Spawning results 1985 B-P-E[b]	1986 B-P-E	1987 B-P-E	Maximum number spawners	Maximum upstream length (m)	Other fish species observed[c]
1136	1,4	N.R.	-	-			
1135	1	N.R.	-	-			
1134		6/20	-	N.R.	2	200	
1133	2	N.R.	-	N.R.			
1132		6/13	-	6/04	5	200	
1131		6/13-6/13-6/20	-	5/21-6/04-6/18	9	300	
1130	1,4,5	N.R.	-	-			
1129	1,4,5	N.R.	-	-			
1128	1,4	N.R.	-	N.R.			
1127		5/30-6/06-6/27	-	5/21-6/05-7/02	24	700	
1126		5/30-6/06-6/27	-	5/21-6/05-7/02	178	950	
GROUSE		6/13-6/20-7/02	-	5/21-6/05-6/18			
1124	1,5	N.R.	-	-			
1123		6/13-6/19-6/28	-	5/21-6/03-6/18	68	1000	R
1122		6/13-6/19-6/19	-	5/21-5/21-6/05	42	600	R,S
CHIPMUNK		6/12-6/20-7/02	-	5/22	261	2000	
1120	4,5	N.R.	-	N.R.			
ALDER LK	5	N.R.	-	5/22	5	200	
1118		6/12	-	6/07	3	200	R
1117	Not found						
1116	1,4	N.R.	-	N.R.			
1115		6/05	-	5/22	3	200	R
1114		6/05-6/05-6/12	-	5/22-5/22-6/06	7	300	R,S
1113		6/05-6/12-7/09	-	5/22-6/08-6/20	43	900	
1112	Not found						
1111		6/12-6/19-7/16	-	6/07-6/07-7/03	54	600	
1110	1	N.R.	-	N.R.			

Table 16. Continued.

Stream	Reason for no spawn[a]	Spawning results 1985 B-P-E[b]	1986 B-P-E	1987 B-P-E	Maximum number spawners	Maximum upstream length (m)	Other fish species observed[c]
110901	1	N.R.	-	N.R.			
1109		N.R.	-	N.R.			
110801	4,5	N.R.	-	N.R.			
110802	4,5	N.R.	-	N.R.			
110803		7/01-7/01-7/09	-	6/20	3	75	
TRAIL		6/14	-	5/23-6/20-7/04	4	500	R
YELL.R.INLET		-	-	-			
BEAVERDAM		6/11-6/18-6/18	-	6/20	640	5000	
1106	2,4	N.R.	-	N.R.			
1105	1,4	N.R.	-	N.R.			
1104	2,4	N.R	-	N.R			
1103		6/18-7/01-7/11	-	6/20-7/04-7/04	19	200	
1102	2,4,5	N.R.	-	N.R.			
1101	1,2	N.R.	-	N.R.			
ALUVIUM	6	N.R.	-	N.R.			
COLUMBINE		6/11-7/01-7/16	-	5/23-6/20-7/17	1682	2100	
1098	1,2,4,5	N.R.	-	-			
MEADOW		6/11-6/11-6/28	-	6/08-7/04-7/29	160	1800	
1096	1,4	N.R.	-	-			
CLEAR		6/18-7/01-7/24	6/17-7/01-8/12	5/24-6/21-7/29	6499	5000	S
1094		6/04-6/18-6/18	6/17-6/17-7/30	N.R	114	800	
CUB		6/04-7/01-7/24	6/17-7/15-8/12	5/24-6/21-7/29	1840	1400	
1092	1,2,4	N.R.	-	-			
1091		6/04-6/28-7/16	6/17-7/01-8/12	5/24-6/08/6/21	99	700	
1090	1,3,4	-	N.R.	-			
SEDGE	6	-	N.R.	-			
1088	2	-	N.R.	-			
1087	1,2	-	N.R.	-			
1086	2	-	N.R.	-			

Table 16. Continued.

Stream	Reason for no spawn[a]	Spawning results 1985 B-P-E[b]	1986 B-P-E	1987 B-P-E	Maximum number spawners (m)	Maximum upstream length	Other fish species observed[c]
PELICAN		-	-	-			S
YELL.R.OUTLET		-	-	-			
1204	1,5	-	N.R.	N.R.			
LODGE		-	5/29-6/03-6/25	5/11-5/11-6/09	128	1500	
HOTEL		-	N.R.	6/12	2	20	
HATCHERY		-	5/28-6/03-6/25	5/07-5/26-6/09	120	450	
1200		-	6/03	5/12	2	25	
1199		-	5/29-6/03-6/27	5/12-5/26-6/09	62	200	
1198	3	-	6/03-6/20-7/08	5/27-5/27-6/09	92	400	
119707	1	-	N.R.	-			
BRIDGE		-	6/03-6/20-6/27	5/07-5/07-6/26	72	1200	R,S
1196	1	-	N.R.	-			
1195	1,3	-	N.R.	-			
1194	1,3	-	N.R.	-			
1193	1,3	-	N.R.	N.R.			
WEASEL		-	6/20-6/20-7/08	5/07-6/02-6/09	25	150	
1191	1,2	-	N.R.	N.R.			
1190	1,2	-	N.R.	N.R.			
1189	1,3	-	N.R.	N.R.			
1188	1,4	-	N.R.	N.R.			
1187	1,3	-	N.R.	N.R.			
1186	1,3	-	N.R.	N.R.			
1185	1	-	N.R.	N.R.			
1184	1	-	N.R.	N.R.			
ARNICA		-	6/20-6/20-7/14	5/07-5/25-6/09	60	1200	S
L. ARNICA		-	5/28-6/20-7/08	5/07-5/25-7/07	99	1000	R
1181	1	-	N.R	N.R.			
1180		-	6/20	5/25-5/25-6/10	7	100	
1179		6/25	6/20	5/13-5/25-7/07	84	300	

Table 16. Concluded.

Stream	Reason for no spawn[a]	Spawning results 1985 B-P-E[b]	1986 B-P-E	1987 B-P-E	Maximum number spawners	Maximum upstream length (m)	Other fish species observed[c]	
1178	3,4	-	N.R.	N.R.				
1177		6/25	6/19-6/19-7/16	5/03-6/10-6/23	476	500		
L. THUMB		6/25	6/19-6/26-7/29	5/13-6/23-7/19	772	900		
1175	1,2,6	-	N.R.	N.R.				
1174	1,2,6	-	N.R.	N.R.				
1173	1,2,6	-	N.R.	N.R.				
1172	Not found							
1171	Not found							
1170	1,2,6	-	N.R.	N.R.				
1169		-	6/19-6/19-7/16	5/13-6/23-7/06	81	600	S,R	
THUMB		-	6/19-6/19-7/08	5/25-5/25-7/06	123	800		
1167		-	6/04-6/04-7/29	5/07-5/18-6/29	353	800		
SANDY		-	6/04-6/19-7/29	5/07-5/25-6/29	971	1800		
1165	1,2	-	N.R.	N.R.				
SEWER		5/29	6/14-6/14-7/04	5/18-6/01-6/29	428	1200		

[a]Reason for no spawn:
1-Stream size too small
2-Natural block
3-Manmade block
4-Gradient too steep
5-Unsuitable substrate
6-Chemical barrier

[b]B-P-E: Beginning-Peak-End ofspawning run.

[c]Other fish species: S-Longnose suckers, R-Redsided shiners.

[d]N.R.: No spawning run observed.

Table 17. Community site analysis for Yellowstone Lake streams.

Stream	Habitat type	Cover type	Distance to cover (m)
Solution Cr	PHAL/AGCA	WET GRAMINOID MEADOW	50
1158	ABLA/CACA	LP2	10
1157	ABLA/CACA	LP2	15
Flat Mtn. Cr	PHAL/AGCA	WET GRAMINOID MEADOW	30
1150	ABLA/CACA	LP3	5
1147	ABLA/CACA	LP3	5
1146	ABLA/CACA	LP3	5
1144	ABLA/CACA	LP3	5
1143	ABLA/CACA	LP3	5
1141	CACA/SETR	WET FOREST OPENING	15
1139	PIEN/EQAR	SF	10
1138	CACA/SETR	WET FOREST OPENING	15
1137	PIEN/EQAR	SF	5
1131	PHAL/AGCA	WET GRAMINOID MEADOW	25
1132	PHAL/AGCA	WET GRAMINOID MEADOW	25
1227	SXWO/CXMI	LOW WILLOW	30
1126	SXWO/CXMI	LOW WILLOW	20
Grouse Cr	SXWO/CXMI	LOW WILLOW	50
1123	PHAL/AGCA	WET GRAMINOID MEADOW	20
1122	PHAL/AGCA	WET GRAMINOID MEADOW	20
Chipmunk Cr	SXWO/CXMI	LOW WILLOW	40
1118	PIEN/EQAR	SF	10
1114	ABLA/CACA	LP3	20
1113	SXWO/CXMI	LOW WILLOW	25
1111	ABLA/CACA	LP3	5
Trail Cr	CXRO/CXRO	MARSH/FEN	25
Beaverdam Cr	ABLA/CACA	LP3	10
1104	ABLA/CACA	SF	5
Columbine Cr	PIEN/EQAR	SF	10
Meadow Cr	CXRO/CXRO	MARSH/FEN	300
Clear Cr	PHAL/AGCA	WET GRAMINOID MEADOW	50
1094	ABLA/CACA	LP3	10
Cub Cr	PIEN/EQAR	SF	5
1092	ABLA/CACA	LP3	5
Lodge Cr	ABLA/CACA	LP3	15
Hatchery Cr	CACA/SETR	WET FOREST OPENING	20
1199	ABLA/CACA	LP2	15
1198	ABLA/CACA	LP2	10
1197	CACA/SETR	WET FOREST OPENING	20
Bridge Cr	CACA/SETR	WET FOREST OPENING	25
Weasel Cr	ABLA/CACA	LP2	10
Arnica Cr	CACA/SETR	WET FOREST OPENING	20
L.Arnica Cr	CACA/SETR	WET FOREST OPENING	15
1180	ABLA/CACA	LP2	10
1179	ABLA/CACA	LP2	15
1177	CACA/SETR	WET FOREST OPENING	25

Table 17. Concluded.

Stream	Habitat Type	Cover type	Distance to cover (m)
L.Thumb Cr	ABLA/CACA	SF	15
1169	CACA/SETR	WET FOREST OPENING	15
Thumb Cr	CACA/SETR	WET FOREST OPENING	20
1167	CACA/SETR	WET FOREST OPENING	15
Sandy Cr	ABLA/CACA	LP2	10
Sewer Cr	ABLA/CACA	LP3	10

Table 18. Survey results for spawning cutthroat trout and bear activity by date on tributaries of Yellowstone Lake.

Stream name or old number	New SOMYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
Solution Cr	1163	1985:5-29	Y - 500 m	3	0	N	S
		6-14	Y - 500 m	3	1B	N	
		6-26	N	0	0	N	
		1986:6-18	N	0	0	N	
		1987:5-19	Y - 800 m	102	1B, 1G	N	
		6-04	N	0	1B, 1G	N	
		6-30	Y - 800 m	1	1G	N	
		7-14	N	0	1B	N	
211	1162	1985:5-31	N[1]	0	0	N	S
		1987:5-19	N	0	0	N	
206	1161	1985:5-31	N[1,2]	0	0	N	
205	1160	1985:5-29	Y - 100 m	8	0	N	
		6-14	N[1]	0	0	N	
		1987:5-19	N[1,2]	0	0	N	
204	1159	1985:5-31	N[1,5]	0	0	N	
		1987:5-19	N[1,2,5]				
203	1158	1985:5-29	Y - 200 m	3	0	N	S, B
		6-07	Y - 500 m	10	1B	N	
		6-26	Y - 500 m	2	0	N	
		1987:5-19	Y - 500 m	54	1B	Y	
		6-03	Y - 500 m	7	1B, 1G	Y	
		6-19	N	0	1G	Y	
		6-30	N	0	1B	Y	
		7-14	N	0	1B	N	
202	1157	1985:5-29	Y - 500 m	5	0	N	S, B
		6-14	N	0	0	N	
		6-26	N	0	0	N	
		1987:5-19	Y - 500 m	6	1Bb	N	
		6-04	Y - 500 m	6	1Bb	N	
		6-19	N	0	1B	Y	
		6-30	N	0	0	N	
		7-14	N	0	1G	N	
201	1156	1985:5-31	N[1,5]	0	0	N	
		1987:7-14	N[1,5]	0	0	N	
Flat Mountain Cr	1155	1985:5-31	Y - 1,400 m[b]	26	1G, 1B	N	S, B, F
		6-07	Y - 1,400 m[b]	430	1G	Y	
		6-26	Y - 1,400 m[b]	101	1Gg, 1G	Y	
		7-03	Y - 1,400 m[b]	77	2Gg, 1G	Y	
		7-10	Y - 1,400 m	179	2G	Y	
		7-25	Y - 200 m	2	1G	N	
		8-06	Y - 200 m[b]	1	0	N	
		1986:6-18	Y - 1,400 m[b]	228	1B, 2-3G	N	
		7-02	Y - 1,400 m[b]	422	1B, 1Bh, 1Gg, 2G	N	
		7-17	Y - 1,400 m[b]	671	1B, 1G	Y	
		7-30	Y - 1,400 m	267	2-3G	Y	
		8-13	N	0	1G	N	
		1987:5-20	Y - 2,000 m	197	3-4B, 1Gg, 1G	Y	
		6-03	Y - 2,000 m	334	2B, 1-2G, 1Gg	Y	
		6-17	Y - 2,000 m	51	2-3B, 1G, 1Gg	Y	
		7-01	Y - 2,000 m	355	1G	Y	
		7-15	Y - 2,000 m	16	1B, 2Gg, 1G	Y	
		7-30	N	0	1B	N	
199	1154	1985:5-31	N[4,5]	0	0	N	
198	1153	1985:5-31	N[4,5]	0	0	N	
197	1152	1985:5-31	N[4,5]	0	0	N	
196-W	115101	1985:5-31	N[4,5]	0	0	N	S
		6-14	N[4,5]	0	0	N	
196-E	115102	1985:5-31	N	0	0	N	
		6-14	N	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
195	1150	1985:5-31	N	0	0	N	S, B, F
		6-14	Y - 500 m	20	1Gg, 1G	Y	
		6-26	N	0	1G	N	
		7-10	Y - 100 m	5	1U	N	
		7-25	Y - 100 m	1	1B	N	
		1986:6-18	Y - 500 m	64	1B	Y	
		7-02	Y - 500 m	12	1B, 1Gg	N	
		7-17	N	0	1B	Y	
		7-30	Y - 500 m	5	1Gg	N	
		8-13	N	0	0	N	
		1987:5-20	N	0	1G	N	
		6-04	N	0	1G	Y	
		6-17	Y - 500 m	8	1B	Y	
		7-01	N	0	1G	Y	
		7-14	N	0	0	N	
		7-30	N	0	1G	N	
194	1149	1985:5-31	N[A]	0	0	N	
		6-14	N[A]	0	0	N	
		1987:5-20	N[B]	0	0	N	
		6-04	N[1,2]	0	0	N	
193	1148	1985:5-31	N[4,5]	0	0	N	S, B
		6-11	N[4,5]	0	0	N	
		6-22	N[4,5]	0	1U	N	
		7-03	N[4,5]	0	0	N	
		7-20	N[4,5]	0	0	N	
		1986:6-14	N[4,5]	0	1B	N	
		7-02	N[4,5]	0	1G	N	
		7-30	N[4,5]	0	0	N	
		1987:5-20	N[4,5]	0	0	N	
		6-04	N[4,5]	0	1G	N	
		6-14	N[4,5]	0	1G	N	
		7-01	N[4,5]	0	1G	N	
		7-14	N[4,5]	0	1Gg	N	
		7-30	N[4,5]	0	0	N	
192	1147	1985:5-31	N	0	0	N	S
		6-14	N	0	0	N	
		6-22	N	0	0	N	
		7-03	N	0	0	N	
		7-10	N	0	0	N	
		7-10	N	0	0	N	
		1986:6-18	Y - 50 m	6	0	N	
		7-02	N	0	1G	N	
		7-17	N	0	0	N	
		7-30	N	0	0	N	
		1987:5-20	N	0	0	N	
		6-04	N	0	1G	N	
		6-19	N	0	1G	N	
		7-01	N	0	1G	N	
		7-14	N	0	1G	N	
		7-30	N	0	0	N	
191	1146	1985:5-31	N	0	0	N	S, B, F
		6-14	N	0	1B, 1U	N	
		6-20	N	0	1U	Y	
		6-27	Y - 400 m	9	1U	Y	
		7-03	Y - 400 m	8	1U	Y	
		7-10	N	0	1U	N	
		7-25	N	0	1B	N	
		1986:6-18	Y - 600 m	82	1G, 1B	N	
		7-03	Y - 100 m	2	1Gg	Y	
		7-17	N	0	1B	N	
		7-30	N	0	1G	N	
		1987:5-20	N	0	1B	N	
		6-04	Y - 200 m	33	1G	N	
		6-19	Y - 200 m	1	1G	Y	
		7-01	N	0	1G	N	
		7-14	N	0	1G	N	
		7-30	N	0	1G	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBBT	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hookins[d]
190	1145	1985:5-31	N[1,4]	0	1B	N	
		6-14	N[1,4]	0	0	N	
		7-20	N[1,4]	0	0	N	
		1986:7-30	N[1,4]	0	1G	N	
		1987:5-20	N[1,4]	0	1B	N	
		5-20	N[1,4]	0	1G	N	
		6-19	N[1,4]	0	1G	N	
		7-01	N[1,4]	0	1G	N	
		7-14	N[1,4]	0	0	N	
189	1144	1985:5-31	N	0	0	N	S
		6-14	N	0	1U	N	
		6-27	N	0	0	N	
		7-03	Y - 100 m	1	0	N	
		7-10	N	0	0	N	
		7-25	N	0	0	N	
		1986:6-18	Y - 100 m	2	1B	N	
		7-03	N	0	1G	N	
		7-17	N	0	0	N	
		7-30	N	0	1G	N	
		1987:5-20	N	0	0	N	
		6-04	Y - 100 m	20	1G	N	
		6-19	N	0	1G	N	
		7-01	Y[2] - 100 m	12	1G	N	
		7-14	N[2]	0	0	N	
		7-30	N[2]	0	1G	N	
188	1143	1985:5-31	N	0	0	N	S, B
		6-14	N	0	1U	N	
		6-27	N	0	0	N	
		7-03	Y - 100 m	2	0	N	
		7-10	N	0	1B	N	
		7-20	N	0	0	N	
		1986:6-18	Y - 200 m	50	1B	N	
		7-03	N	0	1G	N	
		7-17	N	0	1U	N	
		7-30	N	0	1G	N	
		1987:5-20	N	0	1B	N	
		6-04	N	0	0	N	
		6-14	N	0	1G	N	
		7-01	N	0	0	N	
		7-14	N	0	0	N	
		7-30	N	0	0	N	
187	1142	1985:5-31	N[1]	0	0	N	
		6-24	N[1]	0	0	N	
		7-03	N[1]	0	0	N	
		7-20	N[1]	0	0	N	
		7-31	N[1]	0	0	N	
		1986:6-18	N[1]	0	0	N	
		7-03	N[1]	0	0	N	
		7-17	N[1]	0	1U	N	
		7-30	N[1]	0	0	N	
		1987:5-20	N[1]	0	0	N	
		6-04	N[1]	0	0	N	
		6-14	N[1]	0	0	N	
		7-01	N[1]	0	0	N	
		7-14	N[1]	0	0	N	
		7-30	N[1]	0	0	N	
186	1141	1985:5-31	N	0	0	N	S
		6-14	Y - 1,000 m	5	1B	N	
		6-27	Y - 1,000 m	2	1G	N	
		7-10	Y - 100 m	1	0	N	
		1987:5-19	Y - 1,000 m	5	0	N	
		6-04	Y - 100 m	50	1G	N	
		6-19	Y[2] - 1,000 m	5	1G	Y	
		7-03	N[2]	0	1G	Y	
182	1140	1985:5-31	N[1,3]	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
181	1139	1985:5-31	N[8]	0	0	N	S
		6-13	N[8]	0	0	N	
		1987:5-20	N	0	0	N	
		6-04	Y - 100 m	2	1B	N	
		6-19	Y - 100 m	2	1G	N	
		7-03	N	0	1G	N	
		7-15	N	0	0	N	
180	1138	1985:5-30	N	0	0	N	S, B, F
		6-13	Y - 1,500 m	30	1Gg	Y	
		6-20	Y - 1,500 m	35	1G,1B	Y	
		6-27	Y - 1,500 m	9	1Gg,1G,1B	Y	
		7-03	N	0	1B	N	
		7-11	Y - 100 m	3	0	N	
		1986:6-18	Y - 1,500 m	262	1G,1B,1Bb	N	
		7-02	Y - 1,500 m	96	1Gg,1Bb,1G	Y	
		7-17	N	0	1Gg	Y	
		7-30	Y - 1,500 m	1	1G	N	
		1987:5-20	Y - 1,500 m	1	1B	N	
		6-04	Y - 1,500 m	18	1G, 1Bb	Y	
		6-19	Y - 1,500 m	6	1G, 1Gg	Y	
		7-05	N	0	1G	N	
		7-03	N	0	1G	N	
179	1137	1985:5-30	N[7]	0	0	N	S, B
		6-13	N[7]	0	0	N	
		6-20	N[7]	0	0	N	
		6-27	N[7]	0	0	N	
		7-02	Y - 100 m	1	0	N	
		1987:6-04	Y - 200 m	2	1G	N	
		6-18	Y - 200 m	3	1G	N	
		7-02	N	0	0	N	
		7-15	N	0	1G,1B	N	
178	1136	1985:5-31	N[1,4]	0	0	N	
		6-13	N[1,4]	0	0	N	
177	1135	1985:5-31	N[1]	0	0	N	
		6-13	N[1]	0	0	N	
176	1134	1985:5-31	N[7]	0	0	N	S
		6-13	N[7]	0	1Gg	N	
		6-20	Y[2] - 200 m	2	0	N	
		6-27	N[2]	0	1B	N	
		1987:6-04	N[2]	0	0	N	
		6-18	N[2]	0	1G	N	
		7-02	N[2]	0	0	N	
175	1133	1985:5-31	N[8]	0	0	N	
		1987:6-06	N[2]	0	0	N	
		6-18	N[2]	0	0	N	
		7-05	N[2]	0	0	N	
174	1132	1985:5-30	N	0	0	N	S
		6-13	Y - 100 m	1	0	N	
		6-20	N	0	0	N	
		6-27	N	0	0	N	
		1987:5-21	N	0	1B	N	
		6-04	Y - 200 m	5	1G	N	
		6-18	N	0	0	N	
		7-02	N	0	0	N	
		7-15	N	0	0	N	
173	1131	1985:5-30	N	0	0	N	S
		6-13	Y - 200 m	9	0	N	
		6-20	Y - 200 m	2	0	N	
		6-27	N	0	0	N	
		1987:5-21	Y - 200 m	1	1B	N	
		6-04	Y - 200 m	4	1G	N	
		6-18	Y - 200 m	1	1B	Y	
		7-02	N	0	0	N	
		7-15	N	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Rookies[d]
172	1130	1985:5-31	N[1,4]	0	0	N	S
		6-13	N[1,4]	0	0	N	
171	1129	1985:5-31	N[1,4]	0	0	N	
		6-13	N[1,4]	0	0	N	
170	1128	1985:5-31	N[1,4]	0	0	N	
169	1127	1985:5-30	Y - 100 m[b]	6	0	N	S, B
		6-06	Y - 700 m[b]	24	1U	Y	
		6-20	Y - 700 m	15	1Gg	Y	
		6-27	Y - 700 m	5	0	N	
		7-02	N	0	1U	N	
		1987:5-21	Y - 600 m	2	1-2G, 1B	N	
		6-05	Y - 600 m	5	1G	N	
		6-18	Y - 600 m	3	1G	Y	
		7-02	Y - 600 m	2	1B	N	
		7-15	N	0	1G, 1Gg		
168	1126	1985:5-30	Y - 200 m	5	0	N	S, B, F
		6-06	Y - 950 m	178	1Gg, 1U	N	
		6-20	Y - 950 m	45	1G, 1Gg	Y	
		6-27	Y - 950 m	19	1Gg	Y	
		7-02	N	0	1Gg,1U	Y	
		7-11	N	0	1Gg	N	
		1987:5-21	Y - 950 m	1	2G, 1-2B	N	
		6-05	Y - 950 m	14	1Gg	Y	
		6-18	Y - 950 m	8	1Gg	Y	
		7-02	N	0	1B	N	
		7-15	N	0	1Gg	N	
Grouse Cr	1125	1985:5-30	N	0	0	N	B
		6-13	Y - 300 m[b]	2	0	N	
		6-20	Y - 1,500 m[b]	80	1G	N	
		7-02	Y - 2,000 m[b]	77	1Gg	N	
		1987:5-21	Y - 1,500 m[b]	140	2G	N	
		6-05	Y - 200 m[b]	183	1G	N	
		6-18	Y - 200 m[b]	71	1G	N	
		7-02	N	0	1G	N	
162	1124	1985:5-31	N[1,5]	0	0	N	
161	1123	1985:5-30	N	0	0	N	S
		6-13	Y - 1,000 m	25	1B	N	
		6-19	Y - 1,000 m	68	1Gg	N	
		6-28	Y - 1,000 m	4	1G	N	
		7-10	N	0	0	N	
		1987:5-21	Y - 1,000 m	25	2G	N	
		6-03	Y - 1,000 m	26	1G	N	
		6-18	Y - 200 m	2	2G	Y	
		7-02	N	0	2G	N	
		7-16	N	0	0	N	
160	1122	1985:5-30	N	0	0	N	S
		6-13	Y - 300 m	2	1B	N	
		6-19	Y - 300 m	5	1G	N	
		6-28	0	0	0	N	
		1987:5-21	Y - 600 m	42	2G	Y	
		6-05	Y - 600 m	11	2G	N	
		6-18	N	0	1G	N	
		7-02	N	0	1B	N	
		7-16	N	0	1B	N	
Chipmunk Cr	1121	1985:5-30	N	0	0	N	S
		6-12	Y - 300 m[b]	6	0	N	
		6-20	Y - 1,000 m[b]	4	0	N	
		7-02	Y - 300 m[b]	1	0	N	
		1987:5-22	Y - 1,000 m[b]	6	1G	N	
		1988:6-28	Y - 2,000 m[b]	261	1G	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hooking[d]
132	1120	1985:5-31	N[4,5]	0	0	N	
		1987:5-22	N[4,5]	0	0	N	
Alder Lake Outlet	1119	1985:5-31	N[5]	0	0	N	
		6-12	N[5]	0	0	N	
		1987:5-22	Y - 200 m	5	0	N	
		6-06	N	0	0	N	
145	1118	1985:5-30	N	0	0	N	
		6-12	Y - 200 m	2	1B	N	
		6-19	N	0	1B	N	
		6-28	N	0	0	N	
		1987:5-22	N	0	1B	N	
		6-06	Y - 200 m	3	2B	N	
		6-19	N	0	1B	N	
		7-02	N	0	0	N	
		7-16	N	0	1B	N	
144	1117	1985:6-04	N[1,4,5]	0	0	N	
		1987:6-06	N[1,4,5]	0	0	N	
143	1116	1985:6-04	N[1,4]	0	0	N	
		1987:6-06	N[1,4]	0	0	N	
142	1115	1985:6-05	Y[5] - 200 m	3	0	N	
		6-12	N[5]	0	0	N	
		1987:5-22	Y[5] - 200 m	2	0	N	
		6-06	N[5]	0	0	N	
		6-20	N[5]	0	0	N	
		7 03	N[5]	0	0	N	
141	1114	1985:6-05	Y - 300 m	3	0	N	
		6-12	Y - 300 m	2	1U	N	
		1987:5-22	Y - 300 m	1	1B	N	
		6-06	Y - 400 m	4	1B	N	
		6-20	N	0	1B	N	
		7-03	N	0	1B	N	
		7-18	N	0	1B	N	
138	1113	1985:6-05	Y - 100 m	1	0	N	S, B, F
		6-12	Y - 900 m	35	0	N	
		6-19	Y - 900 m	20	1G	N	
		7-01	Y - 900 m	5	1G	N	
		7-09	Y - 900 m	2	0	N	
		1987:5-22	Y - 900 m	31	1G,1B	N	
		6-08	Y - 900 m	43	1G	N	
		6-20	Y - 900 m	10	1G	N	
		7-03	N	0	1G	N	
		7-16	N	0	0	N	
137	1112	1985:6-05	N[3]	0	0	N	
		6-07	N[3]	0	0	N	
		1987:5-23	N	0	0	N	
136	1111	1985:6-04	N	0	0	N	S, B, F
		6-12	Y - 600 m	10	1U	N	
		6-19	Y - 600 m	28	1G	N	
		7-01	Y - 600 m	5	1U	Y	
		7-09	Y - 600 m	9	1U	N	
		7-16	Y - 600 m	1	1B	N	
		1987:5-23	N	0	1G	N	
		6-07	Y - 600 m	54	1G,1B	Y	
		6-20	Y - 600 m	5	1G	Y	
		7-03	Y - 600 m	1	1G	Y	
		7-16	N	0	0	N	
135	111001	1985:6-04	N[1]	0	0	N	
		6-12	N[1]	0	0	N	
		6-19	N[1]	0	0	N	
		1987:5-23	N[1]	0	0	N	
		6-07	N[1]	0	0	N	
		6-20	N[1]	0	0	N	
		7-17	N[1]	0	0	N	

Table 18. Continued.

Stream name or old number	New RONTEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hookins[d]
135.5	111002	1987:5-23	N[1]	0	0	N	
		6-07	N[1]	0	0	N	
134	1109	1985:6-04	N[7]	0	0	N	S
		6-12	N[7]	0	0	N	
		6-19	N[7]	0	0	N	
		7-01	N[7]	0	0	N	
		7-09	N[7]	0	0	N	
		7-17	N[7]	0	0	N	
		1987:5-23	N[7]	0	0	N	
		6-07	N[7]	0	0	N	
		6-20	N[7]	0	0	N	
		7-04	N[7]	0	0	N	
133	110801	1985:6-04	N[4]	0	0	N	
		6-12	N[4]	0	0	N	
		6-19	N[4]	0	0	N	
		7-01	N[4]	0	0	N	
		7-09	N[4]	0	0	N	
		1987:5-23	N[4]	0	0	N	
		6-07	N[4]	0	0	N	
		6-20	N[4]	0	0	N	
		7-04	N[4]	0	0	N	
		7-17	N[4]	0	0	N	
132	110802	1985:6-04	N[4,5]	0	0	N	
		6-12	N[4,5]	0	1U	N	
		6-19	N[4,5]	0	0	N	
		7-01	N[4,5]	0	0	N	
		7-09	N[4,5]	0	0	N	
		1987:5-23	N[4,5]	0	0	N	
		6-07	N[4,5]	0	0	N	
		6-20	N[4,5]	0	1G	N	
		7-04	N[4,5]	0	1G	N	
		7-17	N[4,5]	0	0	N	
131	110803	1985:6-04	Y - 100 m	1	1U	N	S
		6-12	N	0	0	N	
		6-19	N	0	0	N	
		7-01	Y - 100 m	3	1B	N	
		7-09	Y - 100 m	1	0	N	
		1987:5-23	N	0	0	N	
		6-07	N	0	0	N	
		6-20	Y - 100 m	2	1G	N	
		7-04	N	0	1G	N	
		7-17	N	0	0	N	
Trail Cr	1108	1985:6-04	N	0	1U	N	S
		6-14	Y - 300 m	2	0	N	
		6-19	N	0	0	N	
		1987:5-23	Y - 500 m	3	1G	N	
		6-07	Y - 500 m	2	1G	N	
		6-20	Y - 500 m	4	1G	N	
		7-04	Y - 500 m	4	1G	N	
		7-17	N	0	1G	N	
Yellowstone R Inlet	0040	Surveyed 1988 Y			2G, 1-2b	N	S
Beaverdam Cr	1107	1985:6-04	N	0	0	N	S
		6-11	Y - 200 m[b]	2	0	N	
		6-18	Y - 200 m[b]	6	0	N	
		7-04	N	0	0	N	
		1987:6-21	N	0	1G	Y	
		Surveyed 1988 Y			1G[g]	Y	
124	1106	1985:6-01	N[2,4]	0	0	N	S
		6-11	N[2,4]	0	0	N	
		6-18	N[2,4]	0	0	N	
		1987:5-23	N[4]	0	0	N	
		6-07	N[4]	0	0	N	
		6-20	N[2,4]	0	0	N	
		7-04	N[2,4]	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hooking[d]
123	1105	1985:6-04	N[1,4]	0	0	N	
		6-18	N[1,4]	0	0	N	
		1987:5-23	N[1,4]	0	0	N	
		6-07	N[1,4]	0	0	N	
122	1104	1985:6-04	N[1,4,6]	0	0	N	
		6-18	N[1,4,6]	0	0	N	
		7-01	N[1,4,6]	0	0	N	
		1987:5-23	N[2,4,6]	0	0	N	
		6-07	N[2,4,6]	0	0	N	
121	1103	1985:6-04	N	0	0	N	S
		6-11	N	0	0	N	
		6-18	Y - 200 m	6	1G	N	
		7-01	Y - 200 m	19	0	N	
		7-09	Y - 200 m	2	0	N	
		7-16	N	1	0	N	
		1987:5-27	N	0	0	N	
		6-07	N	0	0	N	
		6-20	Y - 200 m	3	1G	Y	
		7-04	Y - 200 m	6	1Gg	N	
		7-17	N	0	1G	N	
120	1102	1985:6-04	N[2,4,6]	0	0	N	
		6-11	N[2,4,6]	0	0	N	
		6-18	N[2,4,6]	0	0	N	
		1986:5-23	N[2,4,6]	0	0	N	
		6-11	N[2,4,6]	0	0	N	
119	1101	1985:6-04	N[1,2]	0	0	N	
		6-11	N[1,2]	0	0	N	
		6-18	N[1,2]	0	0	N	
		1987:5-23	N[1,2]	0	0	N	
		6-07	N[1,2]	0	0	N	
Alluvium Cr	1100	1985:6-04	N[6]	0	0	N	
		6-11	N[6]	0	1U	N	
		6-18	N[6]	0	0	N	
		1987:5-23	N[6]	0	0	N	
		6-07	N[6]	0	0	N	
Columbine Cr	1099	1985:6-04	N	0	0	N	S
		6-11	Y - 500 m[b]	4	0	N	
		6-18	Y - 500 m[b]	310	0	N	
		7-01	Y - 800 m[b]	730	1G	N	
		7-09	Y - 800 m[b]	340	1-2G,1U	N	
		7-16	Y - 800 m[b]	46	1G, 1U	N	
		8-06	N	0	1G	N	
		1987:5-23	Y - 300 m	6	0	N	
		6-07	Y - 700 m	6	0	N	
		6-20	Y - 2100 m	1682	2G	N	
		7-04	Y - 2100 m	471	2Gg,1-2G	N	
		7-17	Y - 1500 m	3	2G,1Gg,1B	N	
		7-28	N	0	1G	N	
114	1098	1985:6-24	N[1,2,4,5]	0	0	N	
Meadow Cr	1097	1985:6-04	N	0	0	N	S
		6-11	Y - 1500 m	21	0	N	
		6-18	Y - 1500 m	5	0	N	
		6-28	Y[2] - 800 m	2	0	N	
		1987:5-23	N[2]	0	0	N	
		6-08	Y[2] - 1800 m	23	0	N	
		6-21	Y[2] - 1800 m	106	1-2G	Y	
		7-04	Y[2] - 1800 m	160	1G,1B	Y	
		7-17	Y[2] - 100 m	7	2-3G	N	
		7-29	N	0	0	N	
112	1096	1985:6-04	N[1,4]	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
Clear Cr	1095	1985:6-04	N	0	0	N	S
		6-18	Y - 1000 m[b]	1015	0	N	
		7-01	Y - 1000 m[b]	1165	1Gg,1-2G	Y	
		7-09	Y - 1000 m[b]	973	1Gg,2-3G	Y	
		7-16	Y - 1000 m	232	1G	N	
		7-24	Y - 1000 m	12	1G	Y	
		8-06	N	0	1G	N	
		1986:6-17	Y - 1000 m[b]	52	0	N	
		7-01	Y - 1500 m[b]	1874	2G,1B	N	
		7-15	Y - 1500 m[b]	1463	2G,1B	Y	
		7-31	Y - 1500 m	105	1G,1B	Y	
		8-12	Y - 1500 m	4	1U	Y	
		1987:5-24	Y - 1000 m[b]	162	1GR,1G	Y	
		6-08	Y - 1500 m[b]	1532	1G	N	
		6-21	Y - 1200 m[b]	6499	2-3G,1B	Y	
		7-05	Y - 2000 m[b]	2718	2-3GR,1G	Y	
		7-18	Y - 2000 m	68	2Gg,2,1B	Y	
		7-29	Y - 1500 m	8	1G	Y	
103	1094	1985:6-04	Y - 100 m	2	0	N	S
		6-11	Y - 200 m	2	0	N	
		6-18	Y - 200 m	3	0	N	
		6-28	N	0	0	N	
		7-09	N	0	0	N	
		1986:6-17	Y_2 - 800 m	114	1G	N	
		7-01	Y^2	38	1B	N	
		7-15	Y^2	35	0	N	
		7-30	Y^2	9	0	N	
		8-12	N^2	0	0	N	
		1987:5-24	N^2	0	0	N	
		6-08	N^2	0	0	N	
		7-18	N^2	0	0	N	
Cub Cr	1093	1985:6-04	Y - 200 m	5	0	N	S
		6-11	Y - 400 m[b]	60	0	N	
		6-18	Y - 900 m[b]	820	1U	Y	
		7-01	Y - 900 m[b]	1020	1-2Gg	Y	
		7-09	Y - 900 m[b]	948	2GR,3G	Y	
		7-16	Y - 900 m[b]	162	2G	Y	
		7-24	Y - 900 m[b]	9	1G	Y	
		8-06	N	0	1G	N	
		1986:6-17	Y - 500 m[b]	8	1G	N	
		7-01	Y - 900 m[b]	1278	2Gg,2G	Y	
		7-15	Y - 900 m[b]	1840	1Gg,1-2G	Y	
		7-31	Y - 900 m[b]	235	2G	Y	
		8-12	Y - 700 m[b]	6	2G	Y	
		1987:5-24	Y - 900 m	21	1-2G,2Gg	N	
		6-08	Y - 900 m[b]	519	1G	N	
		6-21	Y - 900 m[b]	1811	2-3G	Y	
		7-07	Y - 1400 m[b]	1058	2GR,1-2G	Y	
		7-19	Y - 1200 m[b]	28	2Gg,2-3G	Y	
		7-29	Y - 200 m	1	1Gg	Y	
099	1092	1983:6-04	N[1,2,4]	0	0	N	
098	1091	1985:6-04	Y - 100 m	2	0	N	S
		6-11	Y - 700 m	3	0	N	
		6-18	Y_2 - 300 m	35	0	N	
		6-28	Y^2	100	1Gg	Y	
		7-01	Y^2	85	1U	N	
		7-09	Y^2	85	1Gg	Y	
		7-16	Y	2	1Gg	Y	
		7-24	N	0	0	N	
		1986:6-17	Y - 700 m	58	1R,1GR	N	
		7-01	Y - 700 m	56	1G,1Gg	Y	
		7-15	Y - 150 m	22	1G,1B	N	
		7-31	Y - 150 m	3	1G	N	
		8-12	Y - 700 m	1	1G	N	
		1987:5-24	Y - 700 m	4	1G	N	
		6-08	Y - 700 m	55	1G	N	
		6-21	Y_2 - 700 m	22	1Gg	Y	
		7-05	N^2	0	1G,1B	N	
		7-19	N	0	0	N	

Table 18. Continued.

Stream name or old number	New BONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
097	1090	1986:6-16	N[1,4,5]	0	0	N	
Sedge Cr	1089	1986:6-16	N[6]	0	0	N	
Indian Pond Outlet	1087	1986:5-29	N[1,2]	0	0	N	
		6-16	N[1,2]	0	0	N	
088	1086	1986:5-29	N[2]	0	0	N	
		6-16	N[2]	0	0	N	
Pelican Cr	1005	Surveyed 1988	Y	0	1G[e]	Y[e]	S, B, F
Yellowstone R Outlet		Surveyed 1988	Y	0	1G[g]	Y	
272	1204	1986:6-16	N[1]	0	0	N	
		1987:5-26	N[1]	0	0	N	
Lodge Cr	1203	1986:5-20	N	0	0	N	S
		5-29	Y - 1500 m	34	0	N	
		6-03	Y - 1500 m	110	0	N	
		6-16	Y - 1500 m	92	0	N	
		6-25	Y - 1500 m	23	0	N	
		7-08	N	0	1G	N	
		1987:4-07	N	0	0	N	
		5-11	Y - 1500 m	128	1G	Y	
		5-26	Y - 1500 m	115	1G	Y	
		6-09	Y - 1500 m	17	0	N	
		6-22	N	0	0	N	
		7-07	Y - 700 m	2	0	N	
		7-21	N	0	1G	N	
Motel Cr	1202	1986:5-20	N[3]	0	0	N	
		1987:5-12[f]	Y[3] - 20 m	2	1G[f]	Y[f]	
Hatchery Cr	1201	1986:8-20	N	0	0	N	S
		5-28	Y - 250 m	10	0	N	
		6-03	Y - 450 m	113	0	N	
		6-16	Y - 450 m	98	0	N	
		6-25	Y - 450 m	22	0	N	
		7-08	N	0	1G	N	
		1987:5-07	Y - 250 m	5	0	N	
		5-12	Y - 350 m	15	1G	Y	
		5-20	Y - 450 m	120	1G	Y	
		6-04	Y - 350 m	74	0	N	
		6-22	N	0	0	N	
		7-07	Y - 50 m	2	0	N	
		7-21	N	0	1G	N	
268	1200	1986:5-29	N[4,5]	0	0	N	S
		6-03	Y - 25 m	2	0	N	
		6-25	N[4]	0	0	N	
		1987:5-12	Y[4] - 25 m	2[f]	1G[f]	Y[f]	
267	1199	1986:5-29	Y[3] - 50 m	2	0	N	S
		6-03	Y[3] - 50 m	4	0	N	
		6-16	N[3]	0	0	N	
		6-27	Y[3] - 100 m	2	0	N	
		7-08	Y[3] - 100 m	1	0	N	
		1987:5-12	Y[3] - 50 m	6	1G	Y	
		5-26	Y[3] - 50 m	62	1G	Y	
		6-09	Y[3] - 100 m	17	0	N	
		6-22	N	0	0	N	
		7-07	N	0	0	N	
		7-21	N	0	1G	N	
266	1198	1986:5-29	N	0	0	N	S
		6-03	Y - 400 m	30	0	N	
		6-16	Y - 400 m	92	0	N	
		6-27	Y - 150 m	4	0	N	
		7-08	N[3]	0	0	N	
		1987:5-13[f]	N[3]	0	0	Y	
		5-27[f]	Y[3] - 100 m	11	1G	Y	
		6-09[f]	Y[3] - 100 m	8	0	N	
		6-22	N[3]	0	0	N	
		7-07	N[3]	0	0	N	
		7-21	N[3]	0	1G	N	

Table 18. Continued.

Stream name or old number	New SONTEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hooking[d]
265	119701	1986:6-10	N[1]	0	0	N	
Bridge Cr	1197	1986:5-08	N	0	1G	N	S
		5-20	N	0	0	N	
		6-03	Y - 350 m	26	0	N	
		6-20	Y - 950 m	72	1G	N	
		6-30	Y - 950 m	3	0	N	
		7-08	Y - 100 m	1	0	N	
		1987:5-07	Y - 900 m	72	0	N	
		5-13	Y - 1200 m	65	1Gg,1G	Y	
		5-20	Y - 1000 m	22	1G	Y	
		6-09	Y - 800 m	10	0	N	
		6-22	Y - 300 m	1	1B	Y	
		7-07	N	0	0	N	
		7-22	N	0	1G	N	
259	1196	1986:6-05	N[1]	0	0	N	
		6-16	N[1]	0	0	N	
258	1195	1986:6-05	N[1,3]	0	0	N	
		6-06	N[1,3]	0	0	N	
257	1194	1986:6-05	N[1,3]	0	0	N	
		6-06	N[1,3]	0	0	N	
256	1193	1986:6-05	N[1,3]	0	0	N	
		1987:6-02	N[1,3]	0	0	N	
Weasel Cr	1192	1986:5-20	N[3]	0	0	N	S
		6-03	N[3]	0	0	N	
		6-20	Y[3] - 450 m	10	0	N	
		6-28	N[3]	0	0	N	
		6-30	Y - 250 m	4	1G	N	
		7-08	Y[3] - 150 m	1	0	N	
		1987:5-07	N[3]	0	0	N	
		5-13	N[3]	0	0	N	
		6-02[2]	Y[3] - 25 m	25	1G	Y	
		6-09	Y[3] - 25 m	11	0	N	
		6-21	N[3]	0	0	N	
		7-07	N[3]	0	0	N	
252	1191	1986:6-12	N[B]	0	0	N	
		1987:6-02	N[1,2]	0	0	N	
251	1190	1986:6-12	N[1]	0	0	N	
		1987:6-02	N[1,3]	0	0	N	
250	1189	1986:6-05	N[1]	0	0	N	S
		1987:6-02	N[1,2]	0	0	N	
249	1188	1986:6-05	N[1,4]	0	0	N	
		1987:6-02	N[1,4]	0	0	N	
248	1187	1986:6-05	N[1,3]	0	0	N	S
		1987:6-02	N[1,3]	0	0	N	
247	1186	1986:6-05	N[1,3]	0	0	N	
		1987:6-02	N[1,3]	0	0	N	
239	1185	1986:5-08	N[1]	0	0	N	
		6-05	N[1]	0	0	N	
		6-16	N[1]	0	0	N	
238	1184	1985:6-25	N[1]	0	0	N	
		1986:5-08	N[1]	0	0	N	
		6-05	N[1]	0	0	N	
		6-15	N[1]	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
Arnica Cr	1183	1985:6-25	N	0	1G	N	S
		1986:5-09	N	0	1G	N	
		5-20	N	0	0	N	
		5-28	N	0	0	N	
		6-05	N	0	0	N	
		6-20	Y - 1200 m[b]	60	0	N	
		6-30	Y - 1200 m[b]	32	1G	Y	
		7-08	Y - 1200 m	6	0	N	
		7-14	Y - 1200 m[b]	9	0	N	
		1987:5-07	Y - 1200 m[b]	20	0	N	
		5-25	Y - 1200 m[b]	32	0	N	
		6-09	Y - 1200 m	18	0	N	
		6-22	N	0	1Gg	N	
		7-07	Y - 400 m	1	1G	N	
Little Arnica Cr	1182	1985:6-25	N	0	0	N	S
		1986:5-09	N	0	0	N	
		5-20	N	0	0	N	
		5-28	Y - 500 m	2	0	N	
		6-05	Y - 500 m	1	0	N	
		6-20	Y - 1000 m	77	1G	N	
		6-30	Y - 700 m	7	0	N	
		7-08	Y - 200 m	4	0	N	
		7-14	N	0	0	N	
		1987:5-07	Y - 1000 m	11	0	N	
		5-25	Y - 1000 m	99	1B	Y	
		6-09	Y - 1000 m	28	1G	N	
		6-22	Y - 200 m	2	1G,1B	N	
		7-01	Y - 200 m	4	1G	N	
		7-20	N	0	0	N	
233	1181	1985:6-25	N[1]	0	0	N	
		1986:6-05	N[1]	0	0	N	
		6-20	N[1]	0	0	N	
		1987:5-25	N[1]	0	0	N	
232	1180	1985:6-25	N	0	1G	N	S
		1986:5-28	N	0	0	N	
		6-05	N	0	0	N	
		6-20	Y - 100 m	4	0	N	
		7-08	N[2]	0	0	N	
		1987:5-13	N[2]	0	1G	N	
		5-25	Y - 100 m	7	0	N	
		6-01	N	0	0	N	
		6-10	Y - 100 m	4	1G	Y	
		6-22	N[2]	0	0	N	
		7-07	N[2]	0	0	N	
231	1179	1985:6-25	Y - 200 m	10	1U	Y	S
		1986:5-28	N	0	0	N	
		6-05	N	0	0	N	
		6-20	Y - 400 m	62	1G	N	
		7-08	N	0	0	N	
		1987:5-18	Y - 150 m	0	1G	N	
		5-25	Y - 300 m	84	1Gg	Y	
		6-10	Y - 300 m	61	1GR,1B	Y	
		6-22	Y - 150 m	6	1U	N	
		7-07	Y - 25 m	2	0	N	
		7-20	N	0	0	N	
230	1178	1986:5-28	N[3,4]	0	0	N	
		6-05	N[3,4]	0	0	N	
		1987:5-11	N[3,4]	0	1G	N	
		5-25	N	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Noskins[d]
229	1177	1985:6-25	Y - 200 m	10	1G	Y	S, B, F
		1986:5-20	N	0	0	N	
		5-28	N	0	0	N	
		6-04	N	0	0	N	
		6-19	Y - 500 m	476	1G,1B	N	
		6-27	Y - 500 m	260	2G,1B	Y	
		7-09	Y - 300 m	2	1Gg,1G	Y	
		7-16	Y - 300 m	1	1Gg	Y	
		7-29	N	0	1G	N	
		8-11	N	0	0	N	
		1987:5-07	N	0	0	N	
		5-03	Y - 300 m	3	1B	N	
		5-25	Y - 500 m	116	1B	Y	
		6-10	Y - 500 m	294	1G	Y	
		6-23	Y - 500 m	25	2G	Y	
		7-06	N	0	1G	Y	
		7-20	N	0	1G	N	
Little Thumb Cr	1176	1985:6-25	Y - 200 m[b]	98	1Gg	Y	S, B, F
		1986:5-08	N	0	0	N	
		5-20	N	0	0	N	
		5-28	N	0	0	N	
		6-04	N	0	0	N	
		6-19	Y - 600 m	173	1G	N	
		6-26	Y - 900 m	772	2Gg	Y	
		7-09	Y - 500 m	313	2Gg, 1G	Y	
		7-16	Y - 500 m	148	1Gg, 1G	Y	
		7-29	Y - 300 m	39	1Gg, 1G	Y	
		8-11	N	0	1G	N	
		1987:5-07	N	0	0	N	
		5-13	Y - 500 m	31	1Gg, 1G	N	
		5-26	Y - 900 m	183	1B	Y	
		6-10	Y - 500 m	397	1G, 1B	Y	
		6-23	Y - 500 m	268	1G, 1B	Y	
		7-06	Y - 300 m	133	2G	Y	
		7-14	Y - 300 m	4	1G	Y	
227	1175	1986:6-05	$N^{1,2,6}$	0	0	N	
		1987:6-02	$N^{1,2,6}$	0	0	N	
226	1174	1986:6-05	$N^{1,2,6}$	0	0	N	
		1987:6-02	$N^{1,2,6}$	0	0	N	
225	1173	1986:6-05	$N^{1,2,6}$	0	0	N	
		1987:6-02	$N^{1,2,6}$	0	0	N	
222	1172	1986:6-05	N^{8}	0	0	N	
		1987:6-02	$N^{1,6}$	0	0	N	
221	1171	1986:6-05	N^{8}	0	0	N	
		1987:6-02	$N^{1,6}$	0	0	N	
220	1170	1986:6-05	N^{8}	0	0	N	
		1987:6-02	$N^{1,6}$	0	0	N	
219	1169	1986:5-08	N	0	0	N	S
		5-20	N	0	0	N	
		6-05	N	0	0	N	
		6-19	Y - 600 m	81	1B	N	
		7-01	Y - 600 m	21	0	N	
		7-09	Y - 600 m	27	0	N	
		7-16	Y - 600 m	7	1G	Y	
		7-29	N	0	0	N	
		1987:5-13	Y - 600 m	5	0	N	
		5-25	Y - 600 m	51	0	N	
		6-10	Y - 600 m	56	1G	Y	
		6-23	Y - 600 m	6	1G	Y	
		7-06	Y - 200 m	1	1G	N	
		7-20	N	0	0	N	

Table 18. Continued.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hookins[d]
Thumb Cr	1168	1985:6-25	N	0	0	N	S
		1986:5-08	N	0	0	N	
		5-22	N	0	0	N	
		5-28	N	0	0	N	
		6-04	N	0	1B	N	
		6-19	Y - 800 m	123	0	N	
		7-03	Y - 500 m	23	0	N	
		7-08	Y - 300 m	4	0	N	
		1987:5-07	N	0	0	N	
		5-25	Y - 800 m	57	1G	N	
		6-10	Y - 300 m	24	0	N	
		6-23	N	0	0	N	
		7-06	Y - 300 m	1	0	N	
		7-20	N	0	0	N	
217	1167	1985:6-25	N	0	0	N	S
		5-08	N	0	0	N	
		1986:5-22	N	0	0	N	
		5-28	N	0	0	N	
		6-04	Y - 800 m	131	0	N	
		6-14	Y - 800 m	135	0	N	
		6-26	Y - 300 m	22	0	N	
		7-08	Y - 300 m	20	0	N	
		7-16	Y - 200 m	17	0	N	
		7-29	Y - 200 m	4	0	N	
		8-13	N	0	0	N	
		1987:5-07	Y - 800 m	59	0	N	
		5-11	Y - 800 m	249	0	N	
		5-18	Y - 800 m	353	0	N	
		5-25	Y - 800 m	330	1U	Y	
		6-01	Y - 800 m	247	0	N	
		6-08	Y - 500 m	144	0	N	
		6-15	Y - 300 m	56	0	N	
		6-22	Y - 200 m	20	1B	Y	
		6-29	Y - 200 m	8	0	N	
		7-20	N	0	0	N	
Sandy Cr	1166	1985:6-25	N	0	0	N	S
		1986:5-08	N	0	0	N	
		5-22	N	0	0	N	
		5-28	N	0	0	N	
		6-04	Y - 800 m	3	0	N	
		6-19	Y - 1800 m	558	0	N	
		6-26	Y - 1800 m	111	0	N	
		7-08	Y - 500 m	19	0	N	
		7-16	Y - 500 m	19	0	N	
		7-29	Y - 400 m	2	0	N	
		8-13	N	0	0	N	
		1987:5-07	Y - 1500 m	40	0	N	
		5-11	Y - 1800 m	174	0	N	
		5-18	Y - 1800 m	176	1G	Y	
		5-25	Y - 1800 m	971	1G	Y	
		6-01	Y - 1800 m	852	1G	Y	
		6-08	Y - 1800 m	292	0	N	
		6-15	Y - 1100 m	67	0	N	
		6-22	Y - 1100 m	36	1B	Y	
		6-29	Y - 900 m	19	0	N	
		7-20	N	0	0	N	
215	1165	1986:5-22	N[2]	0	0	N	S
		6-04	N[1]	0	0	N	
		1987:5-25	N[1]	0	0	N	
Sewer Cr	1164	1985:5-29	Y - 100 m	5	1U	N	S, B, F
		6-25	N	0	0	N	
		1986:5-08	N	0	0	N	
		5-20	N	0	0	N	
		5-28	N	0	0	N	
		6-04	N	0	0	N	
		6-14	Y - 1200 m[b]	428	1G,1B	N	
		6-26	Y - 1200 m	134	1B	Y	
		7-04	Y - 150 m	2	1B	N	
		7-06	N	0	0	N	
		8-13	N	0	0	N	

Table 18. Concluded.

Stream name or old number	New SONYEW number	Dates surveyed by IGBST	Spawning run (YES-NO[a]) - LENGTH	No. spawners observed	No. and species of bears[c]	Bear fishing (YES,NO)	Hoskins[d]
Sewer Cr (cont.)		1987:5-11	N	0	0	N	
		5-18	Y - 900 m[b]	190	1U	Y	
		5-25	Y - 1200 m[b]	270	1G	Y	
		6-01	Y - 1200 m[b]	337	1G,1Bb	Y	
		6-08	Y - 100 m	104	1B	Y	
		6-15	Y - 400 m	8	1Bb	Y	
		6-23	N	0	1B	N	
		6-29	Y - 200 m	5	1B	Y	
		7-20	N	0	0	N	

[a]Reasons for no spawning run:

1 = Stream size or flow too small
2 = Natural block
3 = Manmade block
4 = Gradient too steep
5 = Unsuitable substrate
6 = Chemical barrier
7 = Unknown causes
8 = Stream not found

[b]Denotes that spawners were observed beyond surveyed distance.

[c]Types of bears found:

G = Lone grizzly
Gg = Grizzly with young
B = Lone black bear
Bb = Black bear with young
U = Unknown bear species

[d]Hoskins' findings 1974, 1975:

S = Spawning run
B = Bear sign
F = Bear fishing observed

[e]Bear fishing observed in 1986 (Gunther 1986).

[f]Bear fishing observed in 1987 (French and French 1990).

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