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Cover photo: The lower Firehole River in Firehole Canyon, between Firehole Falls and Firehole Cascades. Image from a glass-plate negative made by the U.S. Army Corps of Engineers in 1913. The Corps of Engineers was Yellowstone National Park to supervise the construction and maintenance of roads and bridges.

TABLE OF CONTENTS

Introduction	1
Parkwide angling	3
Yellowstone Lake	8
Lake Area-Bridge Bay spawning survey	29
Grant Village spawning survey	36
Yellowstone River	44
Yellowstone River spawning survey	53
Lamar River	64
Soda Butte Creek	74
Fluvial Arctic Grayling restoration studies	93
History of Fishery Management of the Firehole River	115
Postfire Observations on stream fisheries	135
Wildlife Resources and Recreational Use in the Lewis River Channel during the brown trout spawning season: 1991 update	166
Nonangling use of the aquatic resource	176
Other project activities	182
Acknowledgments	187
Literature Cited	189

LAKE AREA-BRIDGE BAY CUTTHROAT TROUT SPAWNING AND ASSOCIATED BEAR ACTIVITY: 1989-1991

Conflicts between humans and wildlife are major concerns in Yellowstone National Park. Human-bear conflicts in the Lake Area (LA) and at Bridge Bay (BB) may occur from May through July when adfluvial Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri* spawn in Yellowstone Lake tributaries and are preyed on by grizzly bears *Ursus arctos horribilis* and black bears *U. americanus*. The National Park Service (NPS) is attempting to minimize the potential for human-bear conflicts in the LA-BB area during the cutthroat trout spawning season by managing human use, and effective management requires accurate information on cutthroat trout spawning and bear activity patterns.

Cutthroat trout spawning tributaries in the LA-BB area have been identified (Hoskins 1974, 1975; Jones et al. 1986, 1987; Reinhart and Mattson 1986, 1987; Reinhart 1990), and data on the timing of spawning runs were collected between 1985 and 1988 (Jones et al. 1986, 1987; Reinhart 1990; Reinhart and Mattson 1990). Based on these studies and recommendations by the U.S. Fish and Wildlife Service, Interagency Grizzly Bear Study Team, and NPS, cutthroat trout spawning and bear activity patterns in the LA-BB area were monitored more intensively from 1989 through 1991 by NPS Resource Management staff. The objectives of this study were to monitor the timing and relative magnitude of cutthroat trout spawning runs and associated bear activity along spawning streams.

Study Area

The LA-BB area is on the northwest shore of Yellowstone Lake (Figure 12). Lake Area visitor services include a ranger station, general store, restaurants, lodging, and hospital. Government and concessioner employee housing is also located in the area. Bridge Bay visitor services include a ranger station, marina, general store, and campground. Sand Point is a developed picnic area with fishing access south of the LA-BB area. Popular LA-BB area recreational activities include sightseeing, picnicking, day hiking, boating, bicycling, and angling.

There are 15 tributaries of Yellowstone Lake in the LA-BB area (Figure 12). Cutthroat trout spawn annually in Stream 1204, Soldier Creek, Hatchery Creek, Stream 1200, Stream 1199, Wells Creek, and Bridge Creek. An elevated culvert prevents trout from ascending Hotel Creek, but trout occasionally spawn in the stream mouth. Spawning occurs in Weasel Creek in years when lake levels are high enough to allow access through the culvert under the Grand Loop Road. Stream 1191 occasionally supports a spawning run. The other five streams are not known to support spawning runs (Jones et al. 1986, 1987; Reinhart 1990).

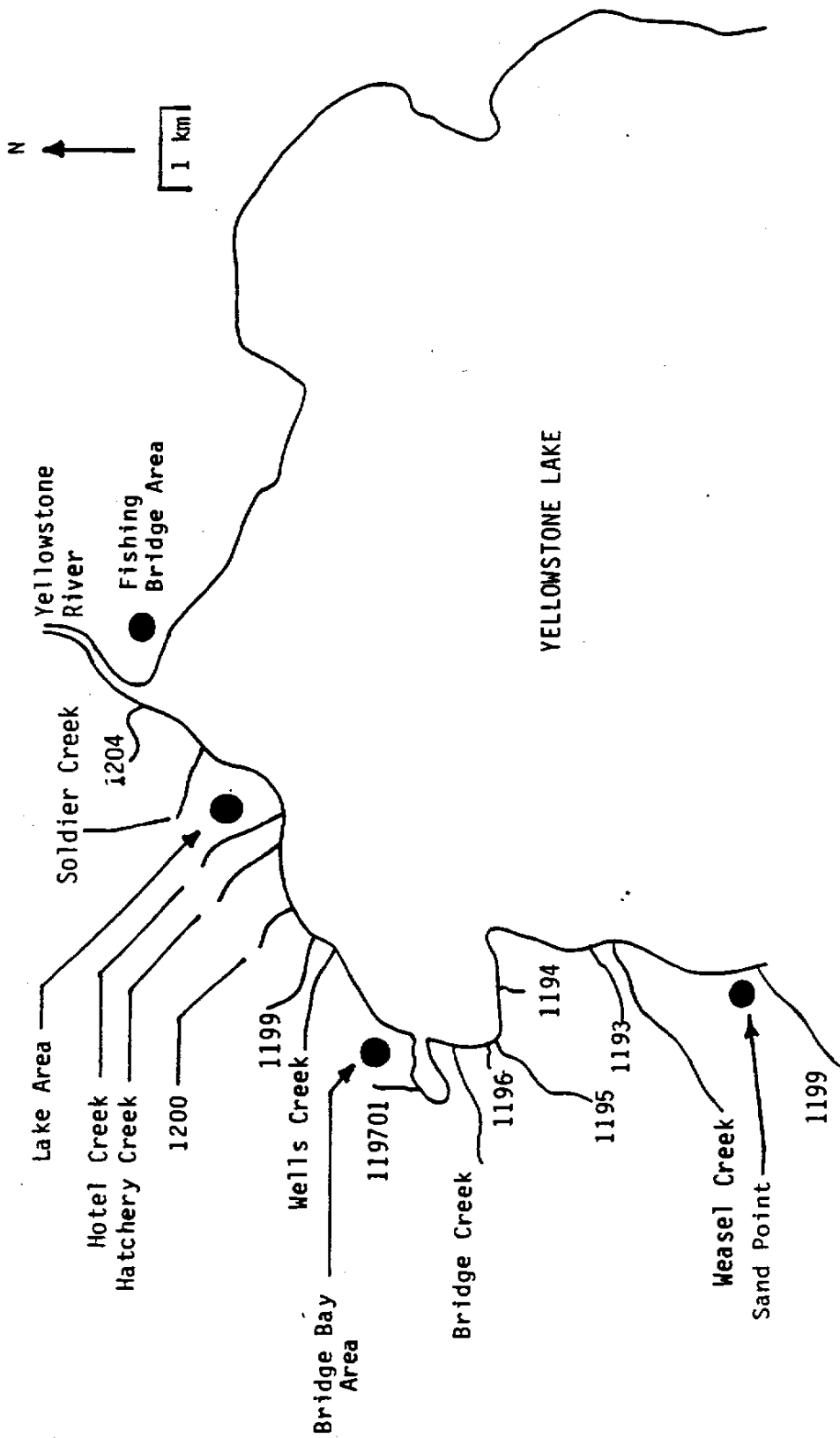


FIGURE 12.-Yellowstone Lake tributaries in the Lake Area and Bridge Bay area, Yellowstone National Park.

Methods

Sample sites and data base.-This report examines cutthroat trout spawning and bear activity data collected annually in the LA-BB area from 1989 through 1991. During this period, sampling was concentrated on cutthroat trout spawning streams near areas of high human use. In addition, Weasel Creek was sampled because a new campground has been proposed near this stream, and Stream 1191 was sampled in 1990 and 1991 because of recent bear activity near the Sand Point picnic area.

Field procedures.-Beginning 1 May in each year of the study, streams in the LA-BB area were checked daily to detect the presence of adult cutthroat trout. Once adult trout were found (i.e., onset of spawning), weekly visual counts of adult trout were used to estimate peak periods and relative magnitude of spawning runs. In each stream on each sample day, two people walked upstream from the stream mouth and recorded the number of adult trout observed. Weekly sampling continued until most adult trout had returned to the lake (i.e., end of spawning).

While making fish counts, observers recorded bear sign (e.g., sightings, fish parts, hair, scats, and tracks). Tracks and track measurements were used to determine the number, species, and association of family groups of bears (Reinhart 1990).

Results

1991

Cutthroat trout.-Evidence of predation on fish (e.g., fish parts) by unknown predators was found along Bridge Creek on 14 May; however, the earliest date on which adult trout were observed in LA-BB area streams was 28 May (two streams). The last date adult trout were found was 2 July (six streams; Figure 13). Weekly counts indicated that the largest spawning run occurred in Wells Creek, followed by Bridge Creek, Soldier Creek, Hatchery Creek, Stream 1199, Weasel Creek, Hotel Creek, and Stream 1191 (Figure 13).

A sand spit that usually blocks the mouth of Stream 1191 was opened periodically by wave action and stream current. Fish parts were first observed on the streambank on 11 June, but adult trout were first observed in the stream on 2 July. Some adult trout became stranded in early July when streamflow became intermittent. The spawning run in Stream 1191 was estimated to have lasted about 3 weeks.

Bears.-Bear sign and evidence of bear predation on spawning trout were found along most LA-BB spawning streams in 1991. Bear tracks (species unknown) were first observed along Stream 1199 on 7 May and along Soldier Creek on 14 May. Grizzly bear tracks

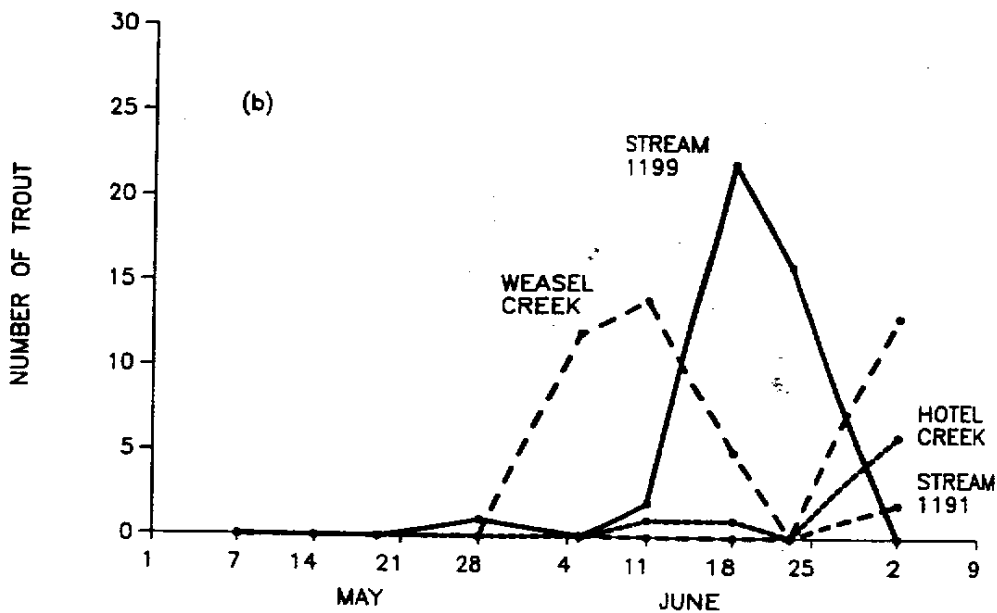
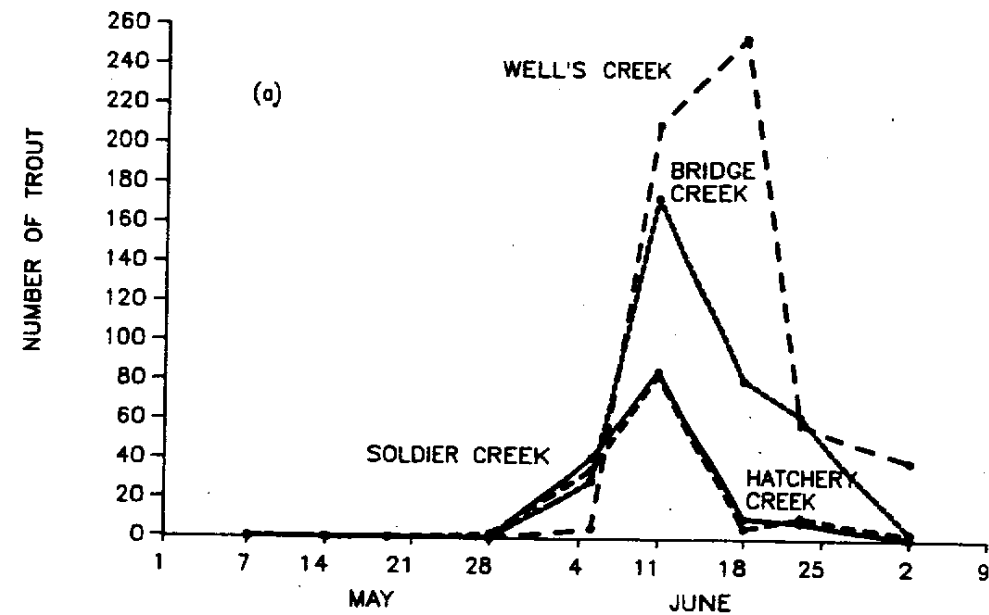


FIGURE 13.-Counts of cutthroat trout spawners in eight streams in the LA-BB area, 1991. (a) streams in which maximum counts of adult trout exceeded 90, and (b) streams in which maximum counts of adult trout were less than 90.

were first found along Wells Creek, Bridge Creek, and Weasel Creek on 14 May; subsequently, grizzly bear tracks were found along Soldier Creek (19 May), Hatchery Creek (28 May), Stream 1191 (11 June), and Stream 1199 (23 June). No bear tracks were observed along Hotel Creek in 1991; however, evidence of bear predation on spawning trout has been observed in previous years at the mouth of this creek (French and French 1990; Reinhart 1990). Track measurements made during fish surveys indicated that between 9 and 11 different bears (i.e., lone bears and family groups) used the LA-BB streams in 1991; nine were grizzly bears (one of these was a sow with a young bear about 2 years old), and two bears could not be identified to species.

Three-Year Trends (1989-1991)

Cutthroat trout.-Timing of cutthroat trout spawning in LA-BB area tributaries varied considerably during the past 3 years; spawning lasted 4 to 6 weeks in 1989 (mid May to late June), 4 to 8 weeks in 1990 (early May to early July), and 3 to 5 weeks in 1991 (late May to early July). Weekly counts of adult trout in each year of the study suggested that the largest spawning runs occurred in Bridge, Wells, Hatchery, and Soldier creeks; spawner access to these four streams is not seriously hampered by road culverts. Spawner access to Weasel and Hotel creeks, however, is severely restricted or blocked by road culverts. Stream 1191 and Stream 1199 are small streams that probably have little suitable spawning substrate. Lack of data from Stream 1200 and Stream 1204 precluded comparisons with the other eight LA-BB area spawning streams.

Bears.-Based on track analyses, the maximum number of bears (i.e., lone bears and family groups) using LA-BB area spawning streams increased from 5 in 1989 to 8 in 1990 to 11 in 1991. Track analysis also indicated that from one to five bears concurrently used a single spawning stream in 1990 and one to three bears concurrently used a single spawning stream in 1991. Observations of seasonal activity patterns revealed that, on most LA-BB area spawning streams, bear activity began at the peak of the spawning run, was highest after peak spawning, and declined thereafter. During the past 3 years, two grizzly bears were trapped and removed from the LA-BB area during the cutthroat trout spawning season.

Discussion

Cutthroat Trout

Timing of cutthroat trout spawning in LA-BB area streams, as in other Yellowstone Lake tributaries, appeared to be influenced by several environmental factors. Spawning usually began as high spring flows subsided, water clarity increased, and stream temperatures rose above 8°C. Factors affecting time of peak spawning are poorly understood, but spawning-run duration in

LA-BB area streams may be limited by interactions among low streamflow, natural blockage of the stream mouth by sand spits, and the ability of adult trout to pass through road culverts. Size of spawning runs in LA-BB area tributaries may be a function of spawner access to streams and availability of suitable spawning habitat.

Bears

Reinhart (1990) stated that the track-measurement method probably underestimated the number of bears using a spawning stream; thus, it is possible that the number of bears using LA-BB area spawning streams from 1989 through 1991 was greater than reported. Substrate suitable for identifying tracks was not always present along streams, and French and French (1990) observed that bears preying on fish often walked in the stream, thus reducing the presence of tracks.

Based on observed patterns of bear activity along Yellowstone Lake spawning streams, Reinhart (1990) concluded that bear predation on spawning trout was positively correlated with volumetric trout density. Trout densities are relatively high at, or just after, peak spawning and during intermittent streamflows when spawners become stranded in pools. Postspawning trout are usually in poor condition and vulnerable to predation.

Reinhart and Mattson (1990) found that bear use of Yellowstone Lake spawning streams within 1 km of park developments was less than expected despite sometimes high spawner densities. Bears using spawning streams near developments, however, may become habituated to humans. Habituation may result when the attraction to "natural" foods (e.g., spawning cutthroat trout) outweighs the tendency of bears to avoid humans, or when subdominant bears are displaced by dominant bears into areas of high human use. Adult female and subadult grizzly bears are more likely than other grizzly bears to forage closer to developments and become habituated (Mattson et al. 1987); consequently, these animals are more likely to be involved in management actions such as trapping and relocation (Mattson 1990).

Management Actions and Recommendations

Several management actions have been used by the NPS to reduce potential human-bear conflicts in the LA-BB area during the cutthroat trout spawning season. These include: 1) monitoring trout spawning and bear activity patterns; 2) closing areas near spawning streams to human use; 3) restricting human use of portions of the LA-BB and Sand Point Picnic areas; 4) delaying openings of lodging units and campgrounds; 5) educating visitors through brochures and the park newspaper; 6) eliminating early-season Lake Lodge conferences and meetings; 7) repairing the Transfer Station fence; 8) closing the Natural

Bridge Road (except for administrative use); and 9) trapping and relocating bears. These management actions should be reviewed and updated annually.

Because of annual variation in timing of cutthroat trout spawning runs and bear activity, it has been difficult to establish a "standard" date for the opening of LA-BB area visitor facilities. However, it is not prudent to allow unregulated human access to spawning areas. Data collected from 1989 through 1991 have been used to reduce the potential for human-bear conflicts in the LA-BB area during the cutthroat trout spawning season. It is recommended that the monitoring of cutthroat trout spawning and bear activity be continued in 1992.