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Fishery and Limnological Surveys of 25 Lakes on the Kenai National Wildlife Refuge, Alaska, 1993

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Fishery and Limnological Surveys of 25 Lakes on the Kenai National Wildlife Refuge, Alaska, 1993

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Abstract.— Fishery and limnological surveys were conducted on 25 remote and roadside lakes on the Kenai National Wildlife Refuge during 1993 to evaluate their potential contribution to recreational fisheries. Experimental gill nets and minnow traps were used to examine species composition and determine relative abundance of fish species. Other objectives were to describe the length, weight, and age composition of rainbow trout *Oncorhynchus gairdneri* and Arctic char *Salvelinus alpinus* populations; evaluate spawning habitat in lake inlets and outlets; and measure various physical and chemical characteristics of each lake.

Sport fish species were found in 11 of the 25 lakes surveyed. Rainbow trout were found in seven lakes, with the highest catch rates occurring in Upper Ohmer, Angler, Kuguyuk, and Kraenberi Lakes. Arctic char were found in three lakes with the highest catch rates observed in Falcon Lake. Small numbers of nonanadromous coho salmon *O. kisutch* were captured in Upper Ohmer Lake (N=4) and Mosquito Lake (N=1).

Catch results indicate that sport fish populations may no longer exist in some lakes that historically supported these species. Rainbow trout, sockeye salmon, and coho salmon stocked in Upper Jean Lake during the 1960's and 70's are no longer present, and rainbow trout that once inhabited Mosquito and Phalarope Lakes now appear to be absent. Low catch rates for rainbow trout in Neckshortka Lake also indicate this population may be in decline.

Population declines in most lakes can be linked to a natural loss of habitat. Additionally, the absence of permanent inlet and outlet streams to and from other lakes surveyed indicate that some sport fish populations have intermittent access to spawning areas or access only to in-lake spawning habitat.

Introduction

The numerous lakes located throughout the Kenai lowlands are a unique geologic feature on the Kenai National Wildlife Refuge (Kenai Refuge) that provide a variety of aquatic habitats for fish and wildlife species. Many of these lakes are very productive and support healthy sport fish populations while others are less productive or possess characteristics which limit sport fish populations. Good baseline information is available describing the fish populations and limnological characteristics of some lakes but is lacking for others. With the demand for recreational fishing opportunities increasing annually, there was a need to expand the baseline information available on refuge lakes and identify potential recreational fishing opportunities.

Since 1960, fish populations have been surveyed in several lowland lakes by the Alaska Department of Fish and Game (Department) and U.S. Fish and Wildlife Service (Service). Department and Service biologists surveyed several lakes during the 1960's and 70's, but the data were never consolidated or summarized in reports and are available only as raw data files. The Service conducted additional surveys on 57 lakes from 1983-1986 (Friedersdorff and Jakubas 1984a and 1984b; Friedersdorff 1985; U.S. Fish and Wildlife Service, unpublished data) and 11 lakes during 1988 and 1989 (Jones et al. 1996).

Five sport fish species were identified during these surveys. Rainbow trout *Oncorhynchus gairdneri* was the most common sport fish species found, and others included Dolly Varden *Salvelinus malma*, Arctic char *S. alpinus*, coho salmon *O. kisutch*, and sockeye salmon *O. nerka*. Because it is nearly impossible to differentiate Arctic char from Dolly Varden by observing external characteristics, distribution records for these species may not be accurate. Where positive identifications have been made, Arctic char were reported primarily from lakes in the Swanson River watershed (USFWS 1995). Dolly Varden were generally found in lakes which were connected to streams. Coho and sockeye salmon were generally residuals found in lakes that were intermittently accessible to anadromous fish. One exception to this was Upper Jean Lake which was stocked with rainbow trout, coho salmon, and sockeye salmon from 1962-1983.

A variety of non-sport fish species were also captured during these surveys. These were longnose sucker *Catostomus catostomus*, round whitefish *Prosopium cylindraceum*, threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pongitius pongitius*, coastrange sculpin *Cottus aleuticus*, slimy sculpin *C. cognatus*, and Arctic lamprey *Lampetra japonica*.

Section 303 (4)(B) of the Alaska National Interest Lands Conservation Act specifically mandates that opportunities for fish and wildlife-oriented recreation be provided if they are compatible with other purposes of the refuge. Furthermore, the Service has adopted a national policy to provide increased recreational fishing opportunities on national wildlife refuges (USFWS 1988). The Kenai Refuge has complied with this policy by providing a variety of fishing opportunities refuge-wide and will attempt to accommodate increasing use as long as it does not adversely impact fish and wildlife populations.

The Service conducted surveys on 25 Kenai Refuge lakes during 1993. Objectives of the surveys were to: (1) examine species composition and relative abundance of fish populations; (2) evaluate the spawning potential of lake inlets and outlets; (3) describe the length, weight, and age composition of rainbow trout and Arctic char populations; (4) describe the physical and chemical characteristics of each lake; and (5) develop recommendations for the management of fish populations.

Study Area

The Kenai Refuge covers 797,000 ha on the Kenai Peninsula in south central Alaska (Figure 1) (USFWS 1995). The eastern third of the refuge lies within the Kenai Mountains which range in elevation from 914 to 2,012 m. The entire range is heavily glaciated, and many of its high valleys are buried beneath the vast Harding Ice Field. The remaining two-thirds of the refuge is part of the Kenai Lowlands composed of low hills and coastal plain. Boreal spruce-birch forests, coastal marshes, and numerous streams and lakes typify this area.

There are 808 lakes on the Kenai Refuge with a surface area of four or more hectares and 2,400 km of streams (USFWS 1995). The surface area of the 25 lakes surveyed during 1993 ranged from 7 to 149 ha. Nine of these lakes are within reasonable walking distance from roads, while others are primarily accessible by aircraft.

Methods

Field Techniques

Twenty-five lowland refuge lakes north of Skilak Lake were surveyed once each between July and October, 1993 (Figure 1). The status of fish stocks was assessed, and limnological characteristics were measured in all of these lakes. Bathymetric data were collected from 19 of these lakes.

Experimental gill nets and minnow traps were used to sample fish populations. Gill nets were 30.5 m long by 2.4 m deep with five 6.1-m panels of 2.5, 5.1, 6.4, 7.6, and 10.2-cm stretch monofilament mesh. One floating net set shallow, and one sinking net set deep, were fished for each 20 ha of lake up to a maximum of eight nets. Minnow traps were baited with salmon eggs and fished in littoral habitats. Five traps were fished for 6 ha, 10 traps for 20 ha, and two more traps were fished for each additional 20 ha up to a maximum of 16 traps. Gill nets and minnow traps were fished overnight.

All captured fish were identified to species and enumerated. Arctic char were differentiated from Dolly Varden by counting gill rakers and pyloric caeca (Morrow 1980). Fork lengths were measured to the nearest mm, and weights were determined using spring scales graduated to different levels of precision. Generally, fish weighing up to 500 g were measured to the nearest 5 g, and fish weighing over 500 g were measured to the nearest 10 g. Otoliths were removed from Arctic char for age determination. Scales were removed from rainbow trout captured in Wren Lake for age determination. After sampling Wren Lake, it became apparent fish generally did not survive capture with gill nets, therefore, we decided to remove otoliths from rainbow trout also.

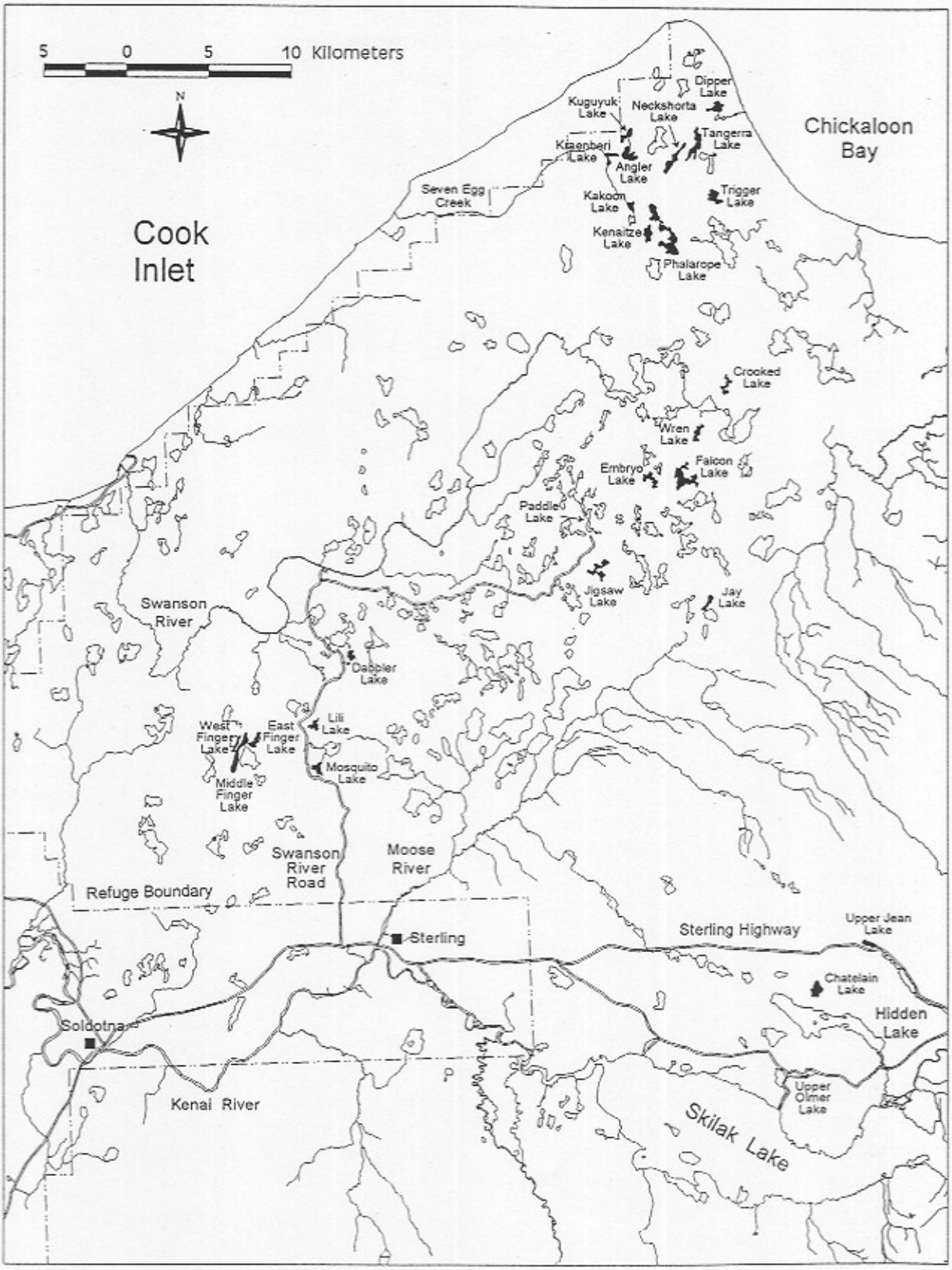

FIGURE 1.—Geographic location of lakes surveyed July-October, 1993, Kenai National Wildlife Refuge, Alaska.

Results and Discussion

Angler Lake

Angler Lake (60°58.0'N, 150°26.7'W) is located in the Seven Egg Creek watershed 23.0 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Angler Lake on August 9-10, 1993. This lake was previously unsurveyed.

Angler Lake has a surface area of 51 ha and a maximum depth of 9.8 m (Appendix A1). It is linked to Kraenberi Lake, 0.1 km to the west, by a 4.5-m wide by 0.6-m deep channel and to Kuguyuk Lake, 0.6 km to the north, by a 6-m wide by 1-m deep channel. The channel leading from Kuguyuk Lake was blocked by a 0.2-m high beaver dam. Detectable flow and gravel were not present in either channel connected to Angler Lake.

Water temperature and dissolved oxygen ranged from 21.0 to 7.5°C and 8.4 to 0.7 mg/L from the top to the bottom of the water column. Conductivity (84 μmho), alkalinity (27 mg/L), and hardness (37 mg/L) were higher than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.3, and water transparency was 4.6 m.

Rainbow trout and threespine stickleback were present in Angler Lake. Six gill nets were fished for a total of 62.41 h resulting in a catch of 61 rainbow trout (CPUE=0.98), and 14 minnow traps were fished for a total of 255.58 h resulting in a catch of 113 threespine sticklebacks (CPUE=0.44) (Appendix B2). Based on higher catch rates in floating gill nets, rainbow trout appeared to be slightly more abundant in the upper water column. Floating and sinking gill net CPUE were 1.02 and 0.93, respectively.

Age was estimated for 60 of the 61 rainbow trout sampled from Angler Lake (Table 1). Sampled fish ranged from ages 3 to 5, and age 4 fish were most abundant (50%) followed by age 3 fish (45%). The high proportion younger-aged fish in the sample indicates recruitment is occurring to the population. Recruitment is probably occurring from Seven Egg Creek through Kraenberi Lake. Lengths and weights ranged from 122 to 423 mm and 110 to 870 g. The sex ratio favored males which comprised 60% of the sample.

TABLE 1.—Lengths and weights at age for rainbow trout captured in Angler Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
3	27	295.6	11.7	122-384	329.8	29.7	110-620
4	30	331.9	8.8	207-423	472.5	33.4	155-870
5	3	370.3	17.3	341-401	591.7	24.9	545-630
Total	60	317.5	7.4	122-423	414.3	23.6	110-870

Chatelain Lake

Chatelain Lake (60°30.1'N, 150°16.2'W) is located in the Kenai River watershed 0.8 km north from Hidden Lake (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Chatelain Lake on July 26-27, 1993. This lake was previously unsurveyed.

Chatelain Lake has a surface area of 49 ha and a maximum depth of 18.6 m (Appendix A2). A dry channel was present on the west side of the lake. According to a 1:63,360 series topographic map, this channel and another at the south end of the lake drain into Hidden Lake. We could not locate the southernmost channel which is probably nonexistent.

Water temperature ranged from 19.0 to 8.0°C from the top to the bottom of the water column. Dissolved oxygen ranged from 8.9 mg/L near the water surface to 12.2 mg/L at depths of 8.0 and 9.0 m and 8.5 mg/L near the lake bottom. Conductivity (122 μmho), alkalinity (54 mg/L), and hardness (72 mg/L) were among the highest values from lakes surveyed in 1993 (Appendix B1). Lake water was alkaline with the highest pH (8.2) value for lakes surveyed in 1993. Water transparency was 6.2 m.

Of the 25 lakes surveyed in 1993, Chatelain Lake supported the highest catch rate of threespine sticklebacks (Appendix B2). Fourteen minnow traps were fished for a total of 201.50 h resulting in a catch of 1,495 threespine sticklebacks (CPUE=7.42). Six gill nets were fished for a total of 77.17 h, and no fish were captured.

Crooked Lake

Crooked Lake (60°50.3'N, 150°20.7'W) is located in the Swanson River watershed 11.8 km northeast from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). The Service collected limited water quality data from this lake in 1976 (U.S. Fish and Wildlife Service, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on August 12-13, 1993.

Crooked Lake has a surface area of 30 ha and a maximum depth of 9.4 m (Appendix A3). A channel at the north end of Crooked Lake linked it to a smaller lake, but observations from a low altitude aerial reconnaissance revealed no other inlets or outlets were associated with the smaller lake. There was no directional flow in the channel, and its substrate lacked suitable spawning gravel for rainbow trout.

Water temperature ranged from 19.0 to 5.5°C from the top to the bottom of the water column. Dissolved oxygen ranged from 8.7 mg/L near the water surface to 10.5 mg/L at a depth of 6.0 m and 2.7 mg/L near the lake bottom. Conductivity (20 μmho), alkalinity (2 mg/L), and hardness (4 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 6.7, and water transparency was 6.9 m.

Threespine stickleback were the only fish species captured in Crooked Lake. Twelve minnow traps were fished for a total of 150.08 h resulting in a catch of four threespine sticklebacks (CPUE=0.03) (Appendix B2). Four gill nets were fished for a total of 51.42 h, and no fish were captured.

Dabbler Lake

Dabbler Lake (60°41.8'N, 150°46.4'W) is located in the Swanson River watershed approximately 0.5 km east from km 21.2 of Swanson River Road (Figure 1). The Department collected bathymetric and fishery resource data from this lake in 1963 (Alaska Department of Fish and Game, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on September 27-28, 1993.

Dabbler Lake has a surface area of 22 ha and a maximum depth of 11.6 m (Appendix A4). A survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present.

Water temperature ranged from 9.0°C at the water surface to 9.5°C at a depth of 4.0 m. Dissolved oxygen ranged from 10.1 to 9.6 mg/L from the top to the bottom of the water column. Conductivity (22 μmho), alkalinity (4 mg/L), and hardness (7 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 6.8, and water transparency was 5.9 m.

Threespine stickleback were the only fish species captured in Dabbler Lake. Twelve minnow traps were fished for a total of 192.33 h resulting in a catch of 92 threespine sticklebacks (CPUE=0.48) (Appendix B2). Four gill nets were fished for a total of 72.33 h, and no fish were captured. The 1963 survey by the Department was limited to three gill nets. No fish were captured.

Dipper Lake

Dipper Lake (60°59.5'N, 150°20.5'W) is located in the Dipper Creek watershed which drains into Chikaloon Bay (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Dipper Lake on August 3-4, 1993. This lake was previously unsurveyed.

Dipper Lake has a surface area of 35 ha and a maximum depth of 14.9 m (Appendix A5). Topographic maps show an outlet at the south end of the lake, but no channels were located during a ground survey of the south shoreline. A survey of the lake perimeter by boat also indicated that no inlets or outlets to streams or other lakes were present. The mouth of Dipper Creek was also inspected during a ground survey, and an extremely steep stream gradient at this point was determined to be a barrier to anadromous fishes.

Water temperature and dissolved oxygen ranged from 19.0 to 9.0°C and 8.9 to 4.1 mg/L from the top to the bottom of the water column. Conductivity (47 μmho) was equal the mean value from lakes surveyed in 1993, and alkalinity (12 mg/L) and hardness (12 mg/L) were below average (Appendix B1). Lake water pH was 7.3, and water transparency was 4.7 m.

Threespine stickleback and sculpin were present in Dipper Lake. Twelve minnow traps were fished for a total of 143.92 h resulting in a catch of seven threespine sticklebacks (CPUE=0.05) (Appendix B2). Sculpin *Cottus* spp. were observed in the lake, but none were captured. Four gill nets were fished for a total of 47.00 h, and no fish were captured.

East Finger Lake

East Finger Lake (60°39.1'N, 150°52.6'W) is located in the Swanson River watershed approximately 2.2 km southwest from km 15.8 of Swanson River Road (Figure 1). The Department collected fishery resource data from this lake in 1964-66 (Alaska Department of Fish and Game, unpublished data) and studied depth distribution, length composition, and fecundity of Arctic char in 1967-68 (Engel 1969). The Service also gathered fishery resource and water quality data in 1975 (U.S. Fish and Wildlife Service, unpublished data) and 1983 (Friedersdorff and Jakubas 1984a). We collected water chemistry and fishery resource data on October 18-19, 1993.

East Finger Lake has a surface area of 29 ha and a maximum depth of 14.6 m (Friedersdorff and Jakubas 1984a). It is connected to Middle Finger Lake, 0.1 km to the west, by a 0.7-m wide by 0.2-m deep outlet channel. Flow was visually estimated to be less than 0.05 m^3/s, and the substrate was composed partially of 1-5-cm diameter gravel. We were unable to locate a channel shown on topographic maps leading from South Finger Lake.

Water temperature and dissolved oxygen ranged from 6.5 to 6.0°C and 10.4 to 9.5 mg/L from near the top to the bottom of the water column. Conductivity (23 μmho) was below average, and alkalinity (1 mg/L) and hardness (1 mg/L) were among the lowest measured in lakes surveyed during 1993 (Appendix B1). Lake water pH was 7.1, and water transparency was 6.5 m.

Previous surveys documented Arctic char, longnose sucker, threespine stickleback, and coastrange sculpin in East Finger Lake (Engel 1969; Friedersdorff and Jakubas 1984a; Alaska Department of Fish and Game, unpublished data; U.S. Fish and Wildlife Service, unpublished data). Friedersdorff and Jakubas (1984a) reported Arctic char and longnose sucker gill net catches of 0.15 and 0.03 fish per net hour, respectively. Engel (1969) showed that Arctic char generally occupied middle or lower water column in this lake during the summer and moved toward the surface during the fall. This vertical distribution was presumably thermal-related, with char preferring temperatures around 10°C.

We fished two gill nets for a total of 54.33 h resulting in a catch of 29 Arctic char (CPUE=0.53) and 15 longnose suckers (CPUE=0.28) (Appendix B2). Both species appeared to be more abundant in the lower water column based on a higher catch rate in the sinking gill net. For Arctic char, floating and sinking gill net CPUE were 0.18 and 0.89, respectively. For longnose sucker, floating and sinking gill net CPUE were 0.04 and 0.52, respectively. Minnow traps were not deployed.

Age was estimated for 28 of the 29 Arctic char sampled from East Finger Lake (Table 2). Sampled fish ranged from ages 3 to 9, and age 4 fish were most abundant (39%) followed by age 5 fish (36%). Lengths and weights ranged from 207 to 464 mm and 145 to 1,060 g. The sex ratio favored males which comprised 57% of the sample.

TABLE 2.—Lengths and weights at age for Arctic char captured in East Finger Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
4	11	274.9	11.7	207-312	235.0	74.9	145-385
5	10	289.7	8.8	250-357	246.5	104.2	150-455
6	5	339.4	8.8	292-409	446.0	229.7	240-725
7	1	-	-	346	-	-	445
9	1	-	-	464	-	-	1,060
Total	28	301.0	53.6	207-464	313.8	205.5	145-1,060

Embryo Lake

Embryo Lake (60°47.2'N, 150°26.0'W) is located in the Swanson River watershed 4.5 km northeast from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Embryo Lake on July 28-29, 1993. This lake was previously unsurveyed.

Embryo Lake has a surface area of 38 ha and a maximum depth of 24.4 m (Appendix A6). A survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present.

Water temperature ranged from 19.7 to 9.8°C from the top to the bottom of the water column. Dissolved oxygen ranged from 8.4 mg/L 3.0 m below the water surface to 11.4 mg/L at depths of 9.0, 10.0, and 11.0 m. Conductivity (18 μmho), alkalinity (2 mg/L), and hardness (2 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 6.6, and water transparency was 11.1 m.

Threespine stickleback were the only fish species captured in Embryo Lake. Fourteen minnow traps were fished for a total of 202.25 h resulting in a catch of three threespine sticklebacks (CPUE=0.01) (Appendix B2). Six gill nets were fished for a total of 87.33 h, and no fish were captured.

Falcon Lake

Falcon Lake (60°47.2'N, 150°23.9'W) is located in the Swanson River watershed 6 km northeast from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). The Department collected fishery resource data from this lake in 1965 (Alaska Department of Fish and Game, unpublished data), and the Service gathered limited water quality data in 1973 and 1978 (U.S. Fish and Wildlife Service, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on October 6-7, 1993.

Falcon Lake has a surface area of 90 ha and a maximum depth of 17.4 m (Appendix A7). A survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present.

Water temperature and dissolved oxygen ranged from 7.5 to 7.0°C and 9.7 to 9.0 mg/L from the top to the bottom of the water column. Conductivity (20 μmho), alkalinity (2 mg/L), and hardness (7 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 6.4, and water transparency was 6.8 m.

We fished four gill nets for a total of 60.42 h resulting in a catch of 65 Arctic char (CPUE=1.08), and 11 minnow traps were fished for a total of 182.67 h resulting in a catch of 112 threespine sticklebacks (CPUE=0.61) (Appendix B2). Arctic char appeared to be more abundant in the upper water column based on higher catch rates in floating gill nets. Floating and sinking gill net CPUE were 1.62 and 0.53, respectively. This is consistent with previous findings by Engel (1969) which showed that Arctic char generally occupy surface waters during the fall. Of the 25 lakes surveyed in 1993, Falcon Lake supported the highest catch rate of Arctic char (Appendix B2). Arctic char were present in Falcon Lake during the Department survey conducted in 1965, however, catch and effort data were not summarized.

Age was estimated for 53 of the 65 Arctic char sampled from Falcon Lake (Table 3). Sampled fish ranged from ages 3 to 7, and age 5 fish were most abundant (43%) followed by age 4 fish (30%). Lengths and weights ranged from 239 to 432 mm and 135 to 855 g. The sex ratio favored males which comprised 60% of the sample.

TABLE 3.—Lengths and weights at age for Arctic char captured in Falcon Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
3	1	-	-	239	-	-	135
4	16	298.3	10.5	248-379	277.7	32.6	155-555
5	23	320.5	9.7	252-430	344.3	32.4	155-770
6	9	358.6	16.3	268-432	491.1	67.4	200-855
7	4	347.3	19.8	294-390	417.5	61.4	260-560
Total	53	320.7	6.8	239-432	350.7	23.2	135-855

Jay Lake

Jay Lake (60°43.1'N, 150°22.4'W) is located in the Moose River watershed 8.2 km southeast from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). The Service collected limited water quality data from this lake in 1978 (U.S. Fish and Wildlife Service, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on July 27-28, 1993.

Jay Lake has a surface area of 26 ha and a maximum depth of 4.6 m (Appendix A8). A survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present.

Water temperature ranged from 22.5 to 18.5°C from the top to the bottom of the water column. Dissolved oxygen ranged from 8.1 mg/L 2.0 m below the water surface to 6.1 mg/L near the lake bottom. Conductivity (12 μmho), alkalinity (2 mg/L), hardness (3 mg/L), and water transparency (3.7 m) were among the lowest values measured in lakes surveyed during 1993 (Appendix B1). Lake water pH was 6.7.

Threespine stickleback and sculpin were present in Jay Lake. Twelve minnow traps were fished for a total of 174.58 h resulting in a catch of 89 threespine sticklebacks (CPUE=0.51) (Appendix B2). Sculpin *Cottus* spp. were observed in the lake, but none were captured. Four gill nets were fished for a total of 58.33 h, and no fish were captured.

Jigsaw Lake

Jigsaw Lake (60°44.3'N, 150°29.8'W) is located in the Swanson River watershed 2.0 km south from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). The Service collected limited water chemistry and fishery resource data from this lake in 1989 (Jones et al. 1996). We collected bathymetric, water chemistry, and fishery resource data on October 20-21, 1993.

Jigsaw Lake has a surface area of 47 ha and a maximum depth of 16.5 m (Appendix A9). A survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present.

Water temperature and dissolved oxygen were 5.0°C and 11.5 mg/L throughout the water column. Conductivity was not measured due to equipment failure. Alkalinity (1 mg/L) and hardness (1 mg/L) were among the lowest measured in lakes surveyed during 1993 (Appendix B1). Lake water pH was 6.3, and water transparency was 4.9 m.

We fished six gill nets for a total of 127.33 h, and no fish were captured. Fourteen minnow traps were fished for a total of 308.00 h resulting in a catch of 238 threespine sticklebacks (CPUE=0.77) (Appendix B2). Only threespine stickleback were documented in this lake during 1989 (Jones et al. 1996).

Kakoon Lake

Kakoon Lake (60°56.3'N, 150°26.7'W) is located in the Seven Egg Creek watershed 20.0 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Kakoon Lake on August 11-12, 1993. This lake was previously unsurveyed.

Kakoon Lake has a surface area of 18 ha and a maximum depth of 4.9 m (Appendix A10). Topographic maps show an outlet at the northwest corner of Kakoon Lake linked to Kraenberi Lake and an inlet at the south end connected to an unnamed lake. During a ground survey, we located only a dry 0.5-m wide by 0.5-m deep channel at the northwest corner of the lake and a grassy floodway between Kakoon Lake and the unnamed lake 0.4 km to the south.

Water temperature and dissolved oxygen ranged from 19.5 to 18.5°C and 8.6 to 7.7 mg/L from the top to the bottom of the water column. Conductivity (22 μmho), alkalinity (3 mg/L), and hardness (4 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 6.8, and water transparency was 4.9 m.

Threespine stickleback were observed in Kakoon Lake. However, no fish were captured in two gill nets fished for a total of 27.25 h, and 10 minnow traps fished for a total of 133.42 h (Appendix B2).

Kenaitze Lake

Kenaitze Lake (60°55.3'N, 150°25.7'W) is located in the Seven Egg Creek watershed 18.0 km north from the Swanson River Canoe Trail entrance at Paddle Lake and 1.0 km southeast from Kakoon Lake (Figure 1). The Service collected limited water chemistry and fishery resource data from this lake in 1977 (U.S. Fish and Wildlife Service, unpublished

data). We collected bathymetric, water chemistry, and fishery resource data on August 2-3, 1993.

Kenaitze Lake has a surface area of 41 ha and a maximum depth of 9.4 m (Appendix A11). A dry, 0.8-m wide channel at the southeast corner of Kenaitze Lake was located during a ground survey. It could potentially tie Kenaitze Lake to a smaller, unnamed lake 0.1 km to the south if lake water levels were extremely high.

Water temperature and dissolved oxygen ranged from 19.6 to 12.0°C and 8.6 to 1.3 mg/L from the top to the bottom of the water column. Conductivity (19 μmho), alkalinity (3 mg/L), and hardness (3 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 6.8, and water transparency was 5.4 m.

Threespine stickleback were the only fish species captured in Kenaitze Lake. Fourteen minnow traps were fished for a total of 194.00 h resulting in a catch of eight threespine sticklebacks (CPUE=0.04) (Appendix B2). Six gill nets were fished for a total of 80.75 h, and no fish were captured. A single gill net was also fished for 24 hours by the Service during a 1977 survey of the lake (U.S. Fish and Wildlife Service, unpublished data). No fish were captured.

Kraenberi Lake

Kraenberi Lake (60°58.0'N, 150°28.0'W) is located in the Seven Egg Creek watershed 22 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). The Department collected limited fishery resource data from this lake in 1964 (Alaska Department of Fish and Game, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on August 10-11, 1993.

Kraenberi Lake has a surface area of 22 ha and a maximum depth of 7.9 m (Appendix A12). It is linked to Angler Lake, 0.1 km to the east, by a 4.5-m wide by 0.6-m deep channel and to Seven Egg Creek by a channel at the northwest corner of the lake. The channel to Seven Egg Creek was blocked by thick vegetation at the time of this survey, but is probably available for fish passage during high water periods or in the spring prior to the proliferation of dense aquatic vegetation. A channel connecting the northwest corner of Kakoon Lake to the south end of Kraenberi Lake is indicated on topographic maps, but only a dry channel was found leading from Kakoon Lake. A 1.5-m wide by 0.6-m deep channel of undetermined length was present at the south end of Kraenberi Lake. Gravel and detectable flow were not present in any of these channels.

Water temperature ranged from 20.0 to 4.0°C from the top to the bottom of the water column. Dissolved oxygen ranged from 8.4 mg/L near the water surface to 9.3 mg/L 9.0 m below the water surface and 2.9 mg/L near the lake bottom. Conductivity (86 μmho),

alkalinity (35 mg/L), and hardness (37 mg/L) were higher than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.3, and water transparency was 4.6 m.

The Department documented the presence rainbow trout and threespine stickleback in 1964 (Alaska Department of Fish and Game, unpublished data). Our catches also consisted of rainbow trout and threespine stickleback. We fished four gill nets for a total of 54.66 h resulting in a catch of 44 rainbow trout (CPUE=0.80), and 12 minnow traps were fished for a total of 170.42 h resulting in a catch of 36 threespine sticklebacks (CPUE=0.21) (Appendix B2). Rainbow trout appeared to be more abundant in the upper water column based on higher catch rates in floating gill nets. Floating and sinking gill net CPUE were 1.13 and 0.48, respectively.

Age was estimated for 41 of the 44 rainbow trout sampled from Kraenberi Lake (Table 4). Sampled fish ranged from ages 3 to 5, and age 4 fish were most abundant (59%) followed by age 3 fish (32%). The high proportion younger-aged fish in the recruitment is occurring to the population. Lengths and weights ranged from 233 to 489 mm and 150 to 935 g. The sex ratio favored females which comprised 68% of the sample.

TABLE 4.—Lengths and weights at age for rainbow trout captured in Kraenberi Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
3	13	288.5	8.8	233-333	290.4	24.3	150-440
4	24	356.3	9.4	285-489	523.8	29.9	305-885
5	4	396.0	13.0	372-433	736.3	73.1	600-935
Total	41	338.7	8.4	233-489	470.5	29.4	150-935

Kuguyuk Lake

Kuguyuk Lake (60°58.5'N, 150°26.8'W) is located in the Seven Egg Creek watershed 24.3 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Kuguyuk Lake on October 4-5, 1993. This lake was previously unsurveyed.

Kuguyuk Lake has a surface area of 28 ha and a maximum depth of 6.7 m (Appendix A13). It is connected to Angler Lake, 0.6 km to the south, by a 6-m wide by 1-m deep channel and to an unnamed lake, 0.2 km to the northeast, by a 6-m wide by 0.5-m deep channel. The channel leading to Angler Lake was blocked by a 0.2-m high beaver dam. Detectable flow and gravel suitable for rainbow trout spawning were not present in this channel. The out-flowing channel at the northeast corner of Kuguyuk Lake was also blocked by a 1-m tall beaver dam at the lake outlet. Flow was visually estimated to be less than 0.3 m^3/s, and the

substrate was partially composed of gravel. However, the suitability of this channel for potential rainbow trout spawning was judged to be poor because the substrate was heavily silted.

Water temperature and dissolved oxygen were consistently 5.0°C and 11.3 mg/L throughout the water column. Conductivity (53 μmho), alkalinity (22 mg/L), and hardness (23 mg/L) were near the mean values for lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.4, and water transparency was 6.8 m.

Four gill nets were fished for a total of 51.17 h resulting in a catch of 48 rainbow trout (CPUE=0.94), and 12 minnow traps were fished for a total of 207.17 h resulting in a catch of 194 threespine sticklebacks (CPUE=0.94) (Appendix B2). Based on nearly equal catch rates for gear types, rainbow trout appeared to be equally abundant throughout the water column. Floating and sinking gill net CPUE were 0.95 and 0.94, respectively.

Age was estimated for 47 of the 48 rainbow trout sampled from Kuguyuk Lake (Table 5). Sampled fish ranged from ages 3 to 5, and age 4 fish were most abundant (70%) followed by age 3 fish (26%). The high proportion younger-aged fish in the sample indicates recruitment is occurring to the population. Recruitment is probably occurring from Seven Egg Creek through Angler and Kraenberi Lakes. Lengths and weights ranged from 212 to 412 mm and 100 to 818 g. Females comprised 86% of the sample for which sex was determined (N=35).

TABLE 5.—Lengths and weights at age for rainbow trout captured in Kuguyuk Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
3	12	304.6	17.0	226-381	350.8	60.7	100-770
4	33	322.1	9.4	212-412	430.5	38.1	100-818
5	2	380.5	10.5	370-391	610.0	40.0	570-650
Total	47	320.1	8.1	212-412	417.8	31.6	100-818

Lili Lake

Lili Lake (60°39.5'N, 150°48.8'W) is located in the Moose River watershed approximately 0.7 km east from km 15.8 of Swanson River Road (Figure 1). The Department collected fishery resource data from this lake in 1965 (Alaska Department of Fish and Game, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on September 28-29, 1993.

Lili Lake has a surface area of 24 ha and a maximum depth of 7.9 m (Appendix A14). An outlet channel connects Lili Lake to a small, unnamed lake 0.1 km to the southeast, which

drains into marshland. This channel was 0.5-m wide by 0.2-m deep, and flow was visually estimated to be less than 0.02 m^3/s. Gravel suitable for rainbow trout spawning was not present in this channel, and flow is probably absent during dry periods.

Water temperature and dissolved oxygen ranged from 7.0 to 7.5°C and 10.6 to 10.3 mg/L from the top to the bottom of the water column. Conductivity (42 μmho) and alkalinity (20 mg/L) were near, and hardness (29 mg/L) was higher than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.1, and water transparency was 4.8 m.

We fished four gill nets for a total of 81.08 h, and no fish were captured. Twelve minnow traps were fished for a total of 245.25 h resulting in a catch of 322 threespine sticklebacks (CPUE=1.31) (Appendix B2). Only threespine stickleback were documented in this lake prior to 1993 (Alaska Department of Fish and Game, unpublished data).

Middle Finger Lake

Middle Finger Lake (60°38.7'N, 150°53.8'W) is located in the Swanson River watershed approximately 3.0 km southwest from km 15.8 of Swanson River Road (Figure 1). Fishery resource data were previously collected from this lake by the Department in 1964 and 1965 (Alaska Department of Fish and Game, unpublished data) and by the Service in 1966, 1975, (U.S. Fish and Wildlife Service, unpublished data) and 1984 (Friedersdorff 1985). The Service also measured water quality parameters and produced a bathymetric map of the lake in 1984. We collected water chemistry and fishery resource data on October 18-19, 1993.

Middle Finger Lake has a surface area of 66 ha and a maximum depth of 23.2 m (Friedersdorff 1985). It is connected to East Finger Lake, 0.1 km to the west, by a 0.7-m wide by 0.2-m deep inlet channel. Flow was visually estimated to be less than 0.05 m^3/s, and the substrate was composed partially of one to five-cm diameter gravel.

In October, 1993, water temperature and dissolved oxygen ranged from 7.5 to 7.0°C and 10.4 to 10.2 mg/L from near the top to the bottom of the water column. Conductivity (28 μmho), alkalinity (2 mg/L), and hardness (1 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.0, and water transparency was 9.0 m.

Previous surveys documented Arctic char, longnose sucker, threespine stickleback, coastrange sculpin, and Arctic lamprey in Middle Finger Lake (Friedersdorff 1985). Historical gill net catches ranged from 0.45 to 1.25 Arctic char per net hour and from <0.01 to 0.48 longnose sucker per net hour.

We fished two gill nets for a total of 43.17 h resulting in a catch of 18 Arctic char (CPUE=0.42) (Appendix B2). Arctic char appeared to be more abundant in the upper water column based on a higher catch rate in the floating gill net. Floating and sinking gill net CPUE were 0.56 and 0.28, respectively. Minnow traps were not deployed.

Age was estimated for all of the Arctic char sampled from Middle Finger Lake (Table 6). Sampled fish ranged from ages 3 to 7 with age 5 fish being most abundant (59%). Lengths and weights ranged from 146 to 366 mm and 23 to 485 g. Females comprised 56% of the sample for which sex was determined (*N*=16).

TABLE 6.—Lengths and weights at age for Arctic char captured in Middle Finger Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
3	2	140.5	5.5	135-146	24.0	1.0	23-25
4	3	267.0	23.5	251-294	176.7	55.1	140-240
5	10	290.4	29.8	251-349	261.5	100.6	140-460
6	2	335.5	43.1	305-366	387.5	137.9	290-485
7	1	-	-	313	-	-	290
Total	18	276.1	13.8	135-366	236.6	29.8	23-485

Mosquito Lake

Mosquito Lake (60°38.2'N, 150°48.7'W) is located in the Moose River watershed approximately 0.1 km east from km 12.5 of Swanson River Road (Figure 1). Fishery resource data were previously collected from this lake by the Department in 1963 (Alaska Department of Fish and Game, unpublished data) and by the Service in 1974, 1975 (U.S. Fish and Wildlife Service, unpublished data) and 1984 (Friedersdorff 1985). The Service also measured water quality parameters and produced a bathymetric map of the lake in 1984. We collected water chemistry and fishery resource data on September 30 and October 1, 1993.

Mosquito Lake has a surface area of 28 ha and a maximum depth of 12.5 m (Friedersdorff 1985). An outlet channel links Mosquito Lake to Silver Lake 0.6 km to the north, which is connected to the West Fork Moose River. This channel was 0.5-m wide by 0.2-m deep, and flow was visually estimated to be less than 0.02 m^3/s. Gravel suitable for rainbow trout spawning was not present in this channel, and Friedersdorff (1985) reported that this channel is probably intermittent during dry periods. In 1963, the channel was partially obstructed by a beaver dam (Alaska Department of Fish and Game, unpublished data); in 1975 the dam completely obstructed fish migration (U.S. Fish and Wildlife Service, unpublished data); and Friedersdorff (1985) suggested the 1964 earthquake may have shifted land structure or created fissures altering the water flow to and from the lake.

Water temperature and dissolved oxygen ranged from 7.5 to 7.0°C and 10.3 to 10.0 mg/L from the top to the bottom of the water column. Conductivity (38 μmho) was lower than, and alkalinity (13 mg/L) and hardness (17 mg/L) were near mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.0, and water transparency was 4.2 m.

Previous surveys documented rainbow trout, coho salmon, and threespine stickleback in Mosquito Lake. In 1963, gill net catch rates for rainbow trout and coho salmon were 0.28 and 0.23 fish per net hour, respectively (Alaska Department of Fish and Game, unpublished data). In 1974, only 3 age 8+ rainbow trout were captured after 44 h of gill net effort (U.S. Fish and Wildlife Service, unpublished data). Only sticklebacks were found during subsequent surveys (Friedersdorff 1985; U.S. Fish and Wildlife Service, unpublished data).

We fished four gill nets for a total of 75.33 h resulting in a catch of one coho salmon. The coho salmon was a male weighing 820 g. Length (417 mm) at age (8 years old) indicated the fish was a nonanadromous residual. Eleven minnow traps were fished for a total of 213.50 h resulting in a catch of 294 threespine sticklebacks (CPUE=1.38) (Appendix B2).

Rainbow trout that once inhabited this lake (Friedersdorff 1985; Alaska Department of Fish and Game, unpublished data) now appear to be absent and only remnant numbers of coho salmon remain. The presence of an age 8 coho salmon suggests that access to suitable spawning habitat and the Moose River has been blocked for several years. As indicated during previous surveys, this blockage is probably the result of beaver activity, the 1964 earthquake, or a combination of both.

Neckshortka Lake

Neckshortka Lake (60°57.8'N, 150°23.6'W) is located in the Seven Egg Creek watershed 23.2 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Fishery resource data were previously collected from this lake by the Department in 1969 (Alaska Department of Fish and Game, unpublished data). The Service also collected fishery resource data and measured water quality parameters in 1983 (Friedersdorff and Jakubas 1984b). We collected bathymetric, water chemistry and fishery resource data on August 5-6, 1993.

Neckshortka Lake has a surface area of 52 ha and a maximum depth of 8.2 m (Appendix A15). A survey of the lake perimeter by boat in 1993 indicated that no inlets or outlets to streams or other lakes were present. An intermittent inlet and outlet were noted in 1969 (Friedersdorff and Jakubas 1984b), but no evidence of these were found in 1983. These channels probably deteriorated through eutrophication.

Water temperature ranged from 19.5 to 14.0°C from the top to the bottom of the water column. Dissolved oxygen ranged from 9.0 mg/L near the water surface to 9.1 mg/L at depths of 2.0 and 3.0 m and 2.1 mg/L near the lake bottom. Conductivity (68 μmho), alkalinity (28 mg/L), and hardness (30 mg/L) were higher than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.5, and water transparency was 4.6 m.

Previous surveys documented rainbow trout and threespine stickleback in Neckshortka Lake (Friedersdorff and Jakubas 1984b; Alaska Department of Fish and Game, unpublished

data). Gill net catch rate in 1969 and 1983 was 0.50 rainbow trout per net hour during both years.

We fished six gill nets for a total of 81.83 h resulting in a catch of 10 rainbow trout (CPUE=0.12), and 14 minnow traps were fished for a total of 183.67 h resulting in a catch of 12 threespine sticklebacks (CPUE=0.07) (Appendix B2). Based on near equal catch rates for gear types, rainbow trout appeared to be equally abundant throughout the water column. Floating and sinking gill net CPUE were 0.10 and 0.15, respectively.

Age was estimated for all of the rainbow trout sampled from Neckshortka Lake (Table 7). Sampled fish ranged from ages 4 to 7, and age 6 fish were most abundant (50%) followed by age 5 fish (30%). Lengths and weights ranged from 353 to 532 mm and 575 to 1,725 g. A 1:1 sex ratio was present in the sample.

TABLE 7.—Lengths and weights at age for rainbow trout captured in Neckshortka Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
4	1	-	-	475	-	-	1,200
5	3	400.0	34.4	353-467	805.0	198.4	575-1,200
6	5	496.8	8.8	487-532	1,350.0	54.8	1,200-1,500
7	1	-	-	475	-	-	1,725
Total	10	467.0	17.8	353-532	1,209.0	113.1	575-1,725

Friedersdorff and Jakubas (1984b) indicated that spawning habitat was not available to Neckshortka Lake rainbow trout and suggested the population was declining in 1983. Age distribution in our sample from Neckshortka Lake (Table 7); a low catch rate (CPUE=0.12) relative to those in 1969 (CPUE=0.50) and 1983 (CPUE=0.50); and the apparent absence of flowing channels also indicate a declining population. However, all the fish in our catch were from parent years later than 1983 which suggests the possibility of interchange between Neckshortka and Angler Lakes through a seasonal or intermittent channel hidden by densely-matted vegetation.

Phalarope Lake

Phalarope Lake (60°55.3'N, 150°23.8'W) is located in the Seven Egg Creek watershed 18.4 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). The Department collected bathymetric and fishery resource data from this lake in 1969 (Alaska Department of Fish and Game, unpublished data). We collected bathymetric, water chemistry, and fishery resource data from Phalarope Lake on August 13-14, 1993.

Phalarope Lake has a surface area of 149 ha and a maximum depth of 11.0 m (Appendix A16). Although the Department identified an intermittent outlet at the north end of the lake in 1969, a survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present in 1993.

Water temperature and dissolved oxygen ranged from 19.0 to 9.0°C and 8.6 to 2.9 mg/L from the top to the bottom of the water column. Conductivity (43 μmho) was near and alkalinity (6 mg/L) and hardness (8 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.0, and water transparency was 5.9 m.

The Department documented rainbow trout and threespine stickleback in Phalarope Lake in 1969 (Alaska Department of Fish and Game, unpublished data). Two gill nets were set overnight resulting in a catch of two mature rainbow trout.

We captured only threespine stickleback in 1993. Sixteen minnow traps were fished for a total of 188.58 h resulting in a catch of two threespine sticklebacks (CPUE=0.01) (Appendix B2). Six gill nets were fished for a total of 70.92 h, and no fish were captured.

Our catch data suggest rainbow trout that once inhabited Phalarope Lake are now absent. Two rainbow trout captured by the Department in 1969 indicated a residual population and is evidence that Phalarope Lake was once linked to spawning habitat or a stream which allowed immigration. The absence of channels connected to the lake indicate spawning habitat is no longer available, possibly a result of eutrophication or the 1964 earthquake.

Tangerra Lake

Tangerra Lake (60°58.1'N, 150°21.9'W) is located in the Dipper Creek watershed 24.8 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Fishery resource data were previously collected from this lake by the Department in 1969 (Alaska Department of Fish and Game, unpublished data) and by the Service in 1975 (U.S. Fish and Wildlife Service, unpublished data) and 1984 (Friedersdorff 1985). The Service also measured water quality parameters and produced a bathymetric map of the lake in 1984. We collected water chemistry and fishery resource data on October 5-6, 1993.

Tangerra Lake has a surface area of 70 ha and a maximum depth of 13.7 m (Friedersdorff 1985). We were able to locate only one of the two channels that Friedersdorff (1985) found connecting Tangerra Lake to other lakes. This outlet channel is located at the northern end of the lake and was 0.5-m wide by 0.2-m deep. Flow was visually estimated to be less than 0.03 m^3/s. Gravel suitable for rainbow trout spawning was not present in this channel.

Water temperature and dissolved oxygen ranged from 7.0 to 6.5°C and 10.6 to 9.3 mg/L from the top to the bottom of the water column. Conductivity (65 μmho), alkalinity (32 mg/L), and hardness (33 mg/L) were higher than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.3, and water transparency was 4.6 m.

Previous surveys documented rainbow trout, threespine stickleback and coastrange sculpin in Tangerra Lake (Friedersdorff 1985; Alaska Department of Fish and Game, unpublished data; U.S. Fish and Wildlife Service, unpublished data). Gill net catch rates ranged from 0.25 to 0.98 rainbow trout per net hour.

We fished eight gill nets for a total of 112.58 h resulting in a catch of 38 rainbow trout (CPUE=0.33), and 16 minnow traps were fished for a total of 289.08 h resulting in a catch of 379 threespine sticklebacks (CPUE=1.31) (Appendix B2). Based on near equal catch rates for gear types, rainbow trout appeared to be equally abundant throughout the water column. Floating and sinking gill net CPUE were 0.25 and 0.43, respectively.

Age was estimated for 37 of the 38 rainbow trout sampled from Tangerra Lake (Table 8). Sampled fish ranged from ages 3 to 7, and age 6 fish were most abundant (70%). Lengths and weights ranged from 265 to 465 mm and 220 to 1,275 g. The sex ratio favored females which comprised 59% of the sample.

TABLE 8.—Lengths and weights at age for rainbow trout captured in Tangerra Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
3	1	-	-	290	-	-	315
4	1	-	-	305	-	-	350
5	5	335.0	20.1	265-375	483.0	84.3	220-680
6	26	384.2	7.4	315-465	698.4	47.2	365-1,275
7	4	423.8	9.4	400-445	882.5	57.0	735-975
Total	37	377.1	46.2	265-465	669.4	249.2	220-1,275

Although a channel was located at the northern end of Tangerra Lake in 1993, age composition in our rainbow trout sample (Table 8) shows poor recruitment. This channel probably offers limited access to spawning habitat in the Dipper Creek watershed. A high percentage (70%) of age 6 fish, and low percentage (5%) of fish younger than age 5 in our sample suggests poor access to spawning habitat in recent years.

Trigger Lake

Trigger Lake (60°56.5'N, 150°20.8'W) is located in the Bedlam Creek watershed 22.0 km north from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Bathymetric, water chemistry, and fishery resource data were collected from Trigger Lake on August 4-5, 1993. This lake was previously unsurveyed.

Trigger Lake has a surface area of 46 ha and a maximum depth of 11.9 m (Appendix A17). A survey of the lake perimeter by boat indicated that no inlets or outlets to streams or other lakes were present.

Water temperature ranged from 20.0 to 8.0°C from the top to the bottom of the water column. Dissolved oxygen ranged from 9.0 mg/L near the water surface to 12.6 mg/L at a depth of 8.0 m and 2.5 mg/L near the lake bottom. Conductivity (26 μmho), alkalinity (5 mg/L), and hardness (6 mg/L) were lower than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.0, and water transparency was 4.1 m.

Threespine stickleback was the only fish species captured in Trigger Lake. Fourteen minnow traps were fished for a total of 186.75 h resulting in a catch of 16 threespine sticklebacks (CPUE=0.09) (Appendix B2). Six gill nets were fished for a total of 79.58 h, and no fish were captured.

Upper Jean Lake

Upper Jean Lake (60°31.7'N, 150°12.5'W) is located in the Kenai River watershed 0.2 km north from Sterling Highway milepost 62 (Figure 1). Fishery resource data were first collected from this lake by the Department in 1960 and approximately 20 times thereafter until 1983 (Alaska Department of Fish and Game, unpublished data). The Department also collected water chemistry data during this time period. The Service gathered bathymetric, water chemistry, and fishery resource data from Upper Jean Lake in 1983 (Friedersdorff and Jakubas 1984a). We collected water chemistry and fishery resource data on October 14-15, 1993.

Upper Jean Lake has a surface area of 20 ha and a maximum depth of 13.4 m (Friedersdorff and Jakubas 1984a). A channel is indicated on topographic maps linking Upper and Lower Jean Lakes through a series of smaller lakes. This channel was not located during a ground survey of the alleged outlet area and is probably nonexistent.

Water temperature and dissolved oxygen ranged from 7.0 to 6.5°C and 10.6 to 8.8 mg/L from the top to the bottom of the water column. Conductivity (130 μmho), alkalinity (82 mg/L), and hardness (92 mg/L) were the highest values measured among lakes surveyed during 1993 (Appendix B1) and indicate a very productive lake. Lake water pH was 8.1, and water transparency was 6.1 m.

Previous surveys documented rainbow trout, sockeye salmon, coho salmon, threespine stickleback, and slimy sculpin in Upper Jean Lake (Friedersdorff and Jakubas 1984a; Alaska Department of Fish and Game, unpublished data). All sport fish species were nonindigenous to this lake. Rainbow trout were privately introduced prior to 1960 and stocked by the Department 1962, 1963, and 1983. Sockeye salmon were stocked by the Department from 1963 to 1967 and in 1977, and coho salmon were stocked in 1969, 1973, 1975, and 1979.

We fished two gill nets for a total of 40.25 h, and no fish were captured. Of the 25 lakes surveyed in 1993, Upper Jean Lake supported the second highest catch rate of threespine sticklebacks (Appendix B2). Ten minnow traps were fished for a total of 211.33 h resulting in a catch of 707 threespine sticklebacks (CPUE=3.35) (Appendix B2).

Our catch data indicate that rainbow trout, sockeye salmon, and coho salmon stocked in Upper Jean Lake during the 1960's and 70's are no longer present. These population declines resulted from a lack of spawning habitat.

Upper Ohmer Lake

Upper Ohmer Lake (60°27.4'N, 150°17.6'W) is located in the Kenai River watershed 2.5 km northwest from the Upper Skilak Lake Campground (Figure 1). Water chemistry and fishery resource data were previously collected from this lake by the Department in 1969 and the Service in 1974 and 1975 (Alaska Department of Fish and Game, unpublished data; U.S. Fish and Wildlife Service, unpublished data). The Department also gathered bathymetric data in 1960. We collected bathymetric, water chemistry, and fishery resource data on October 12-13, 1993.

Upper Ohmer Lake has a surface area of 7 ha and a maximum depth of 6.4 m (Appendix A18). A 1.2-m wide by 0.3-m deep outlet channel flows into Lower Ohmer Lake, 0.6 km to the west. A 1-m tall beaver dam at the lake outlet, with only a shallow pool below, would probably be a formidable barrier to upstream fish migration. A ground survey was conducted from the lake outlet to a point approximately 200 m downstream. Flow was visually estimated to be less than 0.06 m^3/s, and the substrate was partially composed of gravel. A 1-m wide by 1-m deep inlet was present at the east end of the lake. A ground survey was conducted from the lake inlet to a point approximately 300 m upstream. Flow was visually estimated to be less than 0.06 m^3/s. The suitability of surveyed portions of both the inlet and outlet streams for potential rainbow trout or salmon spawning was judged to be poor, because the substrates were heavily silted.

Water temperature was 6.0°C throughout the water column. Dissolved oxygen ranged from 11.2 mg/L near the water surface, to 10.0 mg/L at a depth of 4.0 m and 10.5 mg/L near the lake bottom. Conductivity (86 μmho), alkalinity (50 mg/L), and hardness (59 mg/L) were higher than mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.5, and water transparency was 6.0 m.

Previous surveys documented rainbow trout, Dolly Varden, coho salmon, and stickleback in Upper Ohmer Lake (Alaska Department of Fish and Game, unpublished data; U.S. Fish and Wildlife Service, unpublished data). Rainbow trout were always predominate in the catch with gill net catch rates of 0.23, 0.17, and 1.12 rainbow trout per net hour in 1960, 1974, and 1975, respectively. Dolly Varden were present in the catch only during 1960 and were nearly as abundant in the catch as rainbow trout (CPUE=0.21 Dolly Varden per net hour in 1960).

We fished two gill nets for a total of 38.75 h resulting in a catch of 91 rainbow trout (CPUE=2.37) and four coho salmon (CPUE=0.10). Ten minnow traps were fished for a total of 207.50 h resulting in a catch of one threespine stickleback (CPUE<0.01) and two

coastrange sculpin (CPUE=0.01) (Appendix B2). Of the 25 lakes surveyed in 1993, Upper Ohmer Lake supported the highest catch rate of rainbow trout (Appendix B2). Rainbow trout appeared to be more abundant in the upper water column based on higher catch rates in floating gill nets. Floating and sinking gill net CPUE were 4.17 and 0.56, respectively. Two coho salmon were captured in each gill net.

Age was estimated for 68 of the 91 rainbow trout sampled from Upper Ohmer Lake (Table 9). Sampled fish ranged from ages 2 to 6, and age 5 fish were most abundant (44%) followed by age 4 fish (37%). Lengths and weights ranged from 105 to 306 mm and 14 to 325 g. Females comprised 74% of the sample for which sex was determined (*N*=87).

TABLE 9.—Lengths and weights at age for rainbow trout captured in Upper Ohmer Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
2	3	110.0	2.6	105-114	15.0	1.0	14-17
3	4	178.0	23.8	108-211	73.5	21.1	14-110
4	25	232.0	3.4	202-264	136.2	5.4	100-190
5	30	250.2	3.8	213-306	170.5	8.6	110-325
6	6	272.2	5.8	255-295	215.8	16.1	180-270
Total	68	235.0	4.8	105-306	149.3	6.9	14-325

Age was not determined for 23 of the 91 rainbow trout sampled from Upper Ohmer Lake. Lengths and weights of unaged fish ranged from 220 to 259 mm and 115 to 280 g. Mean length and weight for these fish were 236.9 mm (SE=2.5) and 147.6 g (SE=7.1). Length-at-age data indicate unaged fish were primarily ages 4 and 5, therefore, these age groups are probably under-represented in Table 9.

Length-at-age data indicate rainbow trout in Upper Ohmer Lake were smaller than those sampled from other lakes during 1993. These fish may be smaller because of competition for food in this small lake. The presence of several age classes of rainbow trout in Upper Ohmer Lake indicates that recruitment is occurring in this population despite the apparent lack of ideal spawning habitat.

Age was estimated for 3 of the 4 coho salmon sampled from Upper Ohmer Lake. Two of the sampled fish were age 4 and one was age 5. Lengths and weights of the aged fished ranged from 238 to 263 mm and 170 to 235 g. Lengths at age indicate these are nonanadromous residuals. The presence of residual coho salmon in this lake indicates it may be intermittently connected to Skilak Lake.

West Finger Lake

West Finger Lake (60°39.0'N, 150°53.9'W) is located in the Swanson River watershed approximately 3.4 km southwest from km 15.8 of Swanson River Road (Figure 1). Bathymetric, limited water chemistry, and fishery resource data were collected from this lake by the Department in 1964 (Alaska Department of Fish and Game, unpublished data), and limited water chemistry data were collected by the Service in 1975 (U.S. Fish and Wildlife Service, unpublished data). We collected water chemistry and fishery resource data on October 18-19, 1993.

Based on results from a survey conducted by the Department during 1964, West Finger Lake had a surface area of approximately 30 ha. What was formally one lake was three separate lakes during our survey. This change is also evident on 1986 edition 1:25,000 scale topographic maps. We surveyed the easternmost West Finger Lake which has a surface area of approximately 11 ha. No inlet or outlet channels were found connecting this lake to other water bodies, although it is possible for the separated portions of West Finger Lake to temporarily rejoin during high water periods. The Department noted that West and Middle Finger Lakes connected during high water. Based on 1993 observations of area topography, these lakes are no longer connected during high water periods. Major physical changes to this lake possibly resulted from the 1964 earthquake.

Water temperature was 6.0°C throughout the water column, and dissolved oxygen ranged from 9.8 to 9.1 mg/L from near the top to the bottom of the water column. Conductivity (41 μmho) was lower than mean values from lakes surveyed in 1993, and alkalinity (1 mg/L) and hardness (1 mg/L) were among the lowest measured (Appendix B1). Lake water pH was 6.9, and water transparency was 4.6 m.

Arctic char, longnose sucker, and stickleback were documented in West Finger during 1964 (Alaska Department of Fish and Game, unpublished data). Stickleback were probably present in the lake, but we did not deploy minnow traps. We fished two gill nets for a total of 37.75 h resulting in a catch of two longnose suckers in the sinking gill net (CPUE=0.05).

Although we did not capture any Arctic char in this lake, this species may be present but not represented in our catch due to inadequate lake coverage and short netting duration. It is also possible that the Arctic char population is declining due to physical changes to the lake with a resulting loss of access to spawning habitat or loss of connecting channels for immigration from Middle Finger Lake.

Wren Lake

Wren Lake (60°48.8'N, 150°22.7'W) is located in the Swanson River watershed 8.9 km northeast from the Swanson River Canoe Trail entrance at Paddle Lake (Figure 1). Water chemistry data were collected from this lake by the Service in 1975 and 1976 (U.S. Fish and Wildlife Service, unpublished data). We collected bathymetric, water chemistry, and fishery resource data on July 29-30, 1993.

Wren Lake has a surface area of 30 ha and a maximum depth of 6.4 m (Appendix A19). Topographic maps show a channel leading to Wilderness Lake, 0.6 km to the north, however, we were unable to locate any channels leading from Wren Lake.

Water temperature and dissolved oxygen ranged from 21.0 to 14.0°C and 8.1 to 8.9 mg/L from the top to the bottom of the water column. Conductivity (48 μmho), alkalinity (16 mg/L), and hardness (19 mg/L) were near the mean values from lakes surveyed in 1993 (Appendix B1). Lake water pH was 7.2, and water transparency was 4.6 m.

Four gill nets were fished for a total of 54.25 h resulting in a catch of 20 rainbow trout (CPUE=0.37). Twelve minnow traps were fished for a total of 162.25 h resulting in a catch of 60 threespine sticklebacks (CPUE=0.37) and six coastrange sculpin (CPUE=0.04) (Appendix B2). Rainbow trout appeared to be more abundant in the upper water column based on higher catch rates in floating gill nets. Floating and sinking gill net CPUE were 0.54 and 0.19, respectively.

Age was estimated for 19 of the 20 rainbow trout sampled from Wren Lake (Table 10). Sampled fish ranged from ages 2 to 7, and age 3 fish were most abundant (37%) followed by age 4 fish (32%). The high proportion younger-aged fish in the sample indicates recruitment is occurring to this population, perhaps through an intermittent connection with Wilderness Lake. Lengths and weights ranged from 102 to 434 mm and 13 to 1,050 g. Males comprised 53% of the sample for which sex was determined (*N*=17).

TABLE 10.—Lengths and weights at age for rainbow trout captured in Wren Lake, Kenai National Wildlife Refuge Alaska, 1993.

		Fork Length (mm)			Weight (g)		
Age	*N*	Mean	SE	Range	Mean	SE	Range
2	2	108.0	6.0	102-114	16.5	3.5	13-20
3	7	250.7	11.1	207-297	169.6	18.0	121-230
4	6	286.0	19.3	226-342	340.3	63.4	150-535
5	1	-	-	302	-	-	353
6	2	413.5	4.5	409-418	940.0	10.0	930-950
7	1	-	-	434	-	-	1,050
Total	19	276.3	20.3	102-434	344.5	72.0	13-1,050

Recommendations

Sport fish species were found in 11 of the 25 lakes surveyed, and populations appear to be stable in eight of the 11 lakes; declining in three of these lakes; and absent in three other lakes that previously supported these species. Although other factors may be involved, population declines are probably a result of limited access to spawning habitat or loss of spawning habitat. In six lakes, spawning habitat loss appears to be natural. In Upper Jean Lake, fish were stocked where spawning habitat was unavailable.

The following summarizes the current status of sport fish populations in the lakes we surveyed and provides recommendations for future management direction. Recommendations are based on our results and make no attempt to integrate other management issues.

- Angler, Kraenberi, Kuguyuk, and Wren Lakes—Gill net catch rates and age distribution in our samples indicate healthy populations of rainbow trout which are capable of supporting increased angler effort. A lower catch rate of rainbow trout in Wren Lake suggests this lake may be capable of supporting only a limited increase in angler effort. Although Angler, Kraenberi, and Kuguyuk Lakes are capable of supporting increased angler effort, they are traditionally used each year by nesting trumpeter swans (Theodore Bailey, Kenai National Wildlife Refuge, personal communication). In order to protect the nesting and rearing habitat of trumpeter swans, refuge regulations do not authorize the landing of aircraft on lakes used by nesting trumpeter swans and their broods.
- Upper Ohmer Lake—This lake supports good numbers of rainbow trout that are small in size. Upper Ohmer Lake is capable of supporting increased angler effort, however, it could be over-exploited easily due to its small size (7 ha). The small size of rainbow trout in this lake might also be undesirable to some anglers. Small numbers of residual coho salmon are present in Upper Ohmer Lake but are not abundant enough to attract anglers. However, their presence does indicate an intermittent connection with Skilak Lake.
- Tangerra Lake—This lake currently supports an abundance of older rainbow trout, but the population appears to be in decline due to limited or intermittent access to spawning habitat. Poor recruitment will limit the potential for a long-term recreational fishery.
- Neckshortka Lake—Low gill net catch rates and poor recruitment to the rainbow trout population indicate this lake is probably incapable of supporting a long-term recreational fishery.
- Falcon, East Finger, and Middle Finger Lakes—Gill net catch rates and age distribution data suggest these lakes are capable of supporting increased angling effort for Arctic char.
- West Finger Lake—The absence of Arctic char in our catch indicates West Finger Lake may no longer support a viable population of this species. This apparent decline may have followed changes in lake water levels which have restricted movement among adjacent lakes.
- Upper Jean Lake—Rainbow trout, sockeye salmon, and coho salmon stocked in Upper Jean Lake during the 1960's and 70's are no longer present. Limnological characteristics measured during 1993 indicate that this lake is very productive and capable of supporting a put-grow-and-take fishery.

Acknowledgments

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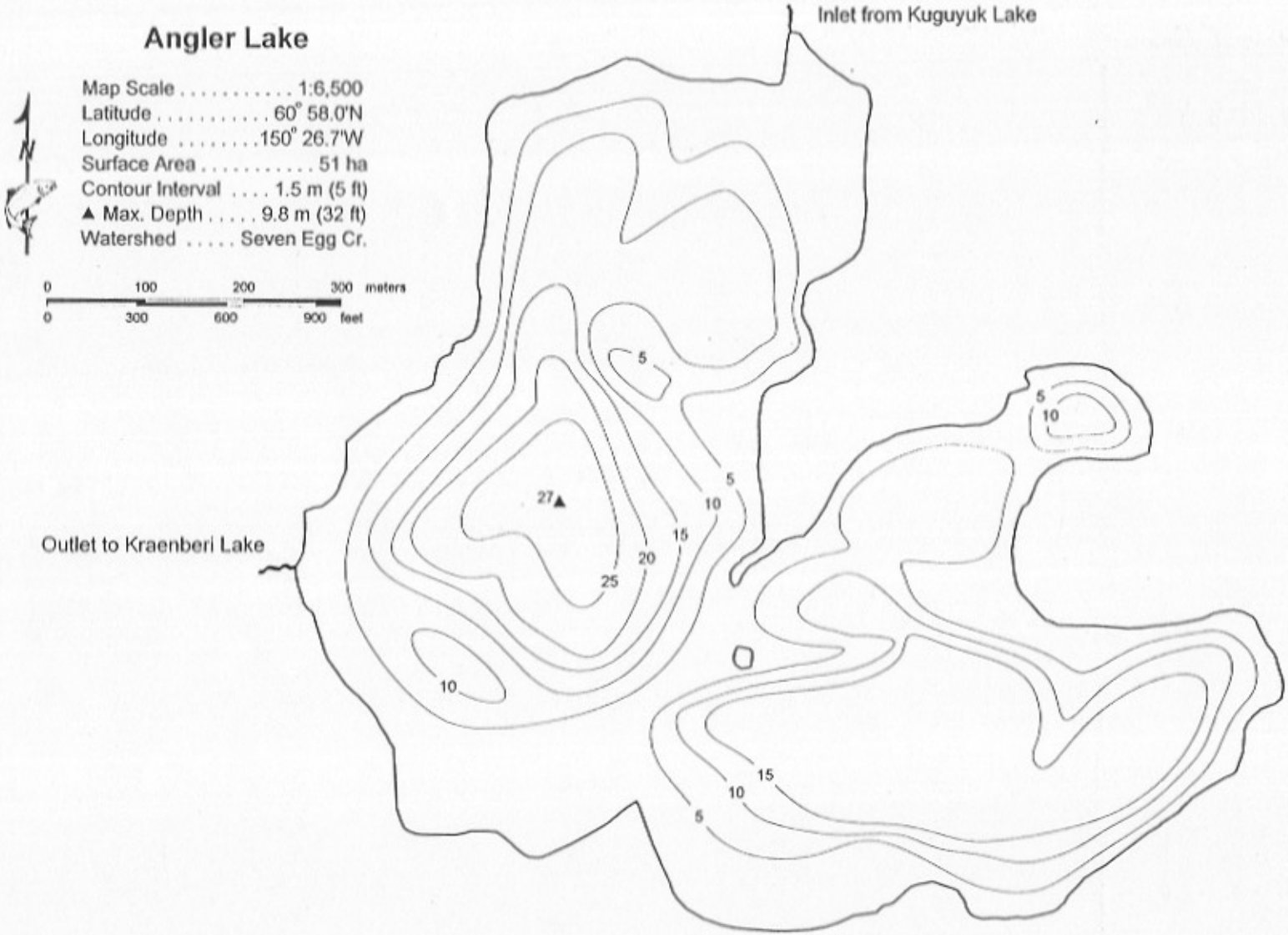
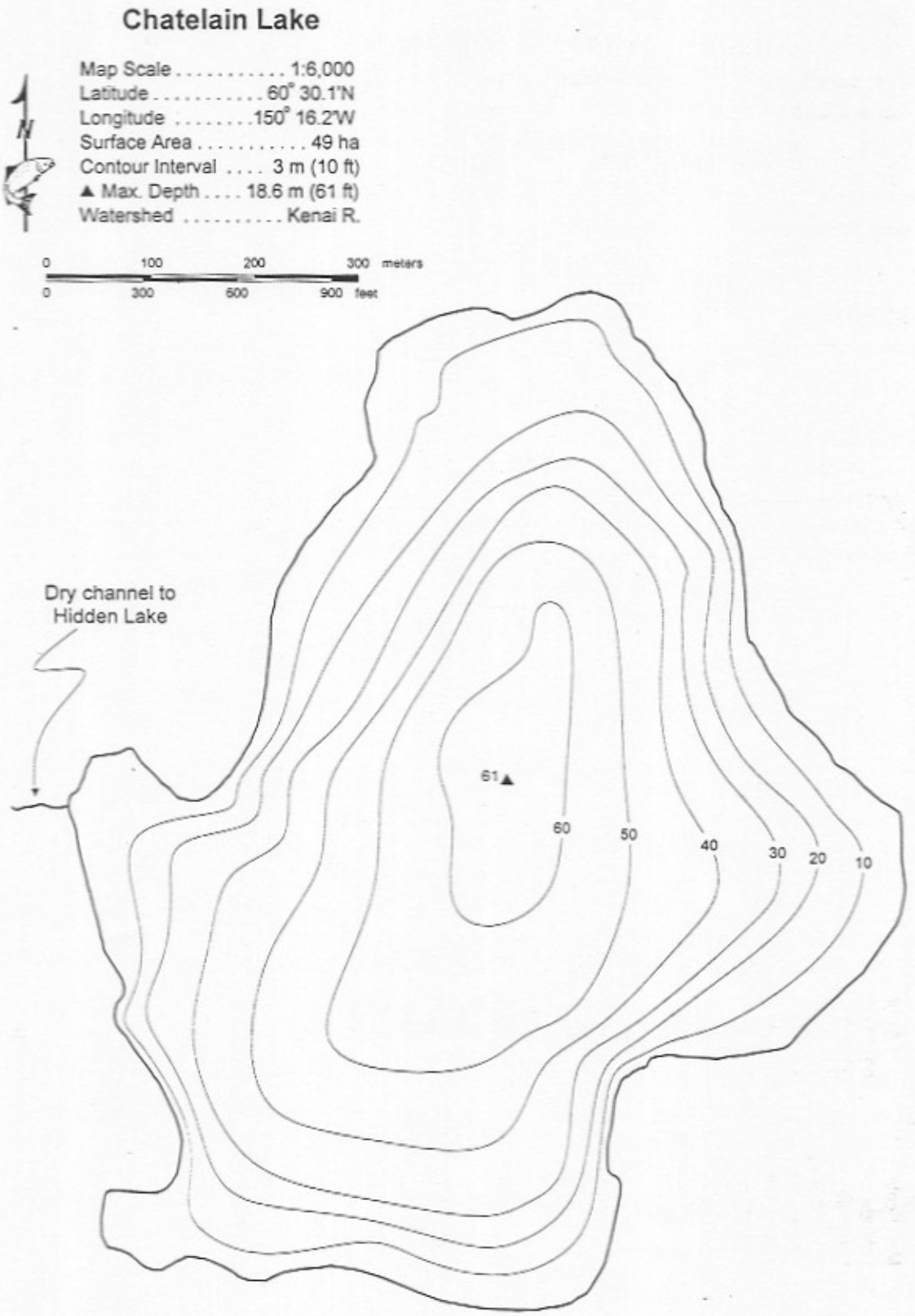
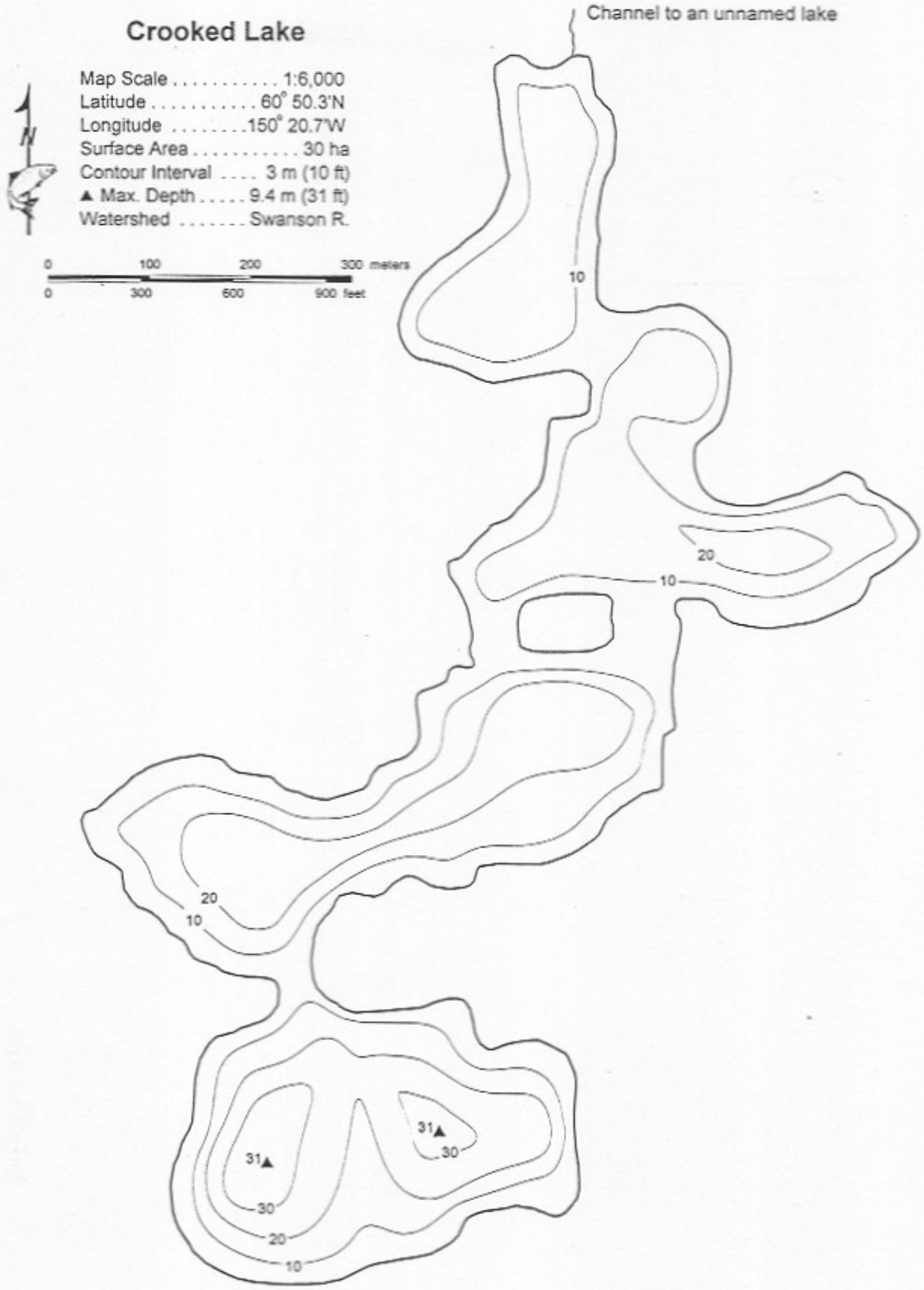


Appendix A1.-Bathymetric map of Angler Lake, Kenai National Wildlife Refuge, Alaska, 1993.



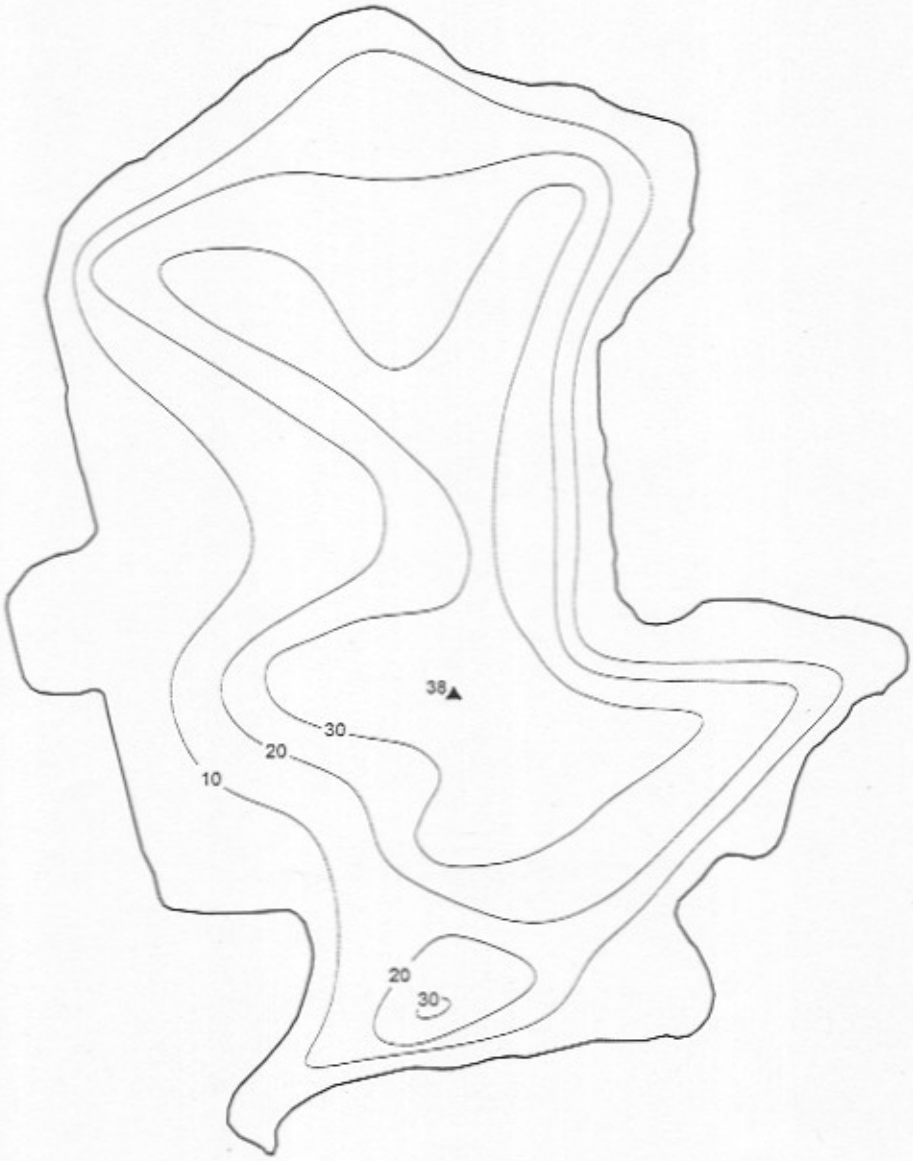
Appendix A2.-Bathymetric map of Chatelain Lake, Kenai National Wildlife Refuge, Alaska, 1993.



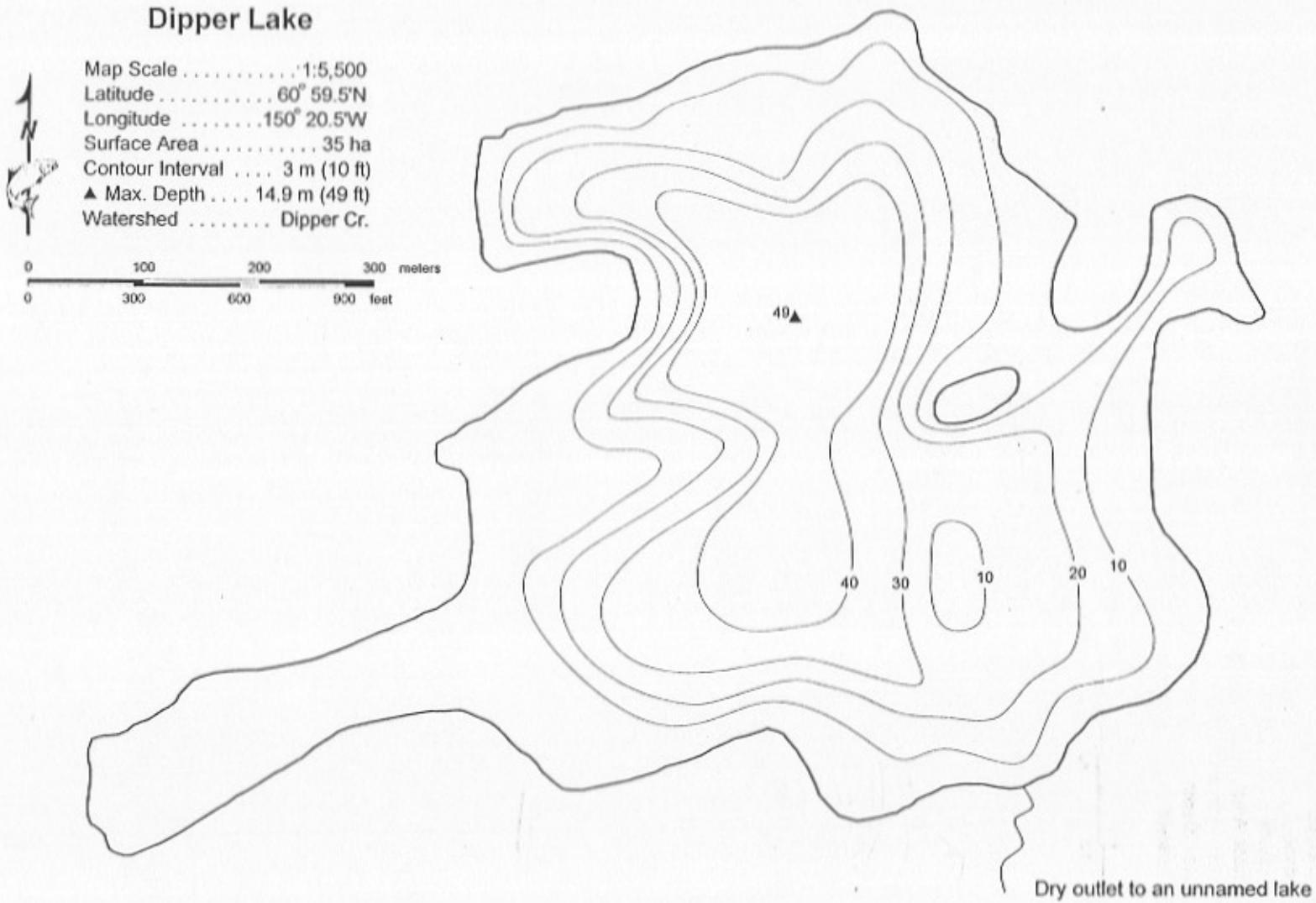
Appendix A3.-Bathymetric map of Crooked Lake, Kenai National Wildlife Refuge, Alaska, 1993.

Dabbler Lake

Map Scale 1:4,600
Latitude . . . . . 60° 41.8'N
Longitude . . . . . .150° 46.4'W
Surface Area . . . . . 22 ha
Contour Interval . . . . 3 m (10 ft)
▲ Max. Depth . . . . 11.6 m (38 ft)
Watershed . . . . . Swanson R.



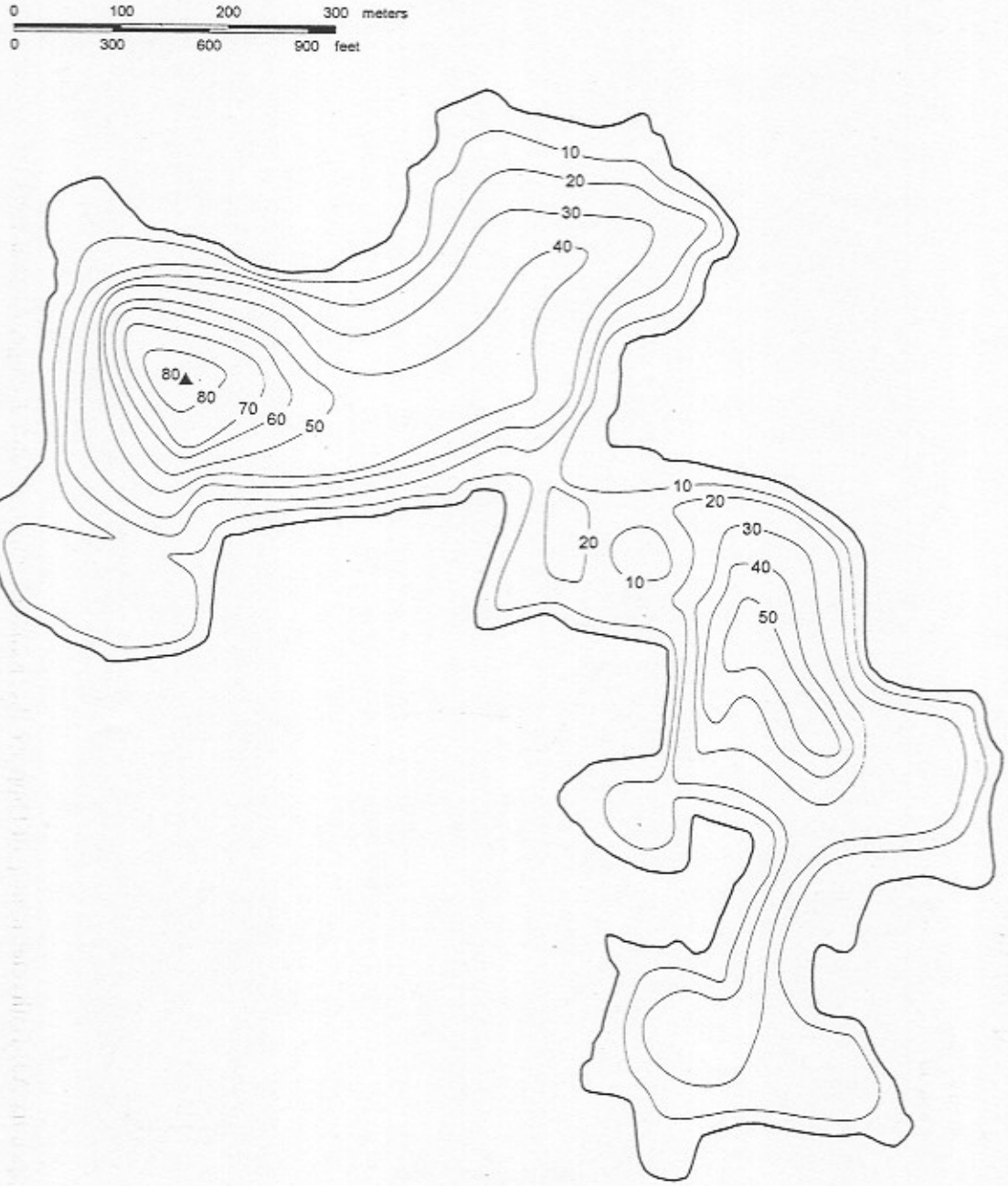
Appendix A4.-Bathymetric map of Dabbler Lake, Kenai National Wildlife Refuge, Alaska, 1993.



Appendix A5.-Bathymetric map of Dipper Lake, Kenai National Wildlife Refuge, Alaska, 1993.

Embryo Lake

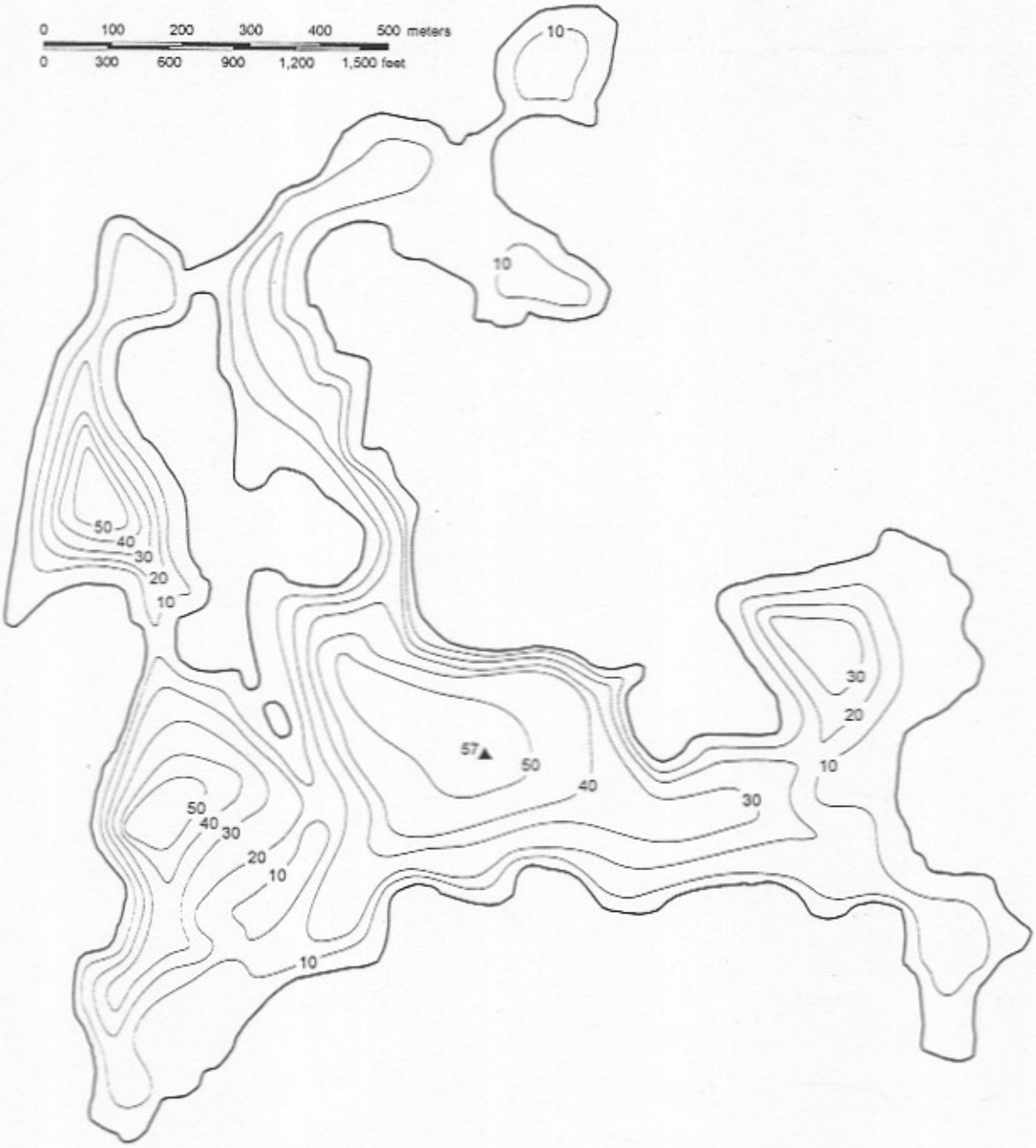
Map Scale 1:6,500
Latitude . . . . . 60° 47.2'N
Longitude . . . . . .150° 26.0'W
Surface Area . . . . . 38 ha
Contour Interval . . . . 3 m (10 ft)
▲ Max. Depth . . . . 24.4 m (80 ft)
Watershed . . . . . Swanson R.



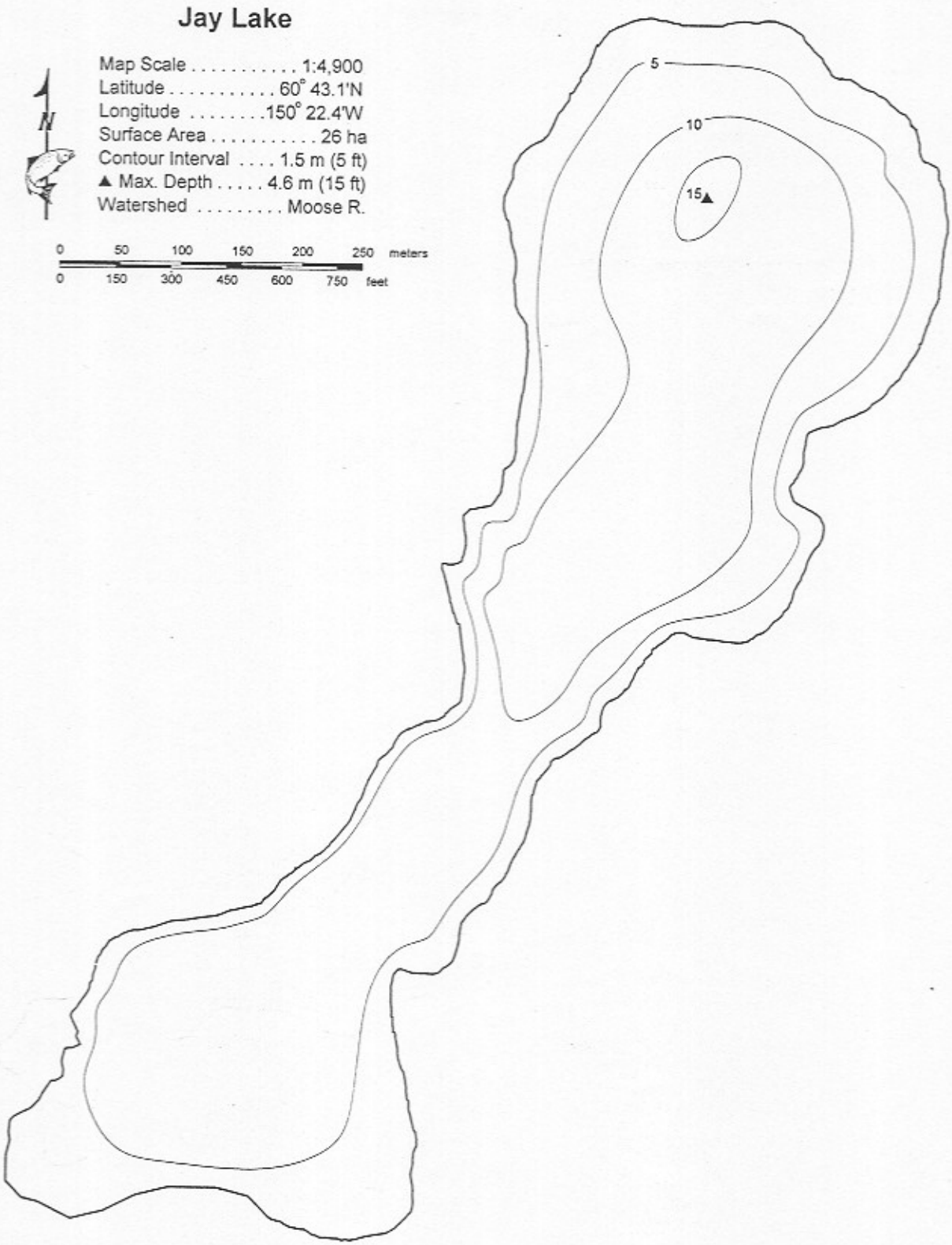
Appendix A6.-Bathymetric map of Embryo Lake, Kenai National Wildlife Refuge, Alaska, 1993.

Falcon Lake

Map Scale 1:9,700
Latitude . . . . . 60° 47.2'N
Longitude . . . . . .150° 23.9'W
Surface Area . . . . . 90 ha
Contour Interval . . . . 3 m (10 ft)
▲ Max. Depth . . . . 17.4 m (57 ft)
Watershed . . . . . Swanson R.

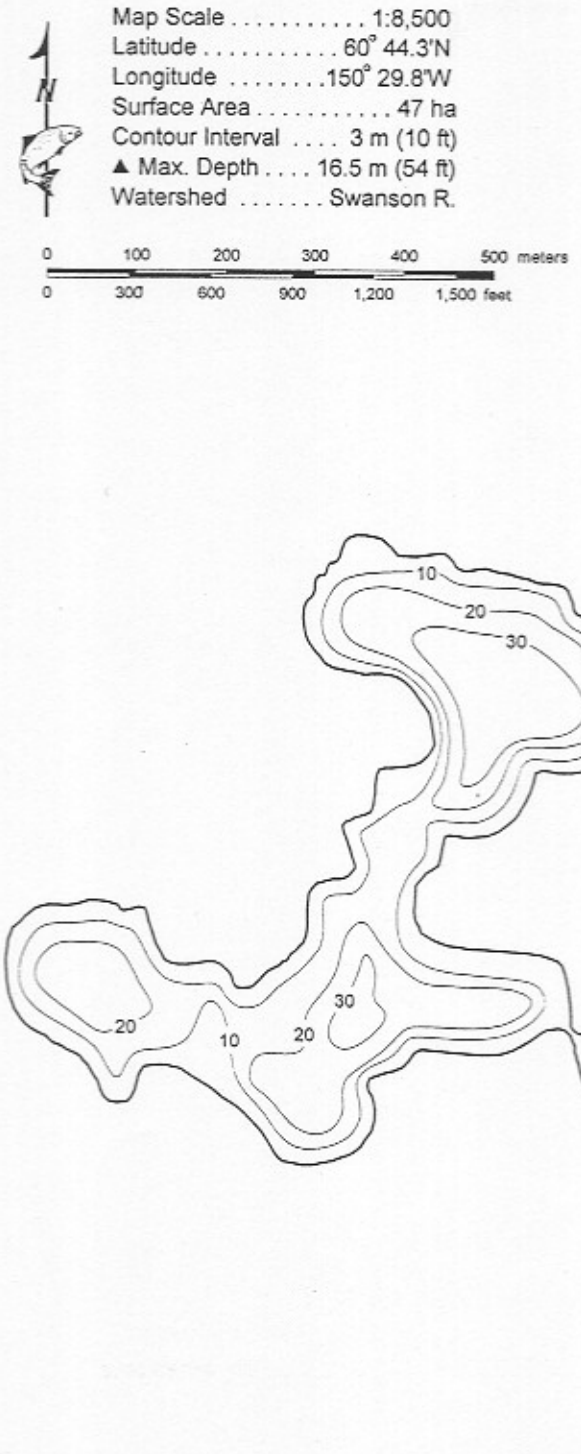


Appendix A7.-Bathymetric map of Falcon Lake, Kenai National Wildlife Refuge, Alaska, 1993.

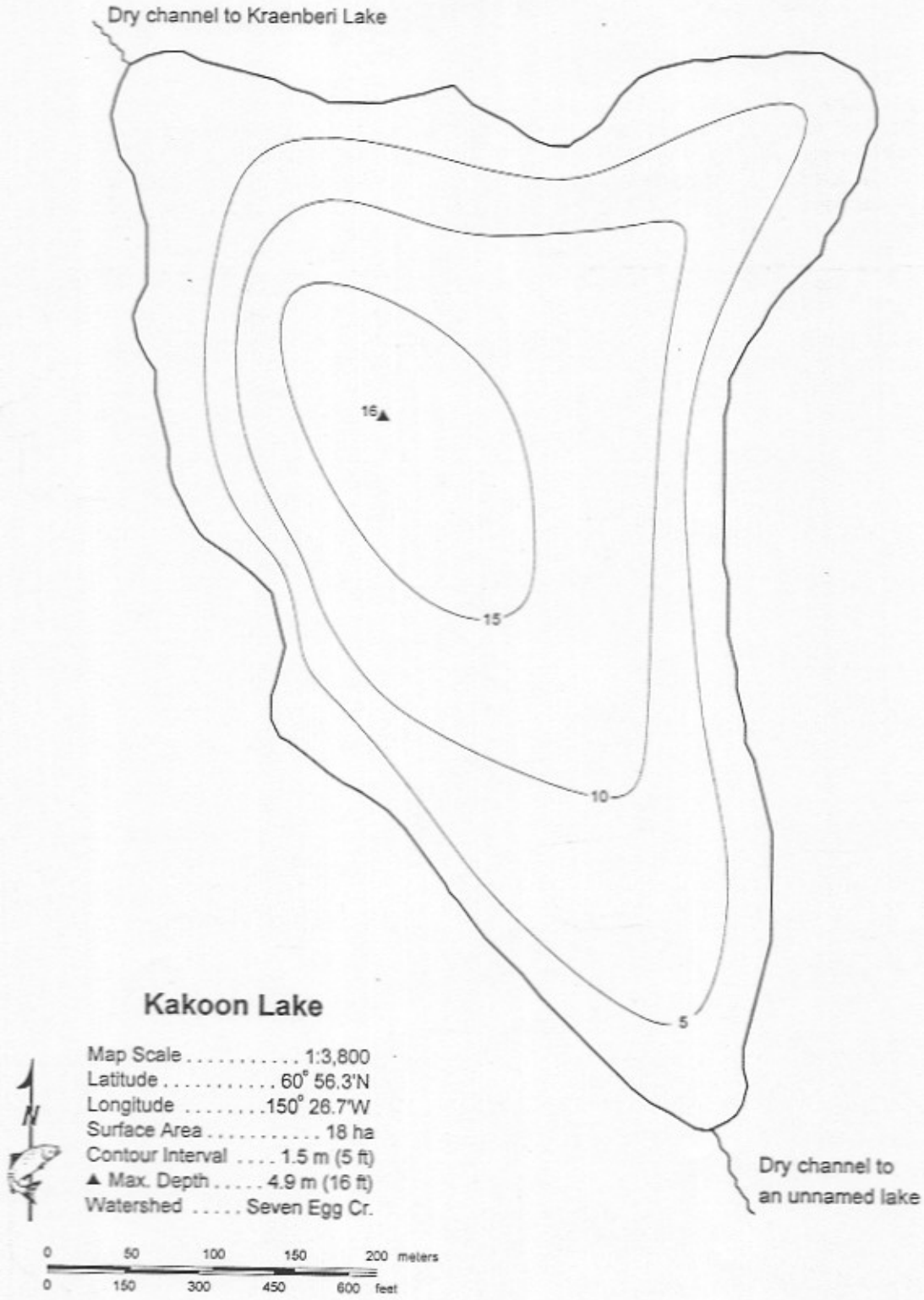


Appendix A8.-Bathymetric map of Jay Lake, Kenai National Wildlife Refuge, Alaska, 1993.

Jigsaw Lake

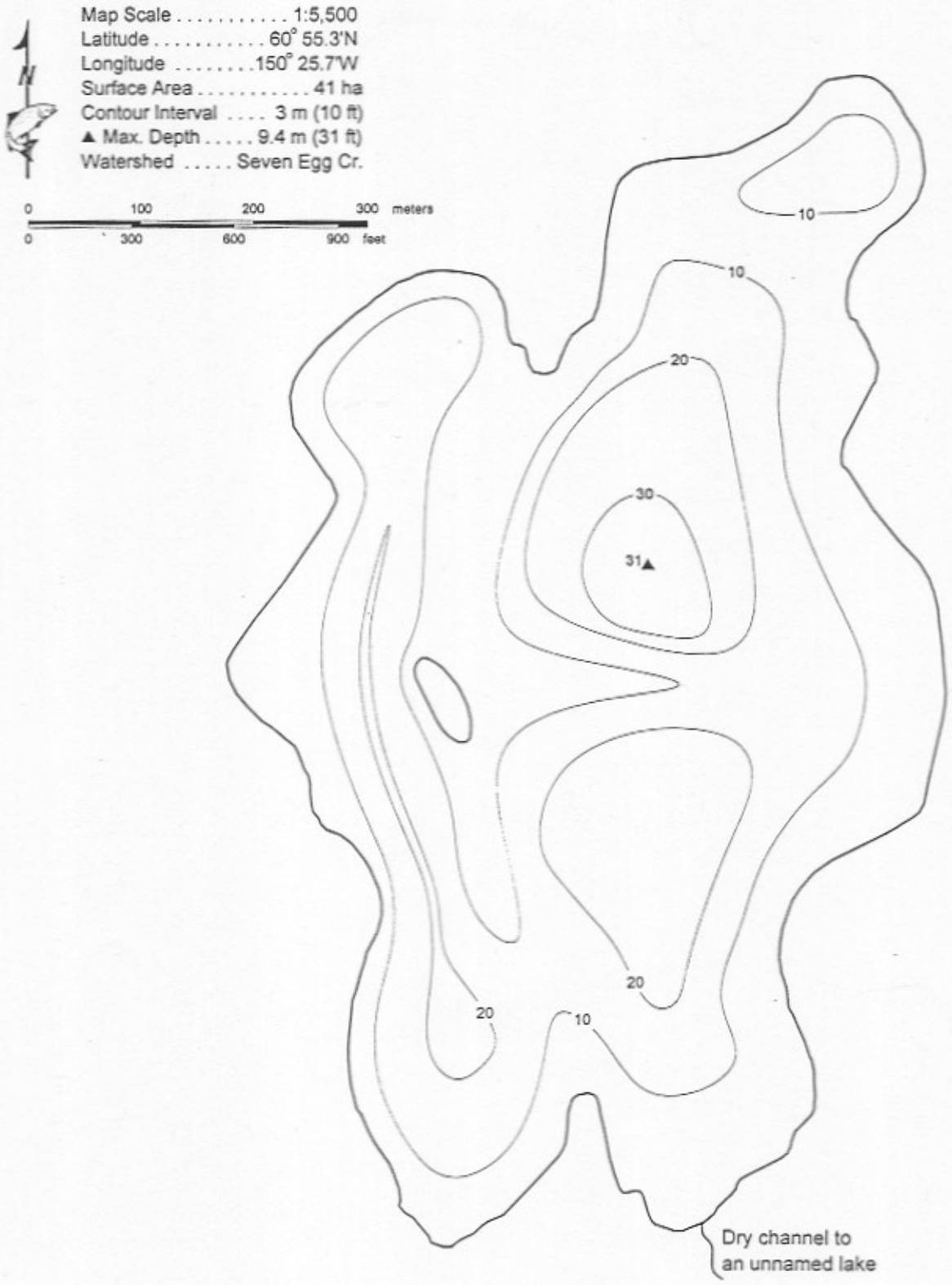


Appendix A9.-Bathymetric map of Jigsaw Lake, Kenai National Wildlife Refuge, Alaska, 1993.

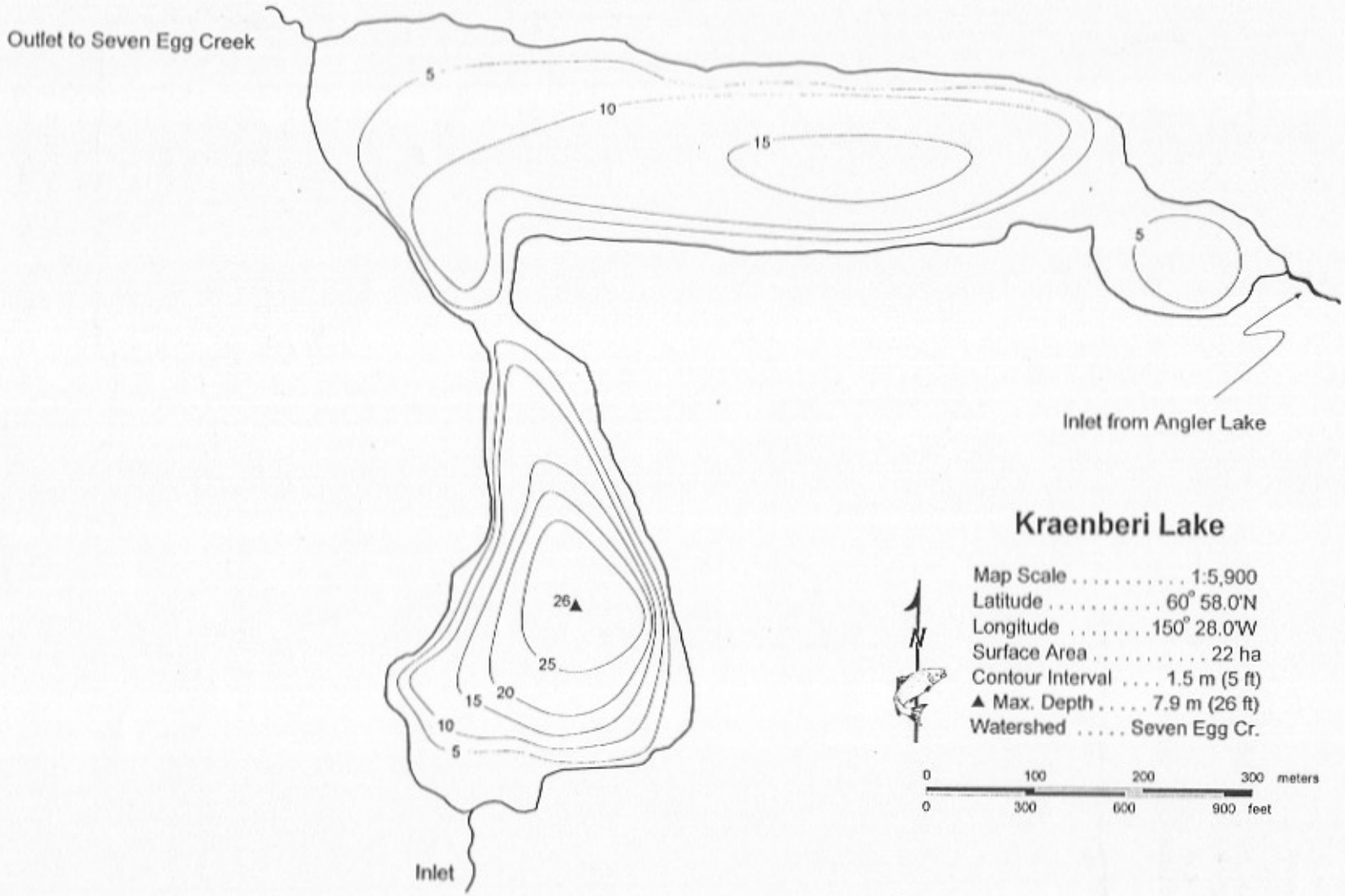


Appendix A10.-Bathymetric map of Kakoon Lake, Kenai National Wildlife Refuge, Alaska, 1993.

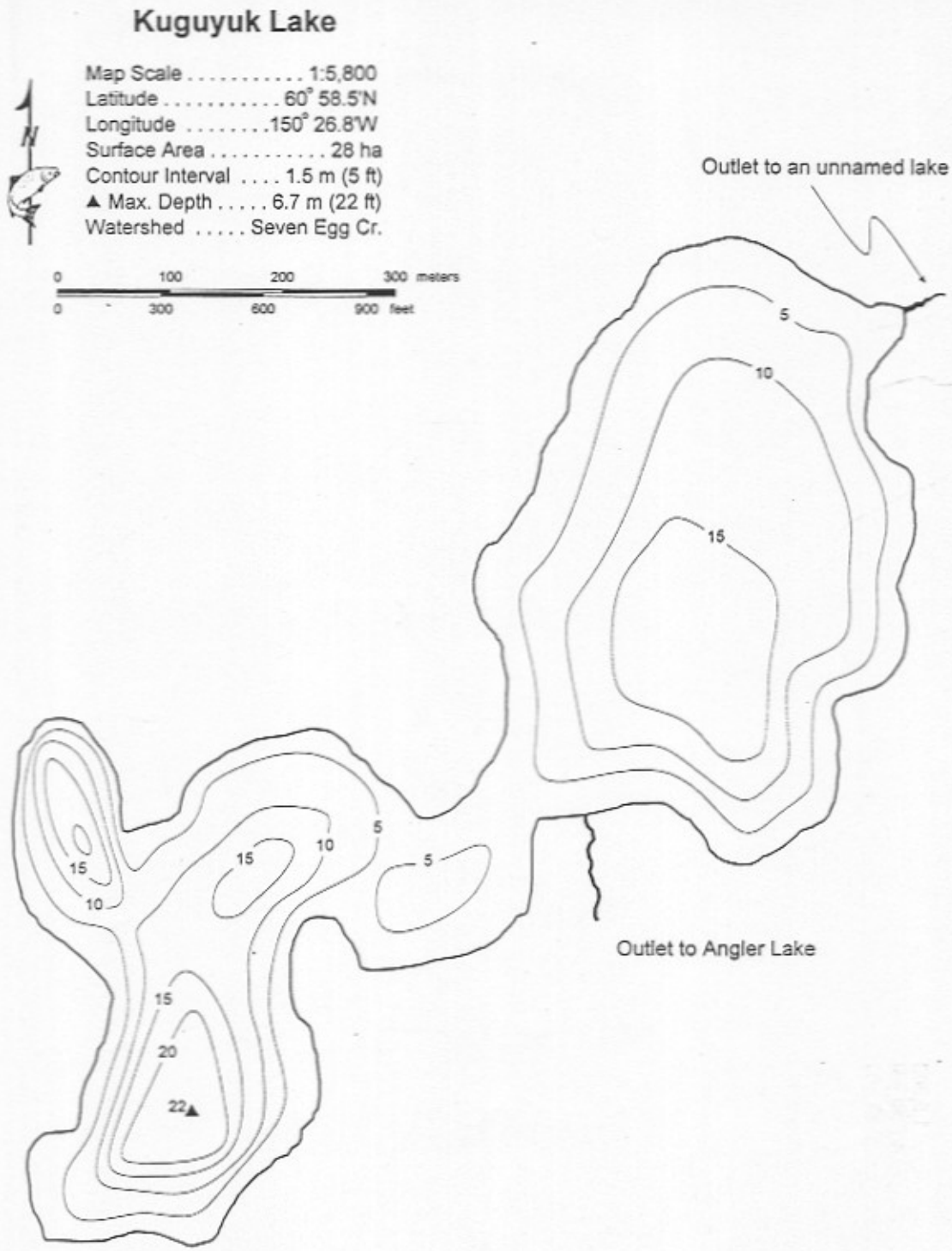
Kenaitze Lake



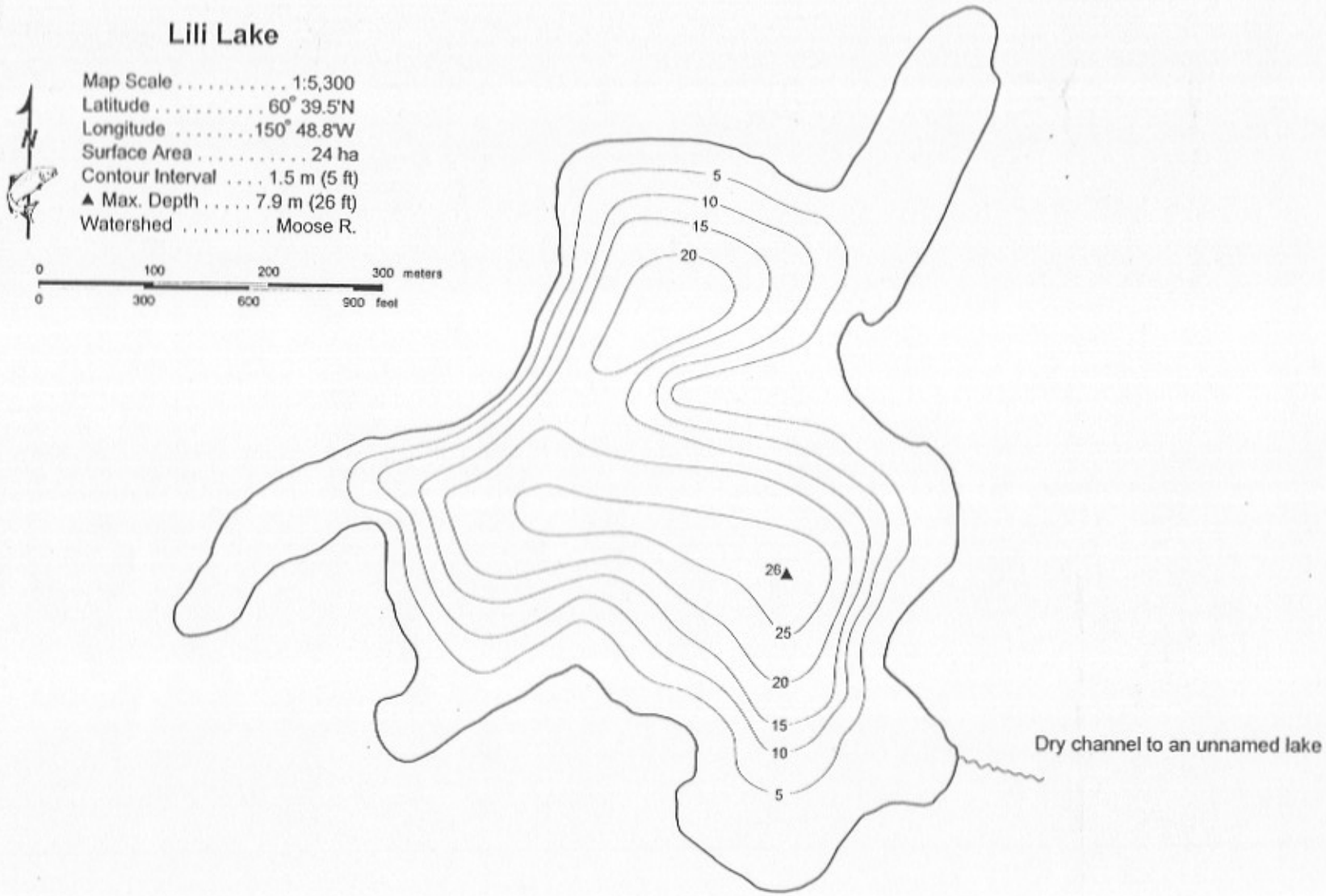
Appendix A11.-Bathymetric map of Kenaitze Lake, Kenai National Wildlife Refuge, Alaska, 1993.



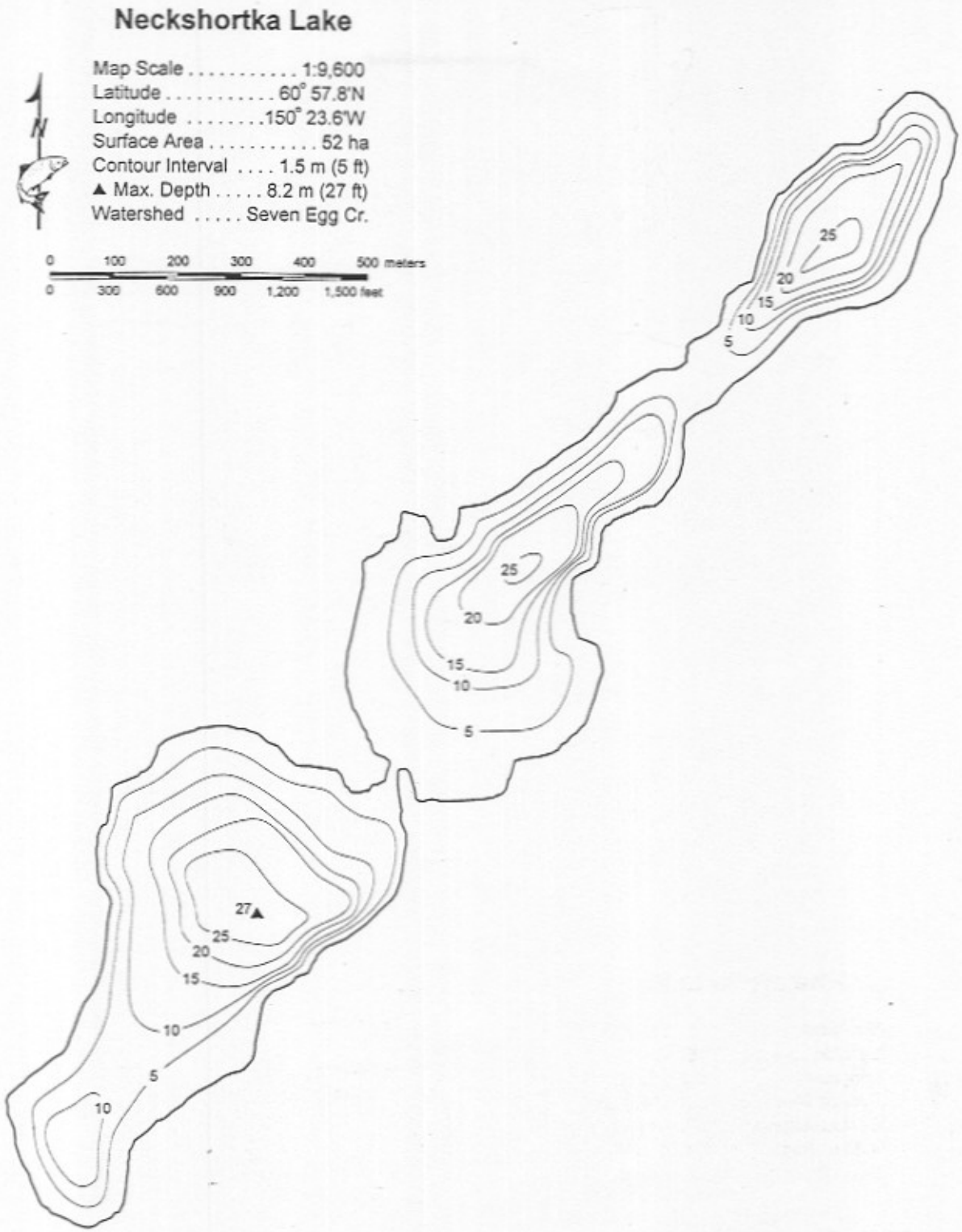
Appendix A12.-Bathymetric map of Kraenberi Lake, Kenai National Wildlife Refuge, Alaska, 1993.



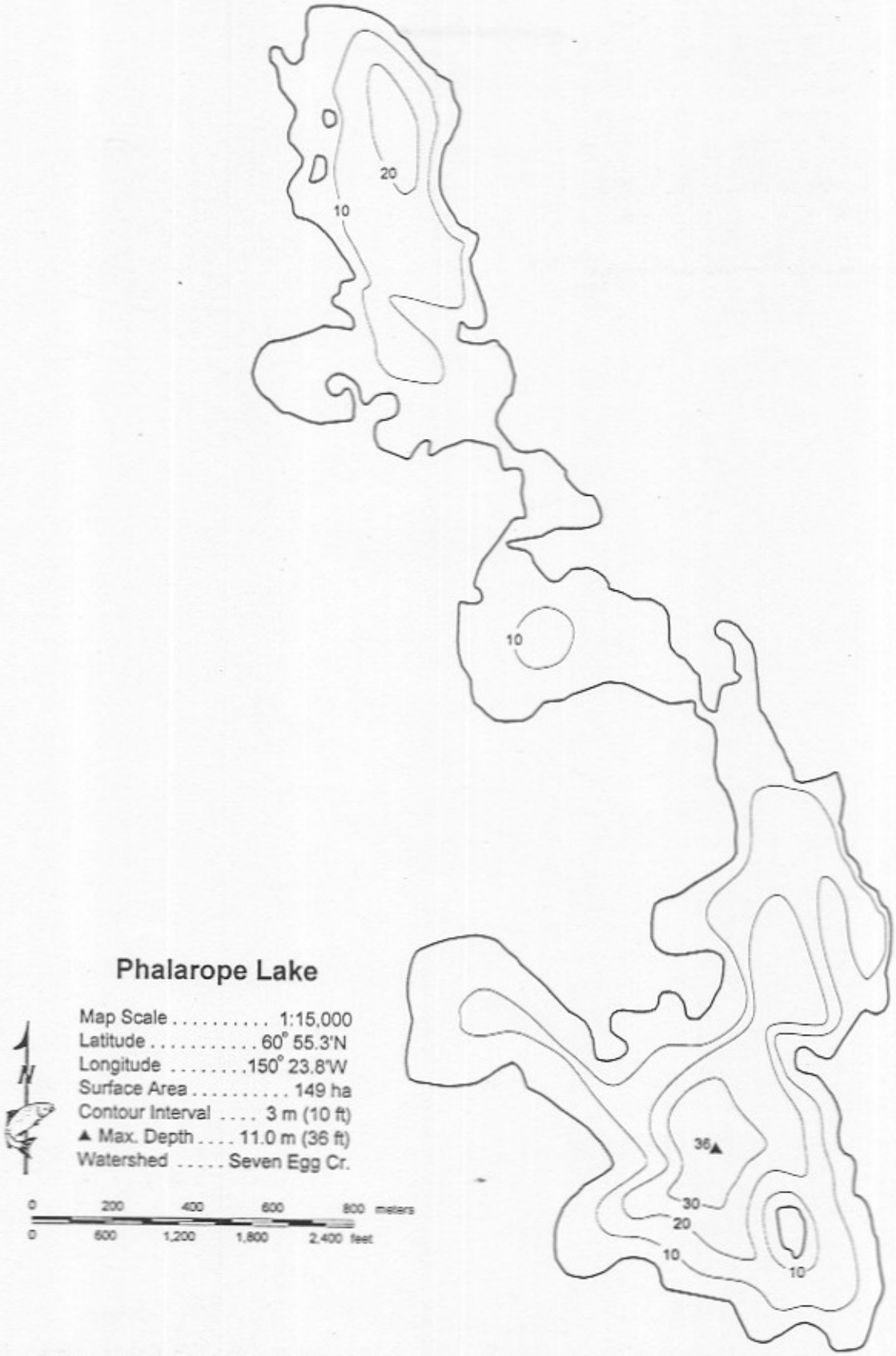
Appendix A13.-Bathymetric map of Kuguyuk Lake, Kenai National Wildlife Refuge, Alaska, 1993.



Appendix A14.-Bathymetric map of Lili Lake, Kenai National Wildlife Refuge, Alaska, 1993.



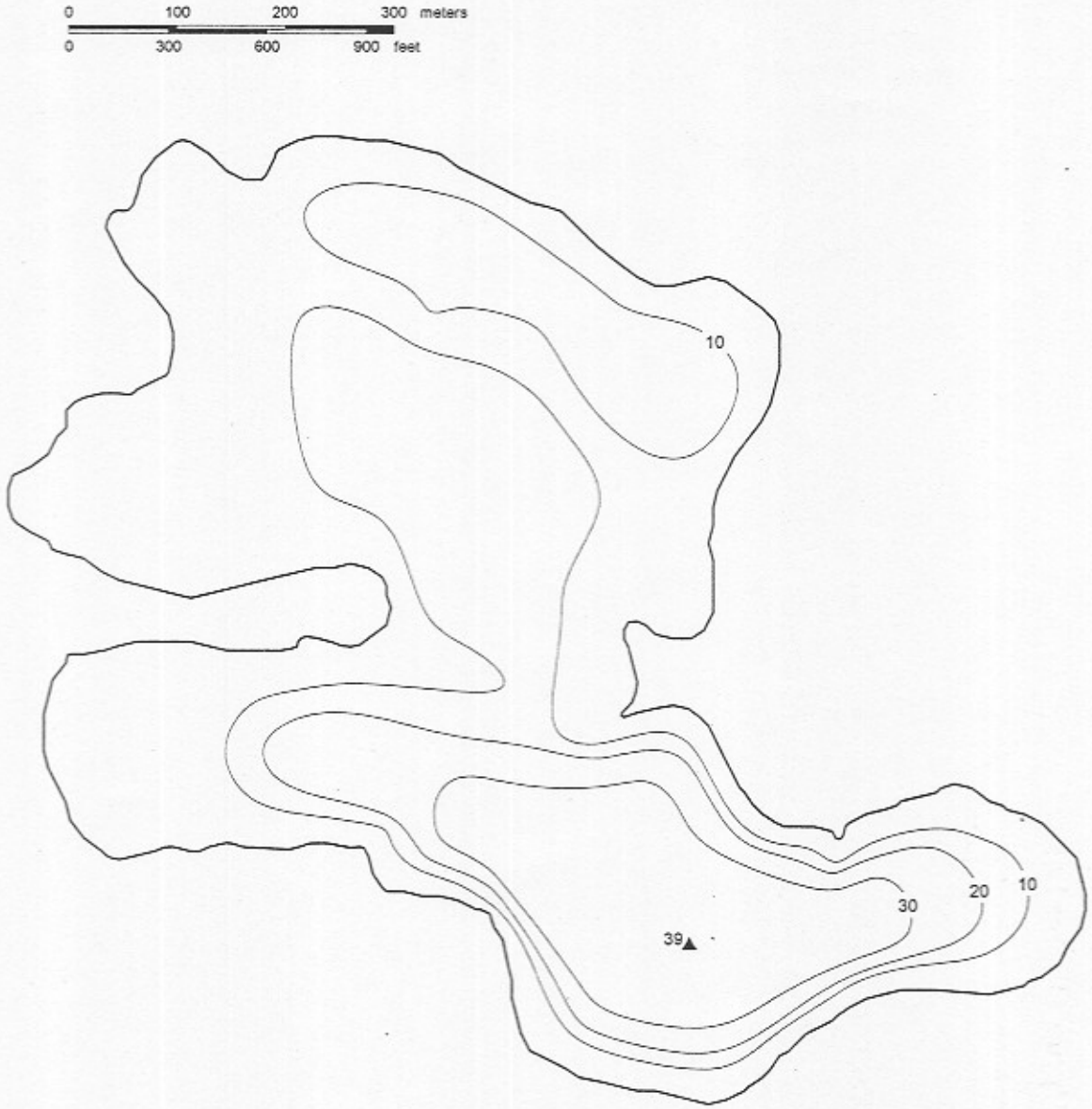
Appendix A15.-Bathymetric map of Neckshortka Lake, Kenai National Wildlife Refuge, Alaska, 1993.



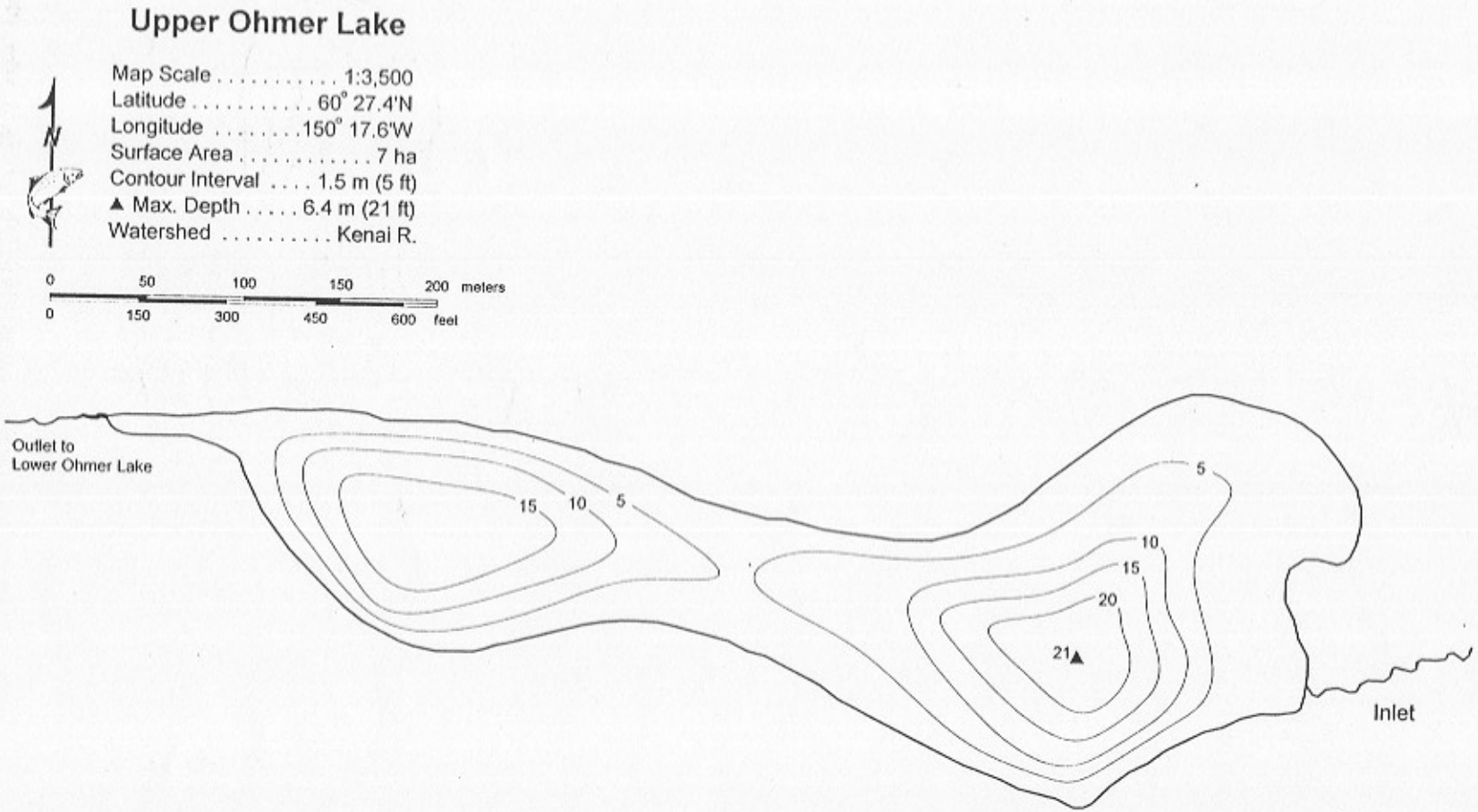
Appendix A16.-Bathymetric map of Phalarope Lake, Kenai National Wildlife Refuge, Alaska, 1993.

Trigger Lake

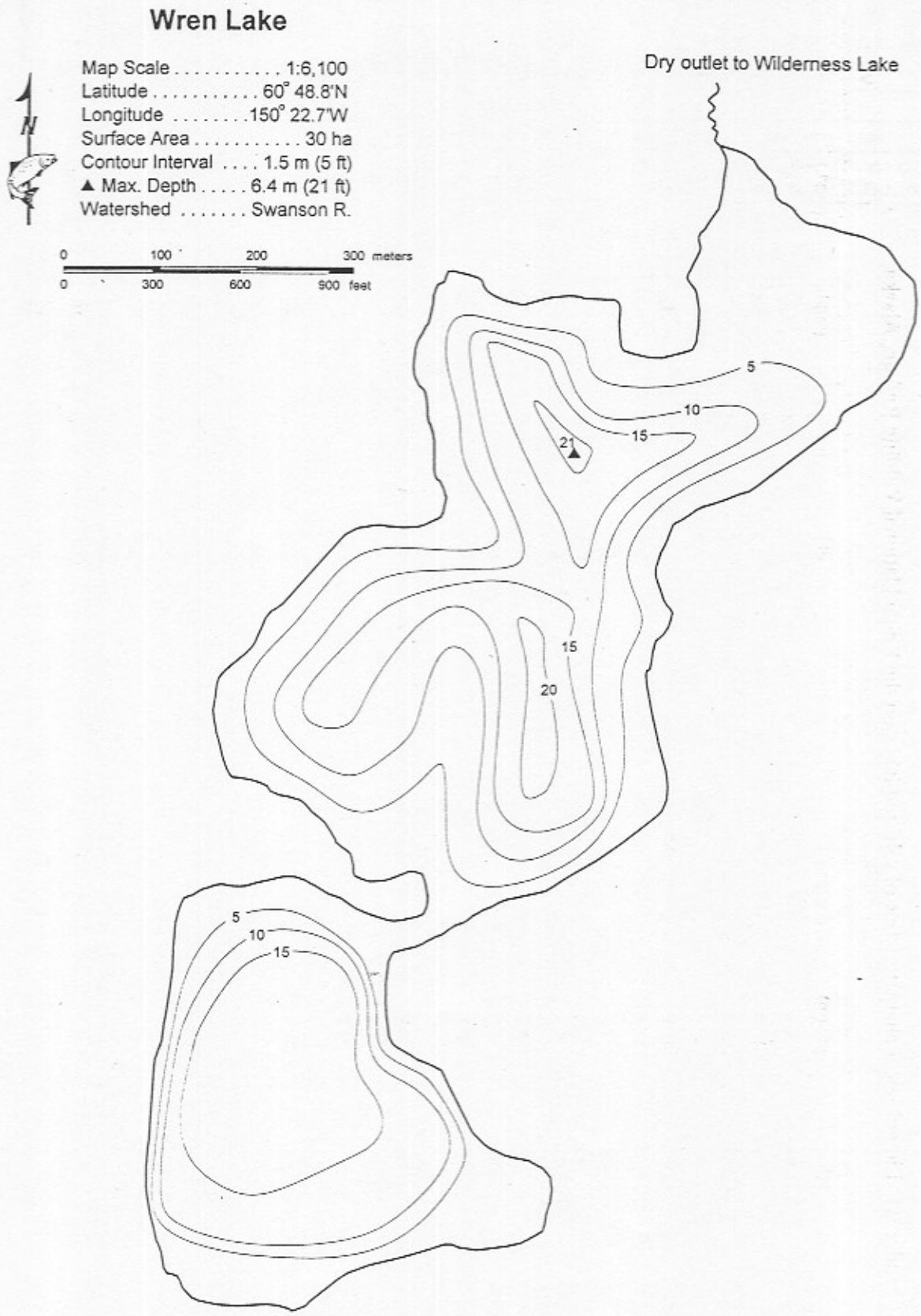
Map Scale 1:6,600
Latitude . . . . . 60° 56.5'N
Longitude . . . . . .150° 20.8'W
Surface Area . . . . . 46 ha
Contour Interval . . . . 3 m (10 ft)
▲ Max. Depth . . . . 11.9 m (39 ft)
Watershed . . . . . Bedlam Cr.



Appendix A17.-Bathymetric map of Trigger Lake, Kenai National Wildlife Refuge, Alaska, 1993.



Appendix A18.-Bathymetric map of Upper Ohmer Lake, Kenai National Wildlife Refuge, Alaska, 1993.



Appendix A19.-Bathymetric map of Wren Lake, Kenai National Wildlife Refuge, Alaska, 1993.

Appendix B1.-Limnological characteristics of selected lakes on the Kenai National Wildlife Refuge, Alaska, 1993.

Lake	Size (ha)	Maximum Depth (m)	Water Temperature Range (°C)	Dissolved Oxygen Range (mg/L)	pH	Conductivity (µmho)	Alkalinity (mg/L)	Total Hardness (mg/L)	Water Transparency (m)
Angler	51	9.8	7.5 - 21.0	0.7 - 8.4	7.3	84	27	37	4.6
Chatelain	49	18.6	8.0 - 19.0	8.5 - 12.2	8.2	122	54	72	6.2
Crooked	30	9.4	5.5 - 19.0	2.7 - 10.5	6.7	20	2	4	6.9
Dabbler	22	11.6	9.0 - 9.5	9.6 - 10.1	6.8	22	4	7	5.9
Dipper	35	14.9	9.0 - 19.0	4.1 - 8.9	7.3	47	12	12	4.7
East Finger	29 [1]	14.6 [1]	6.0 - 6.5	9.5 - 10.4	7.1	23	1	1	6.5
Embryo	38	24.4	9.8 - 19.7	8.4 - 11.4	6.6	18	2	2	11.1
Falcon	90	17.4	7.0 - 7.5	9.0 - 9.7	6.4	20	2	7	6.8
Jay	26	4.6	18.5 - 22.5	6.1 - 8.0	6.7	12	2	3	3.7
Jigsaw	47	16.5	5.0 - 5.0	11.5 - 11.5	6.3	-	1	1	4.9
Kakoon	18	4.9	18.5 - 19.5	7.7 - 8.6	6.8	22	3	4	4.9
Kenaitze	41	9.4	12.0 - 19.6	1.3 - 8.6	6.8	19	3	3	5.4
Kraenberi	22	7.9	4.0 - 20.0	2.9 - 9.3	7.3	86	35	37	4.6
Kuguyuk	28	6.7	5.0 - 5.0	11.3 - 11.3	7.4	53	22	23	6.8
Lili	24	7.9	7.0 - 7.5	10.3 - 10.6	7.1	42	20	29	4.8
Middle Finger	66 [2]	23.2 [2]	7.0 - 7.5	10.2 - 10.4	7.0	28	2	1	9.0
Mosquito	28 [2]	12.5 [2]	7.0 - 7.5	10.0 - 10.3	7.0	38	13	17	4.2
Neckshortka	52	8.2	14.0 - 19.5	2.1 - 9.1	7.5	68	28	30	4.6
Phalarope	149	11.0	9.0 - 19.0	2.9 - 8.6	7.0	43	6	8	5.9
Tangerra	70 [2]	13.7 [2]	6.5 - 7.0	9.3 - 10.6	7.3	65	32	33	4.6
Trigger	46	11.9	8.0 - 20.0	2.5 - 12.6	7.0	26	5	6	4.1
Upper Jean	20 [1]	13.4 [1]	6.5 - 7.0	8.8 - 10.6	8.1	130	82	92	6.1
Upper Ohmer	7	6.4	6.0 - 6.0	10.0 - 11.2	7.5	86	50	59	6.0
West Finger	11 [3]	-	6.0 - 6.0	9.1 - 9.8	6.9	41	1	1	4.6
Wren	30	6.4	14.0 - 21.0	8.1 - 8.9	7.2	48	16	19	4.6
Mean Values:	41	11.4	8.6 - 13.6	7.1 - 10.1	7.1	47	17	20	5.7

[1] From Friedersdorff and Jakubas (1984a)

[2] From Friedersdorff (1985)

[3] Surface area was calculated from a U.S. Geological Survey 1:25,000 scale (provisional edition 1986) topographic map using a planimeter.

Appendix B2.-Catch per unit of effort (CPUE) of fish species in gill nets and minnow traps fished in selected Kenai National Wildlife Refuge lakes, 1993.

	Number of Fish Captured per Hour						
	Combined Average CPUE for Floating & Sinking Gill Nets					Minnow Traps	
Lake	Rainbow Trout	Arctic Char	Longnose Sucker	Sockeye Salmon	Coho Salmon	Threespine Stickleback	Coastrange Sculpin
Angler	0.98	0	0	0	0	0.44	0
Chatelain	0	0	0	0	0	7.42	0
Crooked	0	0	0	0	0	0.03	0
Dabbler	0	0	0	0	0	0.48	0
Dipper	0	0	0	0	0	0.05	*a*
East Finger	0	0.53	0.28	0	0	*b,c*	*b,c*
Embryo	0	0	0	0	0	0.01	0
Falcon	0	1.08	0	0	0	0.61	0
Jay	0	0	0	0	0	0.51	*a*
Jigsaw	0	0	0	0	0	0.77	0
Kakoon	0	0	0	0	0	*a*	0
Kenaitze	0	0	0	0	0	0.04	0
Kraenberi	0.80	0	0	0	0	0.21	0
Kuguyuk	0.94	0	0	0	0	0.94	0
Lili	0	0	0	0	0	1.31	0
Middle Finger	0	0.42	*c*	0	0	*b,c*	*b,c*
Mosquito	*d*	0	0	0	0.01	1.38	0
Neckshortka	0.12	0	0	0	0	0.07	0
Phalarope	*d*	0	0	0	0	0.01	0
Tangerra	0.33	0	0	0	0	1.31	*c*
Trigger	0	0	0	0	0	0.09	0
Upper Jean	*d*	0	0	*d*	*d*	3.35	*c*
Upper Ohmer	2.37	0	0	0	0.10	<0.01	0.01
West Finger	0	*c*	0.05	0	0	*b,c*	*b*
Wren	0.37	0	0	0	0	0.37	0.04

a = Genus observed but not represented in catch
b = Minnow traps not deployed
c = Documented in previous surveys, but not represented in 1993 catch
d = Documented in previous surveys, but probably no longer present