

## Alpine Lakes Hurt by Fish Stocking

**Studies show that stocking fish into once “fishless” alpine lakes is a misguided practice exacting a heavy toll on fragile alpine aquatic ecosystems.**

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Kokanee salmon are among the large species of game fish that have been introduced throughout the Sierra Nevadas. These fish are running in a stream that feeds into Lake Tahoe.

The stocking of sport fish, especially trout, creates lots of opportunities for recreational fishermen as well as the small communities that cater to them.

About a decade ago, I along with two climbing buddies of mine were making our way to the base of Cathedral Peak (el. 10,911 ft.), in Yosemite National Park's Tuolumne Meadows area. Cathedral Peak is a giant shark fin of granite, which offers technical rock climbers several beautiful climbing routes up its flanks.

As we hoofed it to the peak's base, we stopped just long enough to watch a solitary angler pull a brilliantly colored and patterned trout from a high-attitude tarn. The fish looked to be a bit malformed and undernourished. And that's the last I thought about the solitary fishermen and the sickly trout until recently when trying to come up with a theme for this blog.

My climbing companions and I had hiked several miles while gaining a couple of thousand feet in elevation by the time we reached the lake and saw the squirming fish being pulled from the water with some 8-pound test. We had hiked several hours up a dusty trail passing en route a stream stairstepped with waterfalls, its source being the leftover snowfields in the area. But how did this anemic-looking fish make it to the lake where we were witnessing its anti-baptism? It hadn't swum upstream against the punishing cataracts. No, this fish had had help of the human kind.

The American West was settled by all manner of eastern dudes in the 19th century, and these same settlers wanted to establish some of the sport fishing traditions they were weaned on. So, they began to stock, from about the 1850s up to the present, thousands upon thousands of formerly fishless high-attitude alpine lakes with the fish of their youth – game fish, mostly trout, mostly non-native. Many a fingerling trout was backpacked into a remote mountain lake by some piscine Johnny Appleseed and released. Later, aerial stocking was used to introduce sport fish into many of these same alpine aquatic ecosystems. And even when stocking some of these fishless lakes with local native rainbow trout et al., the good souls doing the stocking were still introducing fish exotic to ecosystems that had evolved sans fish. Some of these western lakes had been without fish since the rollback of Ice Age glaciers more than 10,000 years earlier.

### Silent Sierras

I live in California, so let's take the magnificent 450-mile-long Sierra Nevada as a case in point as to the devastating impacts predatory game fishes can have when stocked into historically fishless lakes. And what has and is still occurring in the Sierras is also taking place in virtually every mountain range in the western United States where there are high-altitude lakes and streams.

Much of the information in this blog was gleaned from the report “Non-Native Trout in Natural Lakes of the Sierra Nevada: An Analysis of Their Distribution and Impacts on Native Aquatic Biota” by Roland A. Knapp. As this report was generated in 1996, I'm sure these irreplaceable ecosystems have degraded even further in the interim while those where fish stocking has stopped have at least somewhat recovered to their pre-fish status.

Prior to the California Gold Rush and the onslaught of tens of thousands of 49ers, trout were not present in lakes and streams much above 6,000 feet. As a result of 150 years of fish stocking throughout the Sierras, every watershed is now home to at least five species of big non-native game fishes, including brook trout, lake trout, Atlantic salmon, kokanee salmon and brown trout. Many of these stocked populations have become self-sustaining and no longer require artificial replenishment.

According to a 1992 study, of the 4,131 mountain lakes in California higher than about 2,600 feet, 63 percent have introduced fishes and 52 percent were being regularly stocked. Most of the estimated 37 percent of fishless lakes were either too small, too shallow or both to support and sustain trout.

A phasing out of stocking fishes in the national parks began in the 1970s and the practice was completely ban in 1991.

Some of the lakes in Yosemite, Sequoia and Kings Canyon national parks have reverted back to their pre-fish glory, with some fish-extirpated fauna even reestablishing itself from nearby refugia that never met the trout criteria and were never stocked as a result.

So, what kind of environmental impact have non-native trout dealt to high-altitude alpine lakes in the Sierras and other parts of the West?

Native fishes have suffered throughout the range where they've come in contact with non-native fishes. Native fishes often can't compete and are displaced by more aggressive newcomers, and hybridization between native species and introduced species has and continues to occur.

Throughout the Sierras native amphibian species are in decline. Various theories as to why include climate change, habitat loss, introduced pathogens and non-native bullfrogs. Trout introductions have been directly implicated in the extirpation of historic populations of mountain yellow-legged frogs from lakes they both came to share, however briefly that may have been.

The life cycle of *Rana muscosa* makes this Sierran amphibian more susceptible than most to predation by introduced predatory fishes. Not only do the adult yellow-legged frogs spend most of their time in the water of the lakes they inhabit, but their tadpoles need at least two years for metamorphosis to a terrestrial stage. This requires that the frogs and tadpoles be found in relatively deep alpine lakes that still retain some oxygen when covered in ice; these are the same lakes where most of the non-native trout are stocked. Obviously, the hungry fish quickly dispatch all future generations of *R. muscosa* found in the same habitat.

The *Saprolegnia* fungus, commonly found on hatchery-raised trout, has been found on amphibian egg masses in the Cascades. It has been discovered on mountain yellow-legged frog egg masses in the Sierras, too.

The stocking of large predatory fishes into fishless environments has also been found to shift a lake's zooplankton population from large-bodied species to small-bodied species. Trout introductions seem to coincide with the extirpation of large-bodied *Daphnia* and *Diaptomus* species from the lakes they all inhabit.

Some studies suggest that Sierran zooplankton species may be able to repopulate lakes once fish are gone, while other studies suggest just the opposite. Many species of zooplankton can lie in wait for years at a time and then reinvigorate a habitat. One species has been shown to remain dormant for more than 300 years, and if some of the Sierran zooplankton species possess similar capabilities, then they could spring back once fish are removed mechanically or non-sustaining populations are left to their own devices.

The stocking of trout into fishless Sierran lakes seems to have extirpated the phantom midge (*Chaoborus americanus*) from throughout the Sierra Nevada.

In the Sierra as well as other western mountain locales, benthic macroinvertebrate communities are decimated by introduced predatory fishes into formerly fishless aquatic ecosystems. Sierran lakes with introduced fishes also lacked otherwise common mayfly and caddisfly larvae and aquatic beetles. A recent study by the University of California, Davis, scientists has shown that aquatic insect populations quickly rebound in alpine lakes once fish are removed.

You can't knock out multiple legs of the food chain in these alpine aquatic ecosystems without the inevitable ripple effect taking place. In the Sierras, one species that is disproportionately affected, albeit indirectly, is the western terrestrial gartersnake (*Thamnophis elegans*), which heavily preys on yellow-legged tadpoles and frogs. No tadpoles, no frogs, no snakes – perhaps?

Tadpoles are also prodigious algae eaters and without them, algae levels rise and can adversely affect a lake's nutrient and oxygen levels, which can lead to the demise of smaller organisms lower down in the food chain.

#### Cultural Mindset

I grew up in the West, and my dad always spoke of fish hatcheries and the stocking of trout in highly favorable terms. And sport fishing keeps many a small western burg afloat during the lean summer months before the snow flies and annual pilgrimages of skiers refill local coffers. I don't fish myself, never had the patience for it. But I believe sport fisheries are part of our western heritage, however ill-conceived the helter-skelter manner in which they may have been originally established was.

But I think that in historically fishless high-altitude lakes that are isolated in backcountry wilderness areas that the practice

of stocking and restocking non-native and even native fishes not native to particular watersheds should be stopped, not tomorrow, but last week. There's no need for it. There are more than enough places to cast one's line. Let these fragile ecosystems rebound and if you want to introduce something, reintroduce locally extirpated species that resided in a particular lake prior to piscine introductions.

The verdict is clear: the practice of introducing non-native (this includes those fish that are hatchery reared) fishes into every river and rivulet, drainage ditch, pond and lake is not the best way to manage our rich natural aquatic heritage. The time – like so many natural-resources philosophies of the 19th and 20th centuries – for the indiscriminate stocking of non-native fishes into our native aquatic biotopes has come and gone. While it would be impossible to completely undo these artificially derived sport fisheries, those in the West's high-elevation lakes, not to mention riparian habitats in the Southwest where non-native species are also exacting a heavy toll on pupfishes and other native fishes, could certainly be reevaluated and a much more enlightened 21st century approach taken.

If you'd like to chime in on this issue, e-mail the United States Dept. of Agriculture and let them know that you'd like to see native fisheries reestablish in our national forests and the practice of stocking non-native game fishes in backcountry lakes and streams in federally protected wilderness areas stopped.

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