Regional Director, Portland, Oregon

January 30, 1957

Fishery Management Biologist, Game-fish and Hatcheries, Portland, Oregon

Fishery Management Reconnaissance Report - Crater Lake, Oregon (1-GF)

Background to 1956

On December 12, 1955 Park Superintendent T. J. Williams sent us scales from 37 kokanee salmon and 88 rainbow trout taken from Crater Lake during the 1953, 1954, and 1955 fishing seasons. These scales were read and the results reported in a letter to Superintendent Williams dated February 10, 1956. The most interesting deduction drawn from these readings was that 75 percent or more of the rainbows caught in each of these years were progeny of the 1950 and 1951 brood years. This indicated that - a) there was very little recruitment to rainbow stocks in Crater Lake by subsequent brood years, and - b) that the quality of sport fishing could be expected to decline markedly in the next few years due to the natural mortality of old fish, unless a suitable management program was inaugurated.

In a letter dated February 15, 1956, Superintendent Williams stated he had a collection of stomach samples from 93 rainbow trout and 37 kokanee salmon on hand that the Park Service wanted analyzed as part of their program of limnological appraisal of Crater Lake. By arrangements made through our office, this material was sent to Fishery Research Biologist Richard D. Thompson at Seattle for analysis last April.

Field Observations in 1956

Due to prior field commitments, Fishery Biologist W. M. Morton was unable to visit the Park until the closing days of the 1956 tourist season. One of his first activities was to set a small gill net (6'x125') in Fumarole Bay just west of Wizard Island. The net was set in about 60 feet of water at 4:00 p.m. on September 19. Details of the set and lake bottom were clearly visible in the remarkably clear water of Crater Lake. A steady driving rain on the 19th and 20th made it virtually impossible to lift the net or work on the lake. The weather finally cleared on September 21, and the gill net was pulled at 10:00 a.m. It did not catch a single fish. The electric thermometer showed the following readings in Fahrenheit degrees on September 21 at 10:25 a.m. in Fumarole Bay and 11:00 a.m. out in the lake southeast of Wizard Island:

Depth	10:25 a.m.	11:30 a.m.
Surface	53.8	55.2
10	53.3	53.9
20	53.2	53.8
30	53.1	53.7
40	50.9	53.5
50	46.6	52.6
60	54.5	47.6
70	45.2	46.6
80	44.9	45.3
90	44.6	44.1
100	--	43.2
110	--	42.6
120	--	42.2
150	--	42.0
170	--	41.2
180	--	41.2
200	--	41.1

Physical Characteristics of Crater Lake

Crater Lake is the highest lake in the Cascade Mountains and the deepest lake in North America. According to Hasler (1938:94) the lake has a surface area of 21 square miles (13,440 surface acres at 6,177 feet above sea level). It has no inlet or outlet and its water is extremely soft. Van Winkle and Finkbinder (1913) found only 80 p.p.m. of solids in Crater Lake water. A Secchi disk was reported visible at 131 feet on August 27, 1937. A definite thermocline existed at the 60-foot level on that date. Summer surface temperatures range from 50° to 65° F. and a uniform temperature of about 40° F. is maintained in the hypolimnion which comprises over 3/4 of the volume of the lake. The greatest recorded depth is 1,996 feet. The lake is nearly round with an average diameter of 5 miles. The shores of Crater Lake rise as sheer cliffs 500 to 2,000 feet above the lake surface. Only one good trail leads from the rim to the lake edge, and the angler or sightseer must descend this 1.5 mile trail. A few people sometimes make their way down a much more difficult descent at the Wineglass. (See attached map).

Biological Characteristics of Crater Lake with Emphasis on Potential Fish Foods

As Crater Lake is less than 7,000 years old, it is far too young to have evolved any life forms of its own. As it has no inlet or outlet, all floral and faunal forms must have entered by aerial or overland migrations, or by accidental or purposeful plantings by man. The most startling biological finding at Crater Lake by Hasler (1938:95) was the collection, by dredge, of green mosses, Fontinalis and Drepanocladus, at the astonishing depth of 394 feet. Hubbard (1934) lists Nostoc* to which Brode (1938) adds Oscillatoria, Calothrive, Chroococcus, Cladophora and Ulothrix as among the more common forms of algae present. Kemmerer et al (1923:108) state that the limnetic zooplankton consisted almost entirely of Daphnia

* and Zygnema as common algae.

pulex. In addition, Bosmina longispinna and the rotifers, Notholca longispina and Anuraea aculeata were taken. Asteronella was the only diatom found in the lake. The color of the strikingly white portion of the lake bottom in places is due to layers of myriads of this diatom's shells. As a whole, the limnetic plankton is rather limited in supply, according to Kemmerer.

Results of trout food studies at Crater Lake have been described by Hubbard (1934), Brode (1938), and Hasler and Farner (1942). In the past, Daphnia, the common water flea, has been found to be the principal food item of trout and salmon diets in Crater Lake. The rest of the phyto-and zoo-plankters mentioned above have not been eaten directly by fish except by accident but they have been important as the basic food of aquatic insect larvae and mollusks which thereby "convert" these microscopic organisms into macroscopic fish food. Larvae of the bloodworm Chironomus, the caddis fly Limnophilus, and the stonefly Alloperla have been commonly found in trout stomachs, as have the three crustaceans, Cyclops, Hyallela, and the crayfish Astacus. These latter forms were introduced into the lake about 1915. Gammarus was also introduced about that time but apparently did not survive as it prefers warmer, plant-abundant waters. The rocky, wave-churned, fluctuating marginal level of Crater Lake is devoid of rooted flowering plants, and all of its aquatic forms are more like stream forms than lake forms, according to Brode (1938:51). Three species of snails (Menetus, Parophalyx and Lymnaea) have been reported as important trout food items. The tiny pea-clam (Sphaerium) is also present, but it is too small and scarce to rate very high as a food item. A few small leeches and annelid worms have also been taken. The amphibian salamander, Ambystoma, and occasionally young trout have been found in trout stomachs from Crater Lake. In addition, many terrestrial insects that have been blown into the crater are consumed by trout.

The Fish of Crater Lake

Kemmerer (1923:106) states: "Originally there were no fish in Crater Lake. W. G. Steel (1907), S. S. Nicoline, and E. D. Dewart carried rainbow trout minnows from Gordon's ranch 41 miles to the lake. Thirty-seven were placed in the lake September 1, 1888. The first trout were caught in 1901. Others have been planted since that date, and the lake now (1913) offers some of the best trout fishing we have ever enjoyed".

According to Hasler and Farner (1942:324) official park records show that from 20,000 to 300,000 rainbow trout were stocked in Crater Lake annually from 1932 to 1935, and from 25,000 to 200,000 silver salmon from 1933 to 1937. These fish were furnished by the former U. S. Bureau of Fisheries hatchery at Butte Falls, Oregon. We have no record of any stocking of Crater Lake since 1939. Although steelhead (Salmon gairdneri), German brown trout (Salmo trutta), and eastern brook charrs (Salvelinus fontinalis), have been introduced in the lake, they, like the silver salmon (Oncorhynchus kisutch) apparently have been unable to reproduce

successfully, and to the best of our knowledge, are not present in the lake today. As there has been no stocking of the lake since 1940, the rainbow trout (Salmo gairdneri) and the kokanee salmon (Oncorhynchus nerka) are the only species that have spawned successfully in Crater Lake, as can be seen from the following creel census results. Nobody seems to know for sure how the kokanee got into the lake. According to Wallis and Bond (1950:192) - "There is a remote possibility that the kokanees may have become mixed with silverside salmon at the egg-taking station and once liberated into Crater Lake, found the situation suitable and reproduced. Or, they may have been planted in the lake without authorization or record."

The Sport Fishery at Crater Lake

Kemmerer records above that the lake offered some of the best trout fishing in 1913 that he had ever enjoyed.

Hubbard (1934) states - "Catches from the lake now consist almost entirely of rainbow with now and then a silverside and once in a while a German brown is reported. The majority of rainbows run about 18" long and some reach 24". They are usually in prime condition, fat and pink-fleshed. The silversides run about 15" long, the flesh is firm and almost as nicely flavored as that of the rainbow. Its food habits are similar to the rainbow, but seem to eat more snails and salamanders. The German brown get the largest, up to 30 inches long and weighing up to 10 pounds. The inferiority of the flesh coupled with the suspicion that it leans toward cannibalism has caused the stoppage of plantings of brown trout in Crater Lake.

The only time fish habits can be studied at Crater Lake is during the short period when the trails down to the lake are cleared of snow - generally from July 1 to September 15...The fishermen have found that trout are not to be found all over the lake, but seem to prefer the shallows about Wizard Island or Skell Channel. They are especially concentrated where small snow-formed streamlets flow into the lake...Trolling is by far the most popular method of catching fish. Fly casting brings poor results - equipment usually consists of plugs, crippled minnow and spoons of various types. Baits are frequently used such as salmon eggs, fish eyes, squares of beef, grasshoppers and earthworms...Fishing is no good on clear, calm days."

Hasler (1938:96) states - "Many anglers have suggested that Crater Lake might be overstocked because of its reputation as a lake 'where the limit can be caught with the least effort'." To test whether this condition actually existed, a creel census was initiated in 1937 which showed the fairly high catch return of 0.84 fish per angler hour of effort during the month of July. The creel census was continued in 1938, 1939, and 1940, and the results as reported by Hasler and Farner (1942:322) are shown in Table III. Only rainbow trout and "salmon" were taken. The average size of these "salmon" was 14" - 16" in 1937-39 which indicates

they were mostly silver salmon (Oncorhynchus kisutch), whereas in 1940 they averaged only 9" in length which indicates these fish were almost entirely kokanee salmon (Oncorhynchus nerka kennerlyi).

Catch records are meagre since 1940. A Crater Lake National Park memorandum of September 15, 1950 reported observations of a school of kokanee passing the boat landing on Wizard Island during a 5-minute interval on July 21. Later, another school took 25 minutes to pass the landing. Boats became available on July 18, 1950 and were utilized until September 4 of that year. Although many tourists combined boating and angling, there were many improperly equipped and inexperienced anglers among them who often fished for hours with little or no success, which caused the number of fish taken per hour to be quite low. The reporter suggested that the catch would be greater if anglers could reach more remote areas of the lake as on two trips to distant points of the lake he had found large rainbows numerous and easily caught by trolling methods.

A memorandum by Park Naturalist Fairbanks on the 1952 fishery stated that due to a large slide the lake trail was not opened during the regular fishing season, and that consequently very little fishing was done. Only 48 rainbow and two kokanee (8½" and 8-3/4" long) were recorded, and no conclusions could be drawn with respect to abundance of fish compared to previous years. Scales were collected from 13 rainbows in 1953, from 25 rainbow and 17 kokanee in 1954, and from 50 rainbow and 20 kokanee in 1955. Lengths and ages of these fish were tabulated and attached to a letter report to Park Superintendent Williams on February 10, 1956.

Creel census data collected in 1956 are presented in Table I and lengths and ages of 29 rainbow trout and five kokanee are presented in Table II.

Interpretation of Creel Census Results at Crater Lake

The creel census for 1956 (Table I) indicates that 147 anglers interviewed fished 299 hours (an average of 2.04 hours per angler-trip) to catch 42 rainbow trout and 19 kokanee salmon for a total of 61 fish (an average of 0.2 fish per angler-hour of effort). The rainbows averaged 14 inches in length and constituted 69% of the catch, and the kokanee averaged 8.2 inches in length and 31% of the total catch in 1956. A comparison of creel census results obtained at Crater Lake in 1956 (Table I) with similar data obtained in 1937 to 1940 (See Table III or Hasler and Farner, 1942:323) indicates the following possibilities:

1. The average angler-day was shorter in 1956 than in any previous year of record (probably due to the poor fishing and limited number of anglers fishing).

2. Rainbow trout constituted the major portion of the catch for the second time in five years of record, and were about the same size as previously.

3. Kokanee salmon averaged smaller than ever before and were less numerous in the catch than in most years.

4. The average catch per angler-hour of effort was lower than in any previous year of record.

A comparison of the 1937-1940 creel census results at Crater Lake with similar data from other cold-water lakes of Western United States (Table III) indicates that:

1. The average number of hours fished on easily accessible lakes is about five hours per angler day - Crater Lake showed this average in 1939 and 1940 when fishing for kokanee was good, but in other years the fishing has been so poor it falls far below the average (between two and three hours per trip).

2. That fishing in Crater Lake probably is as poor or poorer than in any other large lake or reservoir in the United States - this is indicated by several things in Table III, namely:

a. The average number of angler days of effort per surface acre of water was 0.05, and the average number of fish caught per surface acre was 0.11 in Crater Lake, which are the lowest records we can find.

b. The best measure of quality of fishing is the average catch per angler-hour, which at Crater Lake is comparatively low. Excluding the fairly good kokanee fishing enjoyed in 1939 and 1940, the average catch per hour at Crater Lake is and has always been lower than in any western lake of record with the possible exception of a few fluctuating reservoirs.

Recommendations for Future Management Program

1. We recognize that the National Park Service's primary emphasis on Crater Lake as a tourist attraction is its superb and singular scenic beauty, as well as its unique geological position.

2. We further recognize that the National Park Service has always opposed the introduction of exotic species within Park boundaries. In the case of Crater Lake, there were no fish species present in or endemic to the lake prior to 1888; and although many salmonid species have been introduced into the lake since that time, only the kokanee (Oncorhynchus nerka kennerlyi) and the rainbow trout (Salmo gairdneri) have been successful in reproducing themselves naturally in the lake. Therefore, these two species could now be considered as native to the lake and we can see no reason why a more successful fishery for kokanee and rainbow trout

could not be developed in the lake without detracting from other natural phenomena that occur there.

3. We recommend the following steps be taken:

a. A more complete creel census of the fishery be conducted in each of the next four years.

b. Consideration be given to the possible stocking of kokanee and rainbow trout fry into Crater Lake.

William M. Morton

Through:

Acting Regional Supervisor
Game-fish and Hatcheries

Copy to: Central Office (3)
Superintendent, Crater Lake Nat'l. Park (2)

TABLE I - Summary of Creel Census Data Collected at Crater Lake in 1956

Census Date	Total Anglers	Total Hours	Kokanee Salmon Length in Inches 5-6	7-8	9-10	Total	Rainbow Trout Length in Inches 5-6	7-8	9-10	11-12	13-14	15-16	17+	Total	Total Both Species
8/5/56	9	31½			2	2			3			1	2 1/	6	8
8/6/56	4	13				0								0	0
8/11/56	13	30½	1	2	5	8				1	2	1	1(22")	5	13
8/12/56	23	32			1	1				1	1	2		4	5
*8/12/56	2	5				0	1							1	1
*8/19/56	2	2				0			1			1		2	2
8/17/56	5	12				0					1			1	1
8/18/56	17	50½	1	1		2				1		1	2 2/	4	6
8/19/56	13	25½		2	1	3					1		1(19")	2	5
8/24/56	12	29				0				1		1	1(18")	3	3
8/26/56	11	23	1	1		2	1	1	1	1		1	1(22")	6	8
9/2/56	24	22			1	1			1	1	1		2 3/	5	6
9/3/56	12	23				0		1	1			1		3	3
	147	299	3	6	10	19	2	2	7	6	6	9	10	42	61

* Wineglass

1/ 21" and 24"
2/ 18" and 20"
3/ 17" and 21"

TABLE II - Crater Lake - Rainbow Trout Data

Slide Number	Date Collected	Length (in.)	Sex [1]	Age [2]	Notes on Scale Envelopes
R-1-56	8-2-56	16½	F-C	4+	Good condition; stomach empty
2	?	11	F-C	4	Good condition; stomach full
3	8-12-56	13	F-D	3+	Good condition; stomach full; Wizard Isl on U-20 Flatfish
4	8-12-56	12	F-D	3+	Good condition; somtach full; Wizard Isl. on Spinner
5	8-12-56	16	F-B	6+	Good condition; stomach full; Wizard Isl. on Spinner
6	8-18-56	14½	M-B	5+	Good condition (1½ lbs.) Stomach full
7	8-19-56	19	F-B	4+	Good condition; Stomach full, Wizard Isl.
8	8-19-56	12	?	3+	
9	8-19-56	12	M-B	3+	Stomach full
10	8-19-56	10	M-B	2+	Stomach full
11	8-19-56	15¼	M	4	
12	8-19-56	14½	M	3+	
13	8-24-56	19 3/4	F-B	5	Stomach full snails, Devils Backbone on flatfish
14	8-24-56	10 3/4	M-C	2+	Stomach full snails, Devils Backbone on flatfish
15	8-25-56	20	F-B	5+	Stomach full; Wizard Isl. on U-20 flatfish
16	8-26-56	19½	F	5+	Stomach full; Wizard Isl. from boat dock
17	8-26-56	15¼	M-D	4+	Stomach full; Wizard Isl. from boat dock
18	8-29-56	17½	F-C	4+	Stomach full; crayfish
19	9-2-56	12	F-D	3+	Stomach empty; Clestwood Cove
20	9-2-56	21	F	4+	Stomach full; Clestwood Cove
21	9-2-56	14	M	4+	Stomach full; Clestwood Cove
22	9-2-56	17	F	4+	Fair condition Stomach full; Clestwood Cove
23	9-2-56	10½	F	2	Fair condition; Stomach full insects and crayfish
24	9-2-56	?	?	?	Estimated over 15" long; stomach full shrimp and shellfish
25	9-3-56	15	M-C	5+	Good condition; stomach full
26	9-3-56	7	F-D	no scale	Inch Long perforations in stomach wall
27	9-3-56	9	F-D	2+	Small perforations thru stomach wall
28	9-16-56	16	M-B	4+	Stomach full; Clestwood Cove on Spinner
R-29-56	9-16-56	13	M-B	3+	
	Crater Lake - Kokanee				
S-1-56	8-1-56	8½	F	4-B	Stomach full
2	8-19-56	10	-	4	Stomach full
3	8-19-56	10	F	4-D	Stomach full

TABLE II - Crater Lake - Kokanee

Slide Number	Date Collected	Length (in.)	Sex	Age	Notes on Scale Envelopes
S-4-56	8-21-56	10	F	6-A	Stomach full; Fish almost ready to spawn
5	9-2-56	10½	M	7	Stomach empty
6	9-2-56	-	-	-	Stomach full; few shrimp
7	9-2-56	-	-	-	Stomach full
S-8-56	9-2-56	-	-	-	Stomach full

1/ Age in rainbows was the number of annuli counted

2/ Age in kokanee was the number of annuli plus one

TABLE III - COMPARISON OF CRATER LAKE CREEL CENSUS DATA WITH SIMILAR DATA FROM OTHER WESTERN UNITED STATES COLD-WATER LAKES

Name of Lake or Reservoir State Max. Surface Acres	Year of Census	Total Angler: Days of Effort	Total Angler: Hours Fished	Number of Fish Caught: Kokanee	Rainbow	Other (a) Cutthroat (b) East. Brook	Total	Average: Hours Fished per Day	Catch per Angler Hour	Angler Days per Acre	Fish Caught per Acre
Lake Pend Oreille	1951	60,172	330,923	820,486	678	(a) 5,271	850,065	5.5	2.6		
Idaho	1952	57,814	308,850	514,913	535	5,850	537,298	5.3	1.7		
92,000 acres	1954	90,566	459,271	1,232,916	2,533	5,322	1,305,528	5.1	2.8		
	1955	67,645	327,551	650,375	2,594	4,982	692,340	4.8	2.1		
Average		69,500					846,308	5.2	2.3	0.76	9.2
Castle Lake	1947	894	2,771	-	45	(b) 5,765	5,810	3.1	2.1		
California	1948	1,213	3,760	-	9	5,190	5,199	3.1	1.4		
48 acres	1949	1,067	2,774	-	0	4,928	4,928	2.6	1.8		
	1950	1,358	3,802	-	0	5,255	5,255	2.8	1.4		
	1951	854	2,562	-	1	2,353	2,354	3.0	0.9		
	1952	1,087	3,587	-	2,326	2,180	4,506	3.3	1.2		
	1953	1,429	4,859	-	2,160	1,828	3,988	3.4	0.8		
	1954	1,079	3,453	-	482	2,475	2,957	3.2	0.9		
Average		1,123	3,446	-			4,375	3.1	1.3	23.3	91.1
Lost Lake	1950	114	378	-	8	(b) 509	517	3.3	1.4		
Colorado	1951	165	551	-	1	523	524	3.3	1.0		
15 acres	1952	151	637	-	0	410	410	4.2	0.6		
Average		143	522				484	3.6	1.0	9.5	32.3
Castle Lake	1941	-	-	-	-	-	-	-	0.38		
California	1942	-	-	-	-	-	-	-	0.45		
47 acres	1943	-	-	-	-	-	-	-	0.98		
	1944	-	-	-	-	-	-	-	0.79		
	1945	-	-	-	-	-	-	-	0.95		
Average									0.71		
Fish Hook Lake	1950	316	1,079	-	8	(b) 761	769	3.4	0.7		
Colorado	1951	245	749	-	6	406	412	3.1	0.6		
84 acres	1952	131	286	-	2	132	134	2.2	0.5		
Average		231	705	-			438	3.1	0.6	27.2	51.5
June Lake	1939	-	-	-	-	-	-	-	0.60		
California	1940	-	-	-	-	-	-	-	0.55		
310 acres	1941	-	-	-	-	-	-	-	0.56		
	1942	-	-	-	-	-	-	-	0.62		
Average									0.58		
S. Twin Lake	1945	3,149	11,989	-	9,178	-	9,365	3.2	0.78		
Oregon	1946	4,729	21,640	-	9,943	-	10,043	4.3	0.46		
130 acres	1947	5,392	25,549	-	8,363	-	8,444	4.4	0.33		
Average		4,423	19,726	-			9,284	4.0	0.52	3.41	7.12
Green Mountain Res.	1945	-	-	-	-	-	-	-	0.30		
Colorado	1946	-	-	-	-	-	-	-	0.25		
2,100 acres	1949	4,610	23,511	-	-	-	5,207	5.1	0.22		
	1950	4,550	18,655	-	-	-	3,589	4.1	0.20		
Average		4,580	21,083	-	-	-	4,298	4.6	0.24	2.1	2.
Deerfield Reservoir	1949	6,720	46,368	-	-	-	19,330	6.9	0.42		
South Dakota	1950	8,190	49,140	-	-	-	23,400	6.0	0.48		
435 acres											
Average		7,455	47,754	-	-	-	21,360	6.4	0.45	17.1	49.1
Crater Lake	1937	1,270	3,428	709	593	-	1,302	2.7	0.38		
Oregon	1938	654	1,826	82	342	-	424	2.8	0.23		
13,440 acres	1939	610	3,469	863	113	-	976	5.7	0.28		
	1940	837	4,219	3,998	190	-	4,188	5.9	0.85	0.05	0.11
Average		840	3,410				1,722	4.3	0.44		
Paulina Lake, Ore.	1946	7,692	37,799	-	2,617	(b) 3,635	7,269	4.7	0.19		
1,300 acres	1947	10,743	49,115	-	10,412	8,448	19,046	4.6	0.39		
Average		9,217	43,457	-			13,457	4.6	0.29	6.7	10.5
Gibson Res., Mont.	1951	895	5,012	-	-	-	1,903	5.6	0.38	0.7	1.4
1,360 acres											
Diversion Res., Mont.	1951	2,328	13,083	-	-	-	4,321	5.6	0.33	23.3	43.2
100 acres											
Madison Res., Mont.	1950	7,972	46,237	-	-	-	14,797	5.8	0.32	2.1	3.9
3,800 acres											
Hebgen Lake, Mont.	1951	10,140	44,109	-	-	-	13,238	4.4	0.30	0.8	1.0
13,400 acres											
Wood Lake, Mont.	1951	385	1,901	-	-	-	494	4.9	0.26	19.2	24.7
20 acres											
Willow Creek Res.,	1951	202	1,060	-	-	-	191	5.2	0.18	0.1	0.1
Mont., 1,400 acres											
Tunnel Lake, Mont.	1951	504	2,565	-	-	-	359	5.1	0.14	1.7	12.0
30 acres											
Fishkun Res., Mont.	1951	1,575	7,623	-	-	-	534	4.8	0.07	1.0	0
1,550 acres											
East Lake, Oregon	1946	14,720	81,733	-	8,521	(a) 7,999	17,390	5.8	0.21		
970 acres	1947	14,084	64,665	-	6,337	6,467	12,933	4.8	0.20		
Average		14,402	73,200				15,160	5.3	0.20	14.8	15.6
Pathfinder Res., Wyo.	1951	7,850	47,022	-	-	-	7,050	6.0	0.15	0.3	0.3
22,600 acres											
Alcova Res., Wyo.	1951	4,752	23,275	-	-	-	6,052	4.9	0.26	1.9	2.4
2,500 acres											

TABLE IV - REFERENCES TO CRATER LAKE FISHERIES

1938 - A. D. Hasler (Ranger Naturalist at Crater Lake National Park - Summer, 1937)
Fish Biology and Limnology of Crater Lake, Oregon
Journal Wildlife Management 2(3):94-103 - July, 1938

1938 - J. S. Brode (Santa Monica Jr., College)
The Denizens of Crater Lake
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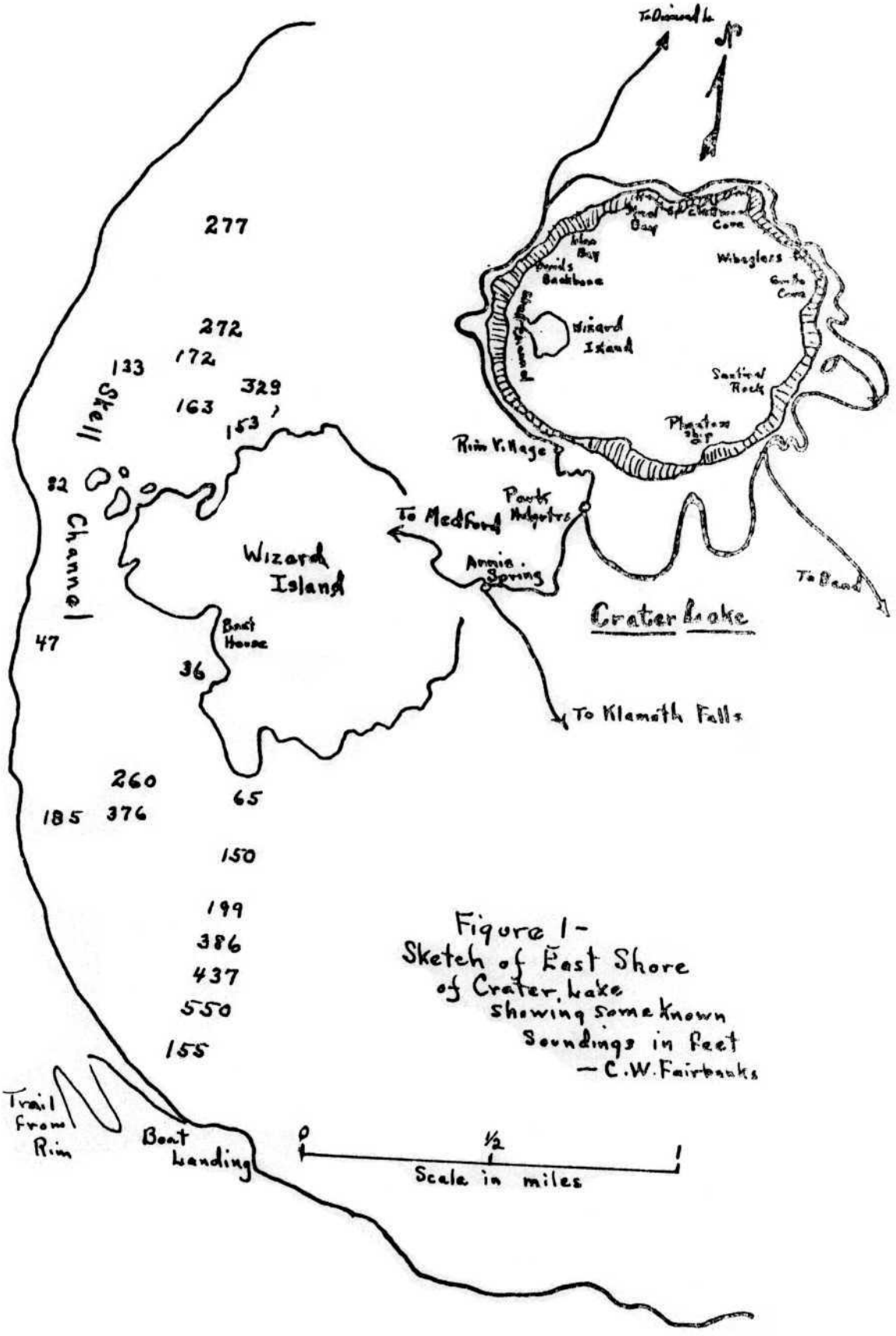

Figure 1-
Sketch of East Shore of Crater Lake showing some known Soundings in Feet
— C.W. Fairbanks