TROUT LAKES OF THE OREGON CASCADES

A Review of Fish Management

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"Life is not comprised entirely of making a living, or arguing about the future, or defaming the past. It should be comprised in part of the outdoors - and fishing."
(Herbert Hoover, U.S. Secretary of Commerce, 1926)

PREFACE

In 1990 the author, a former Oregon Department of Fish and Wildlife (ODFW) career fish biologist, retired and began gathering material to pen a brief description of Oregon's Cascade Mountain lakes and their trout. He shortly set the collected records aside, opting to travel and go fishing instead. Upon recent discovery of the stored information, he decided to prepare this summary, largely to provide a partial list of aging documents which might otherwise become lost or forgotten.

Many reports have been written regarding Cascade Range lakes and their fish. Unfortunately, a large number of those were unpublished, so may now be difficult to find. Larson and Donaldson (1971) probably offer the most comprehensive bibliography of those reports. The reference list herein adds several documents not contained in Larson and Donaldson, but only limited effort was made to identify or include those written after the late 1980s.

LAKE CREATION

Different geologic processes formed the vast majority of Cascade Mountain lakes. Foremost among those events were glaciers and volcanic activity thousands of years ago that created land depressions or blocked water courses. Available literature concerning origins of individual Oregon high lakes is mainly directed upon popular ones like Waldo and Crater. Waldo, and most other Cascade lakes both large and small, resulted from glaciation. Much has been written about geology of Crater Lake National Park's famous namesake, which lies within a deep volcanic caldera. However, Crater Lake certainly differs substantially from a typical high lake.

Lava flows accompanying volcanic eruptions produced a number of high lakes; prime examples are Davis, Hosmer and Linton lakes - also Clear and Fish lakes in the headwaters of the McKenzie River. Surface levels of lakes such as Davis and Linton can fluctuate widely and unpredictably due to their porous lava basins coupled with changes in annual precipitation.

Landslides triggered by earthquakes or heavy rainfall occasionally create some high lakes. Pamelia Lake near Mount Jefferson and Fish Lake in Douglas County resulted, at least in part, from landslides. Several small mountain lakes and ponds that support trout

are formed or made deeper by beaver dams; though some such impoundments endure for years, others can be here today and gone tomorrow.

LAKE NAMES

Early settlers named several prominent Oregon Cascade lakes. As examples: In 1852 John Diamond discovered Diamond Lake from atop his other namesake, Diamond Peak; Pamelia Lake was named in 1879 for Pamelia Ann Berry, cook for a group attempting to develop a road across the Cascade Mountains; and Oregon's largest high lake, Waldo, was named for judge and horseman John Breckenridge Waldo, who liked to summer camp there in the late 1880s. However, nearly another century passed before all of Oregon's roughly 750 Cascade lakes that currently support angling were discovered and surveyed - with the aid of aerial photography - and provided with identifying names.

High lake trout stocking programs that began in the early 1900s spurred the naming process. Persons who did the first stocking, and others who conducted initial biological and physical surveys years later, contributed most of the lake names. Those early visitors typically named lakes after themselves, friends and relatives, pets and wildlife, lake physical features or lake-related events.

To illustrate: The Eddeeleo lakes of the North Fork Willamette River drainage were given their monikers by the three horse packers - Ed Clark , Dee Wright and Leo McMahon - who first stocked them; approximately 65 lakes received the first names of women (from "Alice" to "Wendy" alphabetically) known by the fish stocking and lake survey crews; Midnight, Pete and Mouse were pack horses that carried fingerling trout or lake survey equipment; certain wildlife species were undoubtedly once observed near Fawn, Muskrat, Wolverine, Otter and Frog lakes; prominent features of Crater, Big, Lava, Clear, Meadow, Cliff, Long, Round and Moraine lakes remain easy to visualize; an old coffee jar was found by surveyors at Java Lake, and previously unknown Boo Boo Lake had no name until it was stocked by mistake from a plane in the 1960s.

To become official, lake names probably should be verified by the Oregon Geographical Names Board and/or listed in the McArthurs' (2003) noted reference book "Oregon Geographic Names". Names of various smaller lakes known to the public, especially to anglers, apparently haven't been submitted for verification, nor do they need to be. Some now overly-popular lakes may wish that they had remained anonymous and not easily accessed.

ORIGINAL PRESENCE OF TROUT

A majority of Oregon Cascade lakes lacked trout or other fish prior to stocking programs begun in earnest in 1912. Perhaps 20 to 30 high lakes on west slopes of the Cascades historically contained native coastal cutthroat trout (*Oncorhynchus clarki clarki)*. Those lakes possess outlets that cutthroat once ascended from lower elevation river systems; Clear and Fish lakes in the upper McKenzie River watershed, and Pamela and Marion lakes, are representative. Introduced fish, especially prolific brook trout, have by now

displaced native cutthroat in most of the west slope high lakes formerly occupied only by cutthroat.

Surprisingly, rainbow trout (*Oncorhynchus mykiss)* do not seem to have been in many Oregon Cascade lakes historically. But it is known that native rainbow existed in some east slope high lakes. In 1914 Glenn Johnson, member of the first packstring trout stocking crew, reported that previously unstocked Big and Little Lava lakes at the head of the Deschutes River "swarm with redsides or rainbow trout" (Johnson, 1914). He also stated that rainbow trout eggs collected in Davis and Odell lakes that same year would be used to stock other Cascade lakes to the south. Native rainbow in those two lakes, along with bull trout and whitefish, were apparently isolated centuries ago by lava flows which blocked Odell Creek to create Davis Lake. And mid-elevation Klamath Lake has long maintained a robust native rainbow population, now perhaps tainted genetically by various past introductions of trout in its watershed.

The widely encountered rainbow trout in Cascade lakes today result almost entirely from periodic planting. In only a few lakes (e.g. Erma Bells and Gold) are rainbows from past stocking able to maintain themselves by natural reproduction. Geneticists are beginning to look at some of those self-sustaining populations to help identify trout characteristics and places of origin.

Native bull trout (*Salvelinus confluentus)*, previously also called Dolly Varden in Oregon, continue to live in a few upper stream areas on both slopes of the Cascades. They also still perpetuate themselves in reduced numbers in a handful of large, deep lakes at higher elevations. Odell is an example of a lake where self-sustaining bull trout retain a tenuous toehold; helping to document historical presence of those trout is this verse composed by U.S. Forest Ranger Cy Bingham as he camped next to an Odell Lake tributary in 1903 (Cox, 1988) :

"*In the inlet there a splashing*
It's the dollys in a fight
Over who will use that riffel
For to spawn their eggs tonight.

Up the glade I hear the horsebell
Indicating all is well
There's no other life about me
In this camp at Lake Odell."

In later years bull trout were often frowned-on, even by fishery agencies, because of their predatory reputation. Due to reduced populations now, they can no longer be legally kept by anglers in most Oregon waters.

Kokanee (*Oncorhynchus nerka)*, a resident form of sockeye salmon, reside in many high elevation Pacific Northwest lakes having outlets to the ocean. Oregon is near the southern

end of this fish's natural distribution. A handful of Oregon Cascade lakes, probably including Suttle and Blue, originally contained kokanee, and still do.

Mountain whitefish (*Prosopium williamsoni)*, members of the trout and salmon family, frequent streams on both flanks of the Cascades. And they - like indigenous cutthroat, rainbow, bull trout and kokanee - still remain in occasional high lakes with outlets connected to lower elevation stream systems. Representative of these are Crescent, Big Cultus and Odell lakes in the Deschutes River drainage.

INTRODUCED TROUT

Exotic brook, brown, golden and lake (Mackinaw) trout, plus several strains of rainbow and cutthroat from hither and yon, have been stocked into one Cascade lake or another since the early 1900s.

Of those fish, brook trout are now the most ubiquitous in Cascade lakes. Brookies have proved the most successful trout in surviving and perpetuating themselves because they adapt well to cool water temperatures and limited spawning habitat prevalent in high lakes. Consequently, brook trout often outcompete and displace other trout sought by anglers. In numerous mountain lakes naturally reproducing brookies are so prolific that they become stunted in size. To counter this tendency, sterile "triploid" brook trout have been stocked recently into several Cascade lakes.

Rainbow are the second most plentiful trout found today in Cascade lakes. In the early 1900s rainbow brood stock for hatcheries came from Oregon waters, predominately the upper Deschutes River system, the McKenzie River and Klamath Lake tributary Spencer Creek. But largely due to hybridization resulting from introduction of a mixed bag of rainbow strains over the years, genetically pure Oregon rainbow are hard to find and no longer used in ODFW's high lakes stocking program. Instead, an introduced fall-spawning strain ("Cape Cod") has been used since the late 1900s; this lessens the chance of hybridizing with native rainbow and cutthroat, both of which spawn in the spring.

When first released into Oregon lakes barren of fish life but rich in their food organisms, rainbow grew fast and large. For instance, in about 1910 previously fishless Diamond Lake was initially stocked using Spencer Creek rainbow. Within a few years anglers there commonly caught rainbow weighing in excess of 15 pounds, at least one reaching over 27 pounds. And by 1924 Diamond Lake became "the largest egg-taking station in the world", with more than 17 million rainbow eggs collected that spring and transferred to various fish hatcheries for hatching and rearing (The Oregon Sportsman, November, 1924). Most Cascade lakes are smaller and less productive than Diamond Lake, so initial stocking of them seldom made a big splash.

Cutthroat are the third most common trout found in, and stocked into, Cascade lakes. As previously mentioned, not many indigenous cutthroat remain in those waters; cutthroat encountered there nowadays result primarily from periodic stocking. Various introduced strains of cutthroat were released into the high lakes since the early 1900s but commonly

did not grow or survive particularly well. In an effort to improve this shortcoming, native cutthroat were collected in 1989 from Upper McKenzie River tributary Hackelman Creek to be used as hatchery brood stock. These remain the primary cutthroat utilized for stocking Cascade lakes.

Brown trout (*Salmo trutta),* also called Loch Levens or German browns, that were horse-carried into several Cascade lakes years ago continue to persist from natural reproduction at only a few locations. Browns stocked in the 1920s do continue to maintain themselves in Linton and Suttle lakes. Good self-sustaining numbers also exist in three or four power company reservoirs in headwaters of the North Fork Umpqua River. Because browns are quite piscivorous, stocking of them in Oregon anymore is usually directed at mid-elevation lakes and reservoirs (e.g. Wickiup Reservoir) that provide a ready diet of "food fish".

Golden trout (*Oncorhynchus (mykiss) aguabonita)* prefer cold alpine waters and were planted in various Cascade lakes over 50 years ago. None grew well or persisted, although some may still maintain themselves in one or two Wallowa Mountain lakes where once introduced.

Lake trout (*Salvelinus namaycush)* were stocked decades ago into several large, deep Cascade lakes. But they still survive and reproduce successfully in only a few. Notable examples of lingering populations are in Odell, Crescent and Cultus lakes, which continue to attract limited numbers of lake trout anglers.

As mentioned earlier, kokanee still reproduce in certain lakes where this small salmon existed historically. Kokanee have since been stocked into other Cascade east slope lakes and reservoirs. Self-sustaining populations have resulted in some of those locations.

Since the 1950s, Atlantic salmon (*Salmo salar)* were experimentally released into a few Oregon lakes that offer somewhat differing habitats. Mid-elevation Hosmer Lake has proved the most successful recipient, where routine Atlantic salmon plants continue. This species is seldom trial-stocked elsewhere in Oregon anymore.

TROUT STOCKING HISTORY AND OBJECTIVES

A rapidly expanding network of roads, railroads and forest trails early in the twentieth century simplified access to Cascades lakes. Around 1911 this led recreationists to ask the newly created Oregon Fish and Game Commission to start stocking barren lakes with trout. In response, the Commission in 1912 began hiring private horse packers to stock mountain lakes. Several thousand fingerling brook, cutthroat and rainbow were packed into 116 Cascade lakes for the first time in the summers of 1912 and 1913 (Johnson, 1914).

Those stocked fingerlings, acquired from various sources, were hauled in 10 gallon milk cans by railroad from Bonneville Hatchery on the Columbia River to railheads near Bend, Detroit and Oakridge. Water in the cans was aerated by hand stirring, with ice sometimes

added for cooling. Near the railheads the trout were transferred to waiting horse pack strings. By 1916 the Fish and Game Commission had its own sophisticated railroad car, named the "Rainbow", which contained up to 180 aerated milk cans and could be attached to any train traveling around the state (Johnson, 1914; Walsh, 1960).

Other specially designed cans were carried by the horse pack strings. To be kept cool during multiple-day pack trips, cans containing the fingerlings were placed when possible into streams at night. If no stream were available, someone stayed awake to periodically stir water in the cans. One recorded pack trip extended nearly nine days with little loss of fish (Johnson, 1914). But when horses occasionally roused yellowjacket nests or met a bear on the trail, fingerling loss was prone to increase significantly!

Use of horse and mule pack strings to stock the high lakes continued until the 1950s. By that time over half of the Cascade lakes capable of supporting trout had been found and were being stocked every few years. Some lakes had adequate spawning habitat to support self-sustaining trout populations. But most lacked such habitat and required routine stocking to maintain trout numbers and angling opportunities.

After World War II, fixed-wing aircraft entered the lake planting picture and soon replaced the pack strings. Small, maneuverable planes contracted by the Oregon State Game Commission (subsequently the Oregon Wildlife Commission and now the ODFW) were outfitted with up to six aerated water compartments. Pilots operated levers to release the compartments' water and fish from heights of 100 to 300 feet above the lakes. Fish injury or mortality when hitting lake surfaces were usually negligible. Stocking was done in early summer each year from small airstrips near fish hatcheries at Fall River, Fort Klamath and Hood River. The project involved 400 or more lakes annually and took two or more weeks to complete.

However, nagging problems plagued the fixed-wing stocking program - few airplane owners were willing to offer bids for such a project, pilots had to locate unfamiliar lakes with only aerial photos for guidance, and it was difficult to drop fish with accuracy into the smaller lakes. At times trout fingerlings fell onto dry shoreline areas despite the best efforts of pilots.

Prior to 1980, use of helicopters for high lake planting was considered but not attempted due to high cost. Beginning that year it was found economically feasible for the ODFW and Forest Service to share expense of helicopter rental. A large rented Bell 212 helicopter kept on standby for summer fire suppression by the Willamette National Forest proved ideal for stocking high lakes. Thus, in 1980 this method quickly replaced fixed-wing stocking.

The chopper carried 30 aerated cans of fingerlings, along with the pilot, an ODFW biologist for lake finding, plus two harnessed Forest Service fire-fighting "rappel crew" members who would lean out and dump the cans' contents into lakes throughout the Cascades. A can held up to about 1,000 fingerlings, and 15 to 25 lakes were stocked in an average flight. Helicopter round trips typically took between 45 and 75 minutes. Each

A pack string stocking high lakes in the early 1900s

The “Rainbow” fish-carrying railroad car

summer's aerial stocking program, conducted mainly from Fall Creek Hatchery near Bend, required about a week to complete, approximately halving the time previously needed to stock from fixed-wing planes.

Within a few years the Forest Service helicopter became unavailable for high lake stocking. The ODFW then began hiring a helicopter to stock up to 650 Cascade lakes every two years. That remains the current procedure, with Fall River Hatchery the primary fish loading site. Somewhat recent advancements include a portable unit with 30 fish-holding cylinders to attach beneath helicopters, and the use of GPS (Global Positioning System) during flights to more easily locate lakes.

Several Cascade lakes now accessed by roads routinely receive fish directly from hatchery trucks. And ever since the early 1900s some lakes continue to be planted off and on by volunteers using buckets or backpack containers provided by fish agencies. Originally barren, nearly 2,000 foot deep Crater Lake was stocked with six fish species via this method between 1888 and 1940. To protect water quality it hasn't been planted since, yet some self-sustaining kokanee and rainbow remain.

Most Cascade lakes are oligotrophic, meaning poorly stratified and low in dissolved solids and plant nutrients. This limits their ability to support lavish numbers of big trout. Yet, if not overstocked, overrun by prolific brook trout or subject to frequent "winter kills", high lakes can grow decent-sized trout.

Winter kills are trout mortalities caused by a lack of oxygen when lake surfaces become frozen for prolonged periods in winter. Contributing factors are lake shallowness, a high elevation location, lack of oxygen-carrying tributaries, and severe winters. If stocked, lakes susceptible to winter kills require periodic trout survival checks to determine if continued stocking is warranted.

Through the years, fish biologists have applied the following rules of thumb when stocking Cascade lakes (Not included are specific guidelines based on recent ODFW-Forest Service coordination):

- Large and popular lakes commonly require frequent stocking to replace trout removed by angling.

- Remote lakes receive lower angling pressure and thereby require less-frequent stocking. A side benefit can sometimes be trophy sized trout.

- A stocking rate near 100 fingerlings per surface acre every 2 to 4 years is adequate for many lakes where natural reproduction does not occur.

- Stocking a mix of trout species in individual larger lakes or among lakes near one another provides diversity for anglers.

- In smaller lakes provision of a single trout species is usually adequate. Trial stocking can be conducted to determine which species a lake will best support.

- Utilize current information gathered from individual lakes regarding trout presence, numbers and growth.

- In lakes containing native cutthroat or rainbow, don't plant other trout strains or species; this precaution includes waters which may drain into those lakes. (Similar protective measures now also address bull trout).

- Generally, don't stock lakes overpopulated with self-sustaining brook trout.

- Avoid future stocking of certain lakes like Crater and Waldo because of their scientific study attributes and wide interest in protecting their uniquely pure water and associated biota.

- Consider discontinuing the stocking of some lakes in order to allow examination of possible related changes in amphibian populations.

- Discontinue stocking lakes which experience frequent winter kills.

LAKE SURVEYS

Numerous biological and/or physical surveys of Cascade lakes, some detailed and others abbreviated, have been conducted since the late 1800s. The majority of rather detailed original studies occurred between 1940 and 1970 and were made by the Oregon State Game Commission. Commission biologists assisted by college students in summer months accomplished the bulk of this information gathering. The students were usually majoring in fish and wildlife management at Oregon State College in Corvallis. (Between his junior and senior years there, the author formed half of the 1955 lake survey crew led by George Maltezos.)

A Game Commission biologist supervising many of those efforts was Bob Borovicka, stationed in Bend. His verbatim description (Borovicka, May, 1955) of typical lake survey procedure follows:

"Survey crews, consisting of two trained men and three untrained horses, have moved into the high country around the first of July with the primary mission of gathering biological and physical facts about the Cascade lakes. The equipment packed into each lake is cut to the minimum, but the necessary items always make a substantial load for one pack horse. Survey material consists of rubber life rafts, several graduated mesh gill nets, scales, minimum-maximum thermometer, sounding rope, measuring board, and a few miscellaneous essentials. The crew usually operates from a base camp situated in the heart of a lake basin. At times it is possible to return each night to the base camp after surveying individual lakes, but on occasions it is necessary to live for several days out of a frying pan and a few carefully chosen supplies. Sourdough is a substantial part of the

diet. The crews must put in long hours and work a demanding schedule to cover the assigned lakes in snow-free July, August and September. Operations start when it is first possible to move the pack string over the snow and terminate in September after the first heavy snowfall.

The physical survey consists of plotting the bottom and shore types of the lake on a prepared map by the use of symbols. It is necessary to cover the shoreline by foot and to make observations in the deep water by boat. Maximum depths and bottom contours are recorded, and a temperature series is taken at four-foot intervals by a minimum-maximum thermometer. Each lake is carefully examined for the presence or absence of spawning areas. Tributaries of the lakes are examined and data recorded as to location, temperature, size, continuity and bottom type.

A good sample of the trout population [if any yet existed] in each lake is necessary to determine condition, growth rate, the length that trout mature, and to obtain information on disease and parasites. Fish are obtained by gill netting, seining and test angling. Each fish is meticulously examined. The specimen is weighed and measured and species and condition are recorded. Scale samples are taken for growth analysis. The abdominal cavity is opened, and the sex, maturity, stomach content, degree of parasitism and general condition of the fish is recorded. The average length and weight of the maturing female fish is used to compare the growth rate of the fish populations with other lakes in the lake basin.

Management recommendations are made for each lake in the field, and additional recommendations are added after analyzing all the data that are collected. Data are analyzed in the fall and winter months, and a detailed report is prepared for future use. The information collected is designed to provide basic information for the fishery biologist ..... to make decisions on stocking policy and fish management for the benefit of the angler."

Since the 1970s, several other Cascade lake studies associated with fish presence have taken place. These were typically conducted by government agencies or through universities. Studies listed in this report's reference section speak mainly to fish and their management; seldom included are lake reports that address primary productivity or water quality, such as the numerous investigations that have peered into Crater and Waldo lakes.

MISCELLANEOUS MANAGEMENT ACTIVITIES

Listed below are brief descriptions of major Cascade lake fish management efforts, primarily those of the Oregon State Game Commission or its successors. Although discussed here largely in the past tense (prior to the 1990s), most of the activities remain ongoing.

Fish Population Status

As earlier noted, original information concerning trout in the high lakes was usually obtained by test angling or netting. Those methods were employed less as years went by, contacts with anglers being relied upon more frequently. In popular large lakes, detailed "creel census" programs were at times conducted to gather angler catch and fish population data. Questionnaire boxes were placed at some lakes and trailheads to gather volunteered information from anglers. And when biologists can shake loose in summer months, they continue to visit Cascade lakes on foot or by horseback to contact anglers, conduct test netting or angling, and make visual observations of fish survival following stocking.

For years the ODFW and its predecessors have employed fish pathologists. When considered necessary, these specialists check health of trout in high lakes, though their work is mainly focused on fish in hatcheries. Probably the most serious and persevering health problem of trout in Cascade lakes is parasitism by tapeworms and roundworms. These invaders, found mostly loose within trout body cavities, impair condition and survival, especially of rainbow and brook trout in a number of east slope lakes and reservoirs. According to parasitologists these particular worms are not a serious threat to human health if ingested.

Angling Regulations and Law Enforcement

Sport fishing regulations, including those applied to high lakes, have been set by the state's fish management agencies since 1941. Prior to that year the Oregon legislature, in its infinite wisdom, enacted most fishing regulations. Those applied nowadays by the ODFW are based primarily on fish population status, management objectives and angler preferences.

Cascade lake angling regulations have changed less through the years than those addressing lower elevation lakes and streams. For instance, "fly-fishing-only" has remained in effect at Davis and Gold lakes for decades.

Of related interest are these eye-openers: One of the first Oregon angling laws passed (in 1901) was a statewide daily catch limit of 125 trout; the first fishing license was required in 1909 and cost one dollar a year (Walsh, 1960); but women weren't required to have a license until several years later.

Mr. L.B.W. Quimby became Oregon's first "Game and Forestry Warden" in 1899 (Walsh, 1960). Records of his accomplishments and those of his successors are apparently scarce. Eventually the responsibility of fish and wildlife law enforcement was assumed by a long arm of the Oregon State Police, their salaries paid by the state fishery agencies. This enforcement approach, unique among most other states, remains successfully in place today.

Coordination, Planning and Public Contacts

The vast majority of Cascade lakes are within national forests or Wilderness areas administered by the U.S. Forest Service. For many years and by mutual agreement, fish

and wildlife on those lands were managed by the ODFW, while habitat management was the responsibility of the Forest Service. That agreement between the two agencies continues, and was formalized in a "Memorandum of Understanding" in 1986.

Ten years later a joint coordination process was developed regarding future stocking of Oregon Wilderness lakes. That Forest Service - ODFW process addressed water quality, native fish (primarily bull trout) and amphibians, plus other Wilderness management concerns. And since then, related meetings between the two agencies are held periodically to discuss emerging fishery, ecosystem and Wilderness management issues (Messmer, 2006).

In the latter half of the twentieth century the Forest Service began bolstering its staff with natural resource specialists - these included habitat biologists, soil scientists, hydrologists, botanists, landscape architects and recreation managers. One positive result was increased Forest Service attention to Cascade lakes' water quality, public uses and aesthetics. But on-the-ground advancements related to those concerns came slowly, often years after the specialists were hired, sometimes years after the Oregon State Game Commission, its successors and the public stressed that activities such as timber harvest and road construction close to high lakes were unnecessarily impacting natural resource and recreation values.

Relevant to that prolonged process, the Forest Service now better recognizes high lake attributes in its various activities and management plans. Meshing with those efforts are ODFW fish management plans for entire watersheds and some individual Cascade lakes.

Offices of the ODFW and Forest Service respond on a daily basis to a wide range of recreation-related inquiries. Many questions involve lake fishing. Biologists from both agencies help with the responses and commonly make presentations about lake and stream angling to sportsman clubs and other groups.

Both agencies offer literature for the public that describes Cascade lake fishing, and the Forest Service provides various lake area maps. A useful aid to those seeking backcountry angling opportunity in the late 1900s was an ODFW series of forest-by-forest pamphlets, no longer published, that provided details about hundreds of high lakes. Some of that information, including updated stocking data, remains available on the "ODFW" website. Unfortunately, many early records of high lake stocking were lost during a headquarters fire in the 1930s.

Control of Undesired Fish

In Cascade Mountain east slope lakes and reservoirs, invasive "rough fish" have for years created headaches. The main culprit remains the Tui chub (*Gila bicolor)*, often called roach. These prolific little interlopers, native to the Klamath basin and areas to its south, compete for food items, thereby inhibiting trout growth and the number of trout that a lake can support well. Anglers sometimes introduce chubs illegally when using them as live bait.

The most successful way found to remove unwanted chubs has been treatment of lake water to kill all fish present, followed by restocking with desired species. Rotenone - not a poison but a plant derivative that suffocates fish - is typically the treatment agent used in those rough fish eradication efforts. The first intensive project to remove chubs via this method was conducted by the Oregon State Game Commission at South Twin Lake in 1940. This was followed through the years by total or partial treatments of Crescent, Diamond, Big and Little Lava, plus a few other lakes. Diamond Lake was rotenoned twice, in 1954 and 2006. Since the latter project, accomplished cooperatively by the ODFW, Forest Service and others, rainbow trout fishing at Diamond Lake is once again productive and attracts thousands of anglers annually.

Use of trap nets to reduce chub numbers in certain waters, like Big and Little Lava lakes, has at times improved angling success for trout. Resort operators and sportsman groups have assisted biologists with some of those efforts. In larger lakes and reservoirs trap-netting usually can't keep pace with chub proliferation. This fish removal method when directed at excessive populations of brook trout has met with partial success at occasional locations such as Gold Lake.

Other Habitat Improvements

Prior discussion described chub removal and increased attention given to protecting lake water quality and aesthetics. Far less effort has been made toward physically altering high lake habitats to benefit fish. Agencies tend to accept Cascade lake habitat deficiencies without tinkering, and in most cases that is commendable. Now and then exceptions have arisen. Examples are installation of low dams in a few lake outlets to stabilize water levels, and plugging of leaks in porous shorelines that threatened to drain Hosmer and Pamelia lakes. And in a limited number of trials outside of Wilderness areas, the Forest Service has anchored tree parts in lakes that lacked fish hiding cover and also placed spawning gravel in lake tributaries or outlets.

ACKNOWLEDGEMENTS

While stationed at Grants Pass about 1949, Oregon State Game Commission fish biologist Cole Rivers planted the seed for this review. That summer he hired an Applegate Valley rancher to horse-pack fingerling trout into remote lakes of the Rogue River watershed. I, a teenage neighbor of the rancher, was allowed to tag along and help.

In the late 1980s, outdoor writer Tom McAllister generously provided me with dusty copies of "The Oregon Sportsman" magazine that held considerable historical information regarding Cascade lakes. Current ODFW fish biologists Rhine Messmer, Kelly Reis and Jeff Ziller helped describe recent high lake fish management procedures. They also supplied the three contained photographs. And considering their advanced years, retired ODFW biologists Chris Christianson, John Fortune and Mike Golden offered some surprisingly keen insights.

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REFERENCES

Andrews, John, 1964. Lake Survey of Some Lakes in the Willamette National Forest (Gold-Waldo Area). Oregon State Fame Commission.

Andrews, John, 1968. Lake Survey of Some Lakes in the Willamette National Forest, 1967-68. Oregon State Game Commission.

Bond, C.E., January, 1973. Keys to Oregon Freshwater Fishes, Technical Bulletin 58. Oregon State University Agricultural Experiment Station, Corvallis, Oregon, 42 p.

Borovicka, Robert L., May, 1955. Mile High Lakes. In Vol. II, No. 11 of the Oregon State Game Commission's "Bulletin" magazine, Portland, Oregon.

Brode, J.S., 1938. The Denizens of Crater Lake. Northwest Science 12 (3): 50-57.

Campbell, C.J., 1940. Lake Survey - Mount Hood National Forest. U.S. Forest Service, Portland, Oregon, 43 p.

Coleman, L.S., 1953. Lake Survey of Some Lakes in the Willamette, Deschutes and Mount Hood National Forests. Oregon State Game Commission, 114 p.

Cope, E.D., 1879. The Fishes of Klamath Lake, Oregon. Am. Nat., 23: 970-982.

Cox, Robert H., 1988. Blazes on the Skyline. Pacific House Books, Eugene, Or., 66 p.

Fairbanks, C.W., 1952. Crater Lake Fishing, 1952. Crater Lake Nature Notes 18: 35-36.

Fortune, John D. Jr., 1964. Masters thesis: Distribution of Kokanee (*Onchorynchus nerka)* Fingerlings in Summer as Related to Some Environmental Factors. Oregon State University, Corvallis, Oregon.

Hasler, A.D., 1938. Fish Biology and Limnology of Crater Lake, Oregon. Journal of Wildlife Management, 2 (3): 94-103.

Hasler, A.D. and D.S. Farmer, 1942. Fisheries Investigations in Crater Lake, Oregon, 1937-40. Journal of Wildlife Management, 6 (4): 319-27.

Heckart, Larry, 1961. Lake Survey of Some Lakes in the Rogue River, Deschutes, and Willamette National Forests, 1960. Oregon State Game Commission, 278 p.

Herrig, Richard, 1958. Lake Survey of Some Lakes in the Willamette and Deschutes National Forests. Oregon State Game Commission.

Hilliker, Ben, 1959. Lake Survey Report of Some Lakes in the Willamette and Mount Hood National Forests. Oregon State Game Commission. 244 p.

Hutchison, James M., April, 1991. Discrete Trout of the McKenzie River Watershed. Oregon Department of Fish and Wildlife, Portland, Oregon, 23 p.

Johnson, Glenn, August and September,1914. Stocking Cascade Mountain Lakes (Parts I and II). In The Oregon Sportsman magazine published by the "Oregon State Sportsmen's League by authority of the Oregon Fish and Game Commission", Portland, Oregon.

Johnson, Daniel M., June, 1985. Atlas of Oregon Lakes. Oregon State University Press, Corvallis, Oregon, 328 p.

Koski, Reino, June, 1949. Back Country Lakes. In the "Bulletin" magazine of the Oregon State Game Commission, Portland, Oregon.

Koski, Reino, 1957. Oregon's Back Country Lakes. Oregon State Game Commission, Portland, Oregon, 25 p.

Koski, C., 1958. Lake Survey of Some Lakes of the Willamette and Hood River National Forests. Oregon State Game Commission, 540 p.

Larmie, Fred, 1952. Lake Survey of Some Lakes in the Deschutes and Willamette National Forests. Oregon State Game Commission.

Larmie, F.M., 1955. Masters thesis: A Survey of 31 Cascade Mountain Lakes, Oregon - with Reference to the Game Fish Populations. Oregon State University, Corvallis, Oregon,145 p.

Larson, Douglas W. and John R. Donaldson, August, 1971. A Compilation of Named Lakes in Oregon. Water Resources Research Institute, Oregon State University, Corvallis, Oregon, 125 p.

Larson, Douglas, 1999. Probing the Depths of Crater Lake: A Century of Scientific Research. Oregon History Quarterly, Vol. 100. No. 3, 288-319.

Lechner, Jack, 1956. Lake Survey of Some Lakes in the Willamette and Deschutes National Forests. Oregon State Game Commission, 279 p.

Locke, F.E., 1947. A Preliminary Report on the Diamond Lake Study. Oregon State Game Commission, 21 p.

Maltezos, George C. and Verne Mallory, 1954. Lake Survey of Some Lakes in the Umpqua, Willamette, Deschutes and Mount Hood National Forests. Oregon State Game Commission.

Maltezos, George C., 1955. Lake Survey of Some High Lakes in the Deschutes and Willamette National Forests. Oregon State Game Commission.

McAllister, Tom, July-August,1988. Last of the Packstring Summers. In the "Oregon Wildlife" magazine of the Oregon Department of Fish and Wildlife, Portland, Oregon.

McArthur, Lewis A. and Lewis L., 2003. Oregon Geographic Names. Oregon Historical Press, 1,073 p.

Messmer, Rhine T., 2006. History and Overview of Oregon Department of Fish and Wildlife's Wilderness (High Lakes) Management Program. Presented at the "High Mountain Lake Management and Research Symposium", National Conservation Training Center, December 12-13, 2006 in Shepherdstown, West Virginia. Oregon Department of Fish and Wildlife.

Mortenson, Eric, July 12, 1987. Tunnel Vision Dooms a Dream. A Eugene Register Guard newspaper article concerning an attempt to drain Waldo Lake.

Nelson, P.O., and G.K. Delwiche, 1983. Sensitivity of Oregon's Cascade lakes to Acid Precipitation. Water Resources Research Institute, Corvallis, Oregon, 56 p.

Newcomb, H.R., 1941. A biological Investigation of 40 Lakes of the Upper Deschutes River in Oregon. Oregon State Game Commission, 207 p.

Pasero, George, July 17,1949. Fishing in Reverse. The Oregon Journal newspaper, Portland, Oregon.

Pillow, B., 1941. Lake Survey Repot Number 2. Oregon State Game Commission, 31 p.

Robinson, R.J., 1941. How Fish Came to Crater Lake. Nature Notes 16: 15-17.

Roth, A.R., 1937. A Survey of the Waters of the South Umpqua Ranger District, Umpqua National Forest. U.S. Forest Service, 41 p.

Smith, W.D. and W. Greenup, 1939. Lakes of Oregon. Northwest Science 13 (4): 76-96.

Smith, F.A. Jr., November, 1947. Oregon's Cascade Lakes. In the "Bulletin" magazine of the Oregon State Game Commission, Portland, Oregon.

State of Oregon Office of the State Engineer, 1939. Streams and Lakes in the State of Oregon. Salem, Oregon, 279 p.

The Oregon Sportsman, November, 1924. A magazine published monthly by the "Oregon State Sportsmen's League by authority of the Oregon Fish and Game Commission", Portland, Oregon.

U.S. Forest Service, 1968. Lake Survey Report for Five Areas - Cache Lake Group, Santiam Area, Mid-Columbia District, Taylor Burn Area and Irish-Taylor Area, 1967. U.S. Forest Service, Portland, Oregon,76 p.

Wallis, O.L. and C.E. Bond, 1950. Establishment of Kokanee in Crater Lake, Oregon. Journal of Wildlife Management, 14: 190-193.

Walsh, Clark, January, 1960. The Good Old Days - A Review of Game and Fish Administration in Oregon. Oregon State Game Commission, Portland, Oregon, 10 p.

Wellman, Roy E. and Thomas S. Donovan Jr., 1975. A Report of General Water Chemistry for Upper Willamette Fish District High Lakes. Lane Community College, Eugene, Oregon.

Wustenburg, Donald W., 1953. Lake Survey of Some Lakes in the Deschutes, Willamette and Rogue River National Forests. Oregon State Game Commission, 362 p.

Wetherbee, J.J., 1963. Central Willamette District Lake Survey Activities, 1962. Oregon State Game Commission, 57 p.

Wetherbee, Joe, September, 1971. Anatomy of a Lake. In the "Bulletin" magazine of the Oregon State Game Commission, Portland, Oregon.

Willamette National Forest, 1971. Lakes of the Willamette. U.S. Department of Agriculture, Forest Service, Eugene, Oregon, 42 p.

Young, F.R., 1962. Survey of Some Lakes in the Willamette and Mount Hood National Forests, 1961. Oregon State Game Commission, 225 p.

Ziesenhenne, F.C., 1937. Lake Survey of the Willamette National Forest. Department of Agriculture, U.S. Forest Service, 32 p.

Ziesenhenne, Fred C., 1938. Lake Survey of the Willamette National Forest. Department of Agriculture, U.S. Forest Service, 44 p.

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