

# Issue Profile: A Review of Temperature-based Fishing Restrictions

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## **INTRODUCTION/BACKGROUND**

Maine's coldwater fisheries are a unique resource and a focus of carefully planned management strategies to ensure their sustainability. Management strategies are developed by fisheries biologists using best available information, including survey data, published literature, professional experiences, and information from anglers. Fishing regulations are often implemented to help achieve specific management strategy goals.

Recent drought conditions and associated potential increases in water temperatures have prompted questions to MDIFW from the angling public regarding the value of implementing temperature-based fishing restrictions to reduce angling related stress and mortality. Many anglers already promote abstaining from fishing when they believe the water is too warm. MDIFW also provides general guidance to the angling public regarding fishing practices that reduce angling stress, particularly when environmental conditions are less optimal in late summer. The public advocacy conveyed appears to be born out of concern that angling above a certain water temperature will negatively impact the targeted fish population. Given the more recent extremes in weather patterns, and expressed public concern, MDIFW conducted a comprehensive review of temperature-based coldwater fishery restrictions to better understand the strategies and science behind these restrictions. This review process included scientific literature, popular articles, and information provided by other state fisheries management agencies across the US.

## **SUMMARY OF RELEVANT FINDINGS**

There are several variations of temperature-based fishing recommendations and restrictions employed by state management agencies across the US. Strategies are very broad, ranging from nonregulatory recommendations that anglers should increase harvest to regulatory bans on all fishing. The most well-known temperature-based fishing restriction is referred to as a "hoot owl" which prohibits fishing during the warmest part of the day. A hoot owl restriction is intended to mitigate potential stress induced angling mortality. The term "hoot owl" was adopted from the western US logging industry which encouraged tree harvest operations during morning hours (when "Hoot Owls" vocalize) to reduce fire risk during the drier hours of the day. Reduced oxygen and elevated temperatures are the primary concerns in fisheries management. The amount of oxygen that can dissolve in water is inversely related to water temperature, therefore as water warms less oxygen is available for fish. Hoot owl restrictions most often target coldwater trout species, as they become stressed and are more susceptible to mortality when water warms (generally  $\geq 68\text{F}$ ) and oxygen levels drop (generally  $\leq 5$  ppm) than warmwater species. The added stress from playing fish on a line and subsequent handling may further increase the incidence of post-release stress and mortality. In most instances when water temperatures or oxygen levels approach unfavorable levels, coldwater fish will relocate to areas with more favorable conditions. These movements can alter the local densities of coldwater fish within a watershed by reducing numbers in less suitable areas and increasing them in more suitable areas.

In the western US where hoot owl restrictions are currently used on a limited basis, elevated water temperatures generally correspond with drought and low flows. Low flows in rivers and streams exacerbate oxygen issues because water temperatures climb more rapidly due to the reduced thermal mass of water. Further, low flow conditions may reduce thermal refugia, areas where fish can find cooler temperatures and higher oxygen concentrations, and force fish to congregate in the remaining deep pools and areas where cooler ground water flows into the stream. Trout concentrated into small areas may be easier targets for knowledgeable anglers and natural predators, the classic fish in a barrel situation, which could further contribute to increased angling stress and mortality.

Though several states implement special fishing regulations due to high water temperatures, it appears only Montana, Oregon, Washington, and Yellowstone National Park have issued true hoot owl restrictions. The Montana Department of Fish, Wildlife and Parks, was the first state to implement hoot owl restrictions in 2008. Montana temporarily closes select native and non-native trout fisheries from 2pm through midnight when water temperatures exceed 73F for three consecutive days (Montana Fish, Wildlife & Parks, 2021). These fisheries are reopened by September 15, or earlier if the daily maximum water temperature is less than or equal to 70F for three consecutive days (though more restrictive reopening criteria are used specifically for Bull Trout, an ESA Threatened species). In 2020 Montana instituted an annual hoot owl restriction on the lower Madison River effective each year from July 15 through August 15.

The Oregon Department of Fish and Wildlife first used hoot owl restrictions in the mid-2010's, due to elevated water temperatures on the Deschutes River caused by a severe heatwave. Oregon has since used hoot owl restrictions to close several salmon, trout, steelhead, and sturgeon fisheries on select flowing waters due to low flows, high water temperatures, and reduced run counts (anadromous fishes are counted at several hydropower dams). These restrictions prevent fishing from 2pm to one hour before sunrise to reduce mortality of native returning adult anadromous fish populations, including some that are ESA listed. The restrictions are typically in effect from July 1 to September 30, but end dates can be amended based on water conditions. In combination with the hoot owl, Oregon has also applied a complete closure to fishing within 200 feet of some tributary mouths to allow fish to safely use these areas throughout the day without any angling pressure. Oregon has also temporarily closed several fisheries where biologists documented reduced run counts, extremely high temperatures (as high as 85F), and resulting fish kills.

The Washington Department of Fish and Wildlife implemented hoot owl restrictions in 2015 (no fishing 2pm–midnight) on more than 60 flowing waters and closed several others due to severe drought but does not appear to have used hoot owls since (Rotter 2015). These fisheries were largely comprised of ESA listed salmonids and other wild salmonids. Lastly, rivers and streams within Yellowstone National Park were closed to fishing for several weeks in 2021 from 2pm through sunrise during low flow conditions when water temperatures exceeded 68F (Warthin, 2021). Yellowstone's fisheries include a mix of native and nonnative species.

Several other states use water temperatures to alter angling regulations that are not true hoot owl restrictions. For example, Colorado Parks and Wildlife reserve the ability to close a fishery temporarily if water temperatures exceed 71F, flows are below 50% baseflow, and/or dissolved oxygen is less than

6ppm (Colorado Parks and Wildlife, 2022). Interestingly, these restrictions were designed to protect non-native trout fisheries, not the native cutthroat trout the state's well known for, because native trout are high in the drainage where water temperatures currently remain cool enough throughout the year.

A completely opposite approach to hoot owl restrictions has been employed by the Utah Division of Wildlife Resources. They increased bag limits on stocked trout ponds when water temperatures were high (Utah Division of Wildlife Resources, 2021). The thinking behind allowing increased harvest is that fish will undoubtedly die due to temperature and oxygen stress, and reducing their numbers decreases competition for thermal refugia giving the remaining fish a better chance at survival.

Massachusetts and Connecticut have adopted a different approach than the other states previously mentioned. Rather than close entire river systems, they close specific areas to fishing from June 15 through September 15 that provide seasonal thermal refuge. These "thermal refuges" exist where cool tributary water flows into mainstem rivers and therefore attract significant numbers of trout seeking relief from the otherwise warm river water. Signs are posted near these confluences indicating the area is closed to fishing within 100' of the sign. The protected fisheries are predominately stocked Brown Trout, though some wild Brook Trout may also occur within the closed areas.

Rather than implement restrictive angling regulations, many states and non-governmental organizations more commonly invest in outreach to create public awareness that encourages responsible angling practices, including refraining from fishing for coldwater species during times of the day when water temperatures are elevated (see examples in Table 1). Some states also encourage anglers to instead target warmwater species or coldwater species in lakes and ponds and higher elevation flowing waters where water temperatures are lower. Outside of Yellowstone, Wyoming encourages anglers that do not refrain from fishing waters with elevated temperatures to harvest the fish they catch, as the fish are more likely to die upon release. Some states, including Maine, Connecticut and Vermont promote responsible angling practices, in addition to precluding angling in critical coldwater refugia where trout congregate when water temperatures increase above preferred levels. The latter perhaps is important where angler use is high.

*Table 1 Examples of temperature-based recommendations.*

<b>State/Organization</b>	<b>Recommendation</b>
California	Compiles a "hoot owl watchlist" that includes waters with sustained water temperatures that exceed 67F and asks anglers to voluntarily not fish these waters after 12pm each day.
Colorado	Issues partial/full day voluntary closures if water temperatures exceed 71F, flows are below 50% baseflow, and/or dissolved oxygen is less than 6ppm.
Maine	Developed "Fishing Responsibly for Trout During Warm Weather" messaging to share with anglers. Recommend fishing for coldwater species early in the morning and limit the time it takes to land and release fish. Also encourage anglers to target warmwater species when water temperatures are high/flows are low.
Michigan	Posts signs along some rivers that encourage anglers to consider not fishing for coldwater species when water temperatures are high.
New York	Recommends anglers avoiding fishing for trout when stream temperatures exceed 70F.
Trout Unlimited	Encourages members to self-regulate and state management agencies to develop regulations to reduce stress on salmonids when water temperatures are high. Various state chapters have also developed their own recommendations, sometimes in coordination with state agencies.
Vermont	When water temperatures exceed 70F: discourages catch-and-release fishing for trout, play and release fish quickly, fish early in the morning, and avoid fishing areas where trout have congregated in unusually high numbers.
Wyoming	Encourages anglers to harvest fish when the water temperature is above 65F and recommends against catch and release angling when temperatures exceed 70F.

Setting the start and end of temperature-based fishing recommendations and restrictions is commonly done using real-time temperature data provided through USGS (United States Geological Survey) gauging stations. Western states, where water rights are carefully allocated, and drought as well as elevated water temperatures are a common occurrence, have many more temperature equipped USGS gauging stations than in Maine. For example, Montana has approximately 64 permanent/seasonal USGS temperature gauges, Oregon has ~ 147, Colorado ~ 91, and California ~ 155. While Maine has ~79 total gauging stations only six provide water temperature data. Furthermore, only three of the six stations in Maine are located in rivers that support coldwater fisheries. There are thousands of miles of flowing water between existing stations with little to no relationship to the temperatures documented at the gauging stations. Maine does have an extensive network of temperature loggers; however, the data must be manually downloaded to provide temperature information. While these loggers would

not be helpful in identifying real-time temperatures, they do provide an important historical reference and can help determine how frequently and during what periods of the year our coldwater river fisheries generally experience elevated temperatures. In addition, these data may also be used in the future to develop models relating air and water temperature so that air temperature data, which is more widely available in real-time, could be used to predict water temperature and allow us to better anticipate potential resource impacts from climate change to focus conservation investments.

Outreach is another significant challenge implementing any “emergency” temperature-based fishing restrictions. Among the states that currently implement unscheduled recommendations and closures, most rely on notifying the public via email (e.g., GovDelivery), press releases, social media, agency website, and signage at popular fishing/parking locations within the affected area. Enforcement can be a challenge with unscheduled mandatory closures and lack of public awareness, as indicated by online posts from anglers suggesting there are still many anglers violating these rules. Documentation of how frequently anglers were cited for fishing closed waters was not readily available, but it is fair to assume there are a mix of intentional and unintentional violators.

## **DISCUSSION/CONCLUSIONS/RECOMENDATIONS**

On the surface, and at the individual fish level, hoot owl restrictions seem logical. Playing and handling fish that are already stressed by temperatures surely increases individual mortality. However, few states have adopted these restrictions and scientific evidence showing positive benefits from these restrictions are lacking. A search of primary literature only revealed one article (Jeanson et al., 2021) that makes use of the phrase “Hoot Owl Fishing”, and the article only mentions their existence. There does not appear to be any published studies that have analyzed the ecological or economic impacts of hoot owl fishing restrictions. However, a recent study, currently under review, by the Idaho Department of Fish and Game found that Hoot Owl restrictions likely do not have population level impacts because angler catch rates decline as water temperatures increase (Meyer & McCormick, 2022). Even though angling induced fish mortality increases with increased water temperatures, fewer fish are actually caught. This recent study combined with the lack of economic and population-level impact information suggests that adoptions of temperature-based fishing restrictions are influenced by public perception of resource benefits and the precautionary principal (Hilborn, Maguire, Parma, & Rosenberg, 2001).

Even if compelling data justified use of hoot owl restrictions, current known restrictions were developed for use in western states with vastly different climate, hydrography, coldwater fish assemblages, and fishing pressure than Maine. Western states experience drought much more frequently than the Northeast (Bolinger, 2019). In addition, Maine’s unique hydrography of interconnected streams and lakes allows fish to more easily move between flowing and non-flowing waters (Jackson & Zydlewski, 2009). This interconnectivity combined with an abundance of deep natural lakes provides vast areas for stream dwelling trout to seek thermal refuge during periods of high stream temperatures. Western states largely lack this interconnectivity, which means stream populations of coldwater fish are generally wholly reliant on the smaller in-stream areas of refuge.

There are also differences in trout assemblages among Maine and western states. Though Brook, Rainbow, Brown, and Cutthroat Trout have similar temperature tolerances (Johnstone & Rahel, 2003; Wehrly, Wang, & Mitro, 2007), Brook Trout appear to outcompete Cutthroat at high temperatures (De Staso & Rahel, 1994), so may be better able to withstand temporary high-water temperatures than the Cutthroat Trout of the Western US. Lastly, fishing pressure among most of Maine's wild coldwater fisheries is much lower than many of the western states where temperature-based fishing closures have been implemented. For example, the Madison River, which supports one of Montana's most popular trout fisheries and has an annual hoot owl restriction, had an estimated 207,000 angler days in 2017 (Montana Fish, Wildlife & Parks, 2020). In comparison, Maine's famed Magalloway River saw an estimated 4,687 angler days in 2016 (Howatt, 2017). Colorado Parks and Wildlife also uses fishing pressure as the primary criteria in their [Fishing Closure Decision Tree](#) to determine when a fishery should be voluntarily closed versus closed through an emergency closure. If a water meets their criteria for potential action (e.g., low flows, high temperatures, etc.) but receives little to no fishing pressure, the state takes an angler education approach instead of pursuing a voluntary or emergency closure. Washington also referenced fishing pressure as a reason to implement hoot owl restrictions on many of the state's flowing waters in 2015.

Ecological theory would suggest that if there are enough thermal refugia to allow the entire population to shelter during high temperatures then temporary closure of thermal refugia to angling would increase survival, as deaths would only occur from predators. However, if there is a lack of thermal refugia then competition for space and oxygen due to overcrowding will increase natural mortality and increased angler induced stress or harvest could reduce competition and increase survival for remaining fish. Any analysis is complex, and the best approach is likely to vary considerably from water to water and even within a water. Unfortunately, without research into the effects of temperature-based closures there is little to scientifically direct efforts and biologists can only apply their best guess based on theory, experiences, and observations.

Available thermal refugia could also be enhanced through habitat improvement projects aimed at creating deep pools, increasing tree cover, increasing stream-lake connectivity, and limiting water extraction to ensure the water table is high enough to maintain pools and allow cool groundwater to flow through stream beds. Habitat improvement projects do have rigorous scientific support (Whiteway, Biron, Zimmermann, Venter, & Grant, 2010), but these projects are costly and the benefits to fish populations may not be evident for years.

In Maine, and as is the case across much of the US, there is little data to suggest that angling during periods of elevated water temperatures is causing population-level impacts to our coldwater fisheries. While Maine's coldwater fish seasonally congregate in coldwater refuges within flowing waters, exact locations of all available refugia are not well documented but are believed to be abundant. Additionally, many stream connected lakes and ponds are either thermally stratified or contain areas of groundwater recharge that provide relief from warm water conditions. Similar to Massachusetts and Connecticut, Maine has established closures of areas providing critical seasonal refugia. For example, a tributary (Abbott Brook in Lincoln Plt) of the popular high angler use Magalloway River is seasonally closed to fishing to protect vulnerable brook trout from angling. Areas outside the refugia remain open to angling for lower density fish that have not relocated to refugia.

MDIFW remains committed to protecting our native fish populations and will continue to manage coldwater fish populations based on known threats, including changes in climate. Our 2021–2035 Strategic Management Plan includes several goals related to mitigating potential climate change-related impacts. Moving forward we will also continue to develop and share outreach materials with anglers to encourage responsible fishing practices, particularly when fish are stressed. Protecting critical habitats will also continue to be a focus in the management of native coldwater fisheries.

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# COOPERATIVE

STATE



FEDERAL

# PROJECT

This report has been funded in part by the Federal Aid in Sport Fish Restoration Program. This is a cooperative effort involving federal and state government agencies. The program is designed to increase sport fishing and boating opportunities through the wise investment of angler's and boater's tax dollars in state sport fishery projects. This program which was founded in 1950 was named the Dingell-Johnson Act in recognition of the congressmen who spearheaded this effort. In 1984 this act was amended through the Wallop Breaux Amendment (also named for the congressional sponsors) and provided a threefold increase in Federal monies for sportfish restoration, aquatic education and motorboat access.

The program is an outstanding example of a "user pays-user benefits" or "user fee" program. In this case, anglers and boaters are the users. Briefly, anglers and boaters are responsible for payment of fishing tackle, excise taxes, motorboat fuel taxes, and import duties on tackle and boats. These monies are collected by the sport fishing industry, deposited in the Department of Treasury, and are allocated the year following collection to state fishery agencies for sport fisheries and boating access projects. Generally, each project must be evaluated and approved by the U.S. Fish and Wildlife Service (USFWS). The benefits provided by these projects to users complete the cycle between "user pays – user benefits."



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