Bull Trout — *Salvelinus confluentus*

By Susan McDougall

She swims far upriver to the most pristine habitats, where the water is clear, the gravel beds clean and plentiful, and the woody debris perfect for shelter. It is cold here, as frigid as the sea, many miles distant. While her mate watches and waits nearby, she scoops a depression, and quivering, lays her eggs. Six-years -old, she is middle-aged for her species: there will be time for another visit. Her eggs fertilized by the attendant male, she covers them, and without a backwards look, turns seaward once again.

As closely related members of the Salmon (Salmonidae) family, for many years the Bull Trout (*Salvelinus confluentus*) was confused with the Dolly Varden Trout (*Salvelinus magma*). The two species are separated by small, difficult to observe differences such as the strong teeth present in the Bull Trout's "medial margins," and differences in gill rakers, the fine toothlike projections at the front of the gills that filter food. Rather than recognizable morphological features, it is these fine distinctions that have secured the separate status of the two species.

With large spots that range from white to yellow to occasionally reddish, the Bull Trout's body varies from gray to pale olive-green in color. It is rounded and slender, the head long and flat, and sharply tapered. The fins lack spots, the mouth curves downward, and the teeth are strong and well-developed. There are approximately 27 branchiostegal rays, curved bonelike structures that support the gills: these rays are more numerous than those of the Dolly Varden.

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Bull Trout is one of six worldwide species that are called "char." These members of the *Salvelinus* genus are distinguished from other trout by the color of their spots and fewer teeth on the roof of the mouth. The number of species included under the char name varies depending on authority and history, but currently there are approximately 51 recognized species worldwide, with five in North America: all have sea-run populations. As with other *Salvelinus*, these are cold water specialists.

The most northerly of all freshwater fish, the Arctic Char (*Salvelinus alpinus*) is circumpolar in distribution. The Bull Trout is more restricted in range, inhabiting freshwater rivers, streams, and lakes, as well as saltwater. This char ranges from Alaska south to Washington, including the Salish Sea and the Columbia River, through Canada as far east as Alberta, and across the northern states to the Missouri River drainage, and south to central Nevada. At one time Bull Trout was present in the McCloud River of northern California; however, that population has been extirpated. It is found in the Olympic Peninsula

freshwater habitats, including rivers that drain into the Strait of Juan de Fuca. In particular, the Bull Trout is resident in the Dungeness and Elwha rivers, and their tributaries. Here an anadromous form matures in the waters of the Strait.

Bull Trout are a long-lived, large char with specific habitat requirements. The maximum length is approximately 28 inches (72 cm), with the largest recorded at 41 inches (104 cm). However, the length is typically from 12-18 inches (30-46 cm). The average weight is 2.4 pounds, although individuals weighing nearly 20 pounds have been caught. Sea-run Bull Trout tend to be larger than freshwater residents.

Slow to mature and long-lived for a trout, Bull Trout are known to reach an old age of 10 years and to mature between four and seven years. They spawn annually or every other year, most often between August and November, but sometimes later. Females lay an average of 5,000 eggs, depositing them in a redd (nest) she digs in clean gravels. The eggs may take as long as 210 days to hatch. Bull Trout fry remain in their natal stream from one to four years before migrating, either within the riverine system, including lakes, or to nearshore marine habitats. Although anadromous adults have been observed in the ocean where they possibly migrate between rivers, they are believed to remain most often close to the river where they hatched.

This native North American char exhibits several lifestyles, and individuals may sometimes “switch” habitats from their accustomed range to a different place. There are riverine and lacustrine forms in addition to the less numerous anadromous populations, with most moving from their spawning grounds in small streams into larger rivers. However, offspring of riverine females may exhibit different life histories, with some migrating to saltwater where they undertake an anadromous existence, while others remain in rivers. Some may travel to high altitude lakes, returning to spawn in streams and rivers. Other populations are isolated by impediments such as waterfalls; such barriers limit their options to an entire life spent in small headwater streams.

Cold and Clean

Sea-run Bull Trout adults are larger than their freshwater cousins, but all exhibit a common requirement for cold, clean water. Tolerated temperature is limited to less than 55 degrees Fahrenheit (13 °C), with 50 degrees more common. Pristine environments are a necessity. Egg incubation is believed to require temperatures between 36- and 39-degrees Fahrenheit (2 - 4 °C), while juvenile growth is best at about 45 °F (7 °C).

Thus, of all the salmon species inhabiting the waters of the Pacific Northwest, Bull Trout are the most demanding in their habitat requirements. They are characterized as requiring what the “4 C’s” — cold, clean, complex, and connected. It has also been shown that the protective cover of logs and other structures provides an excellent habitat for juvenile Bull Trout.

With such specific requirements, it is not surprising that this species shows a preference for waters distant from the impacts of human habitation, including that of agriculture, logging, development, and other factors that alter river conditions. The increase in sediment alone from such activities is enough to alter water quality, impacting the reproductive cycle of the trout. Quantitative research into stream sediment load has shown a positive correlation to spawning success.

Away from modifications, Bull Trout can thrive in cold, clear waters; pristine rivers like the Gray Wolf River, the largest tributary of the Dungeness River, offer such an environment free of human impact. Here Bull Trout spawning can result in a much higher success rate, measurable by observations of the number of fry that emerge from gravel beds free of sediment.

Although historically widely distributed across the west, this salmonid's specific demands for cold clear water and clean gravel have resulted in Bull Trout spawning success in waters away from development. Whereas in the past adults may have successfully spawned throughout a river basin, their specific needs mean that their range has been severely reduced. In some cases, local Bull Trout populations have been extirpated. And while many Bull Trout exhibit a traveling lifestyle, moving from small streams to riverine environments, and migrating downstream to the rich waters of the sea, all require that combination of cool habitat conditions. Such a demand is perhaps not surprising, given the evolutionary path of this robust species.

Char — Evolutionary Time Scales

Recent research has placed the beginnings of the Salmonidae family at approximately 59.1 million years ago. A fossil named *Eosalmo driftwoodensis* dates to 50 MYA; fragments were first identified in Driftwood Canyon Provincial Park in British Columbia. Apparently, a land-locked species, this ancient salmonid is considered the most primitive member of the Salmoninae, a subfamily of the Salmonidae. It is believed to have evolved from a grayling-like fish. These fish, members of a different subfamily —the Thymallinae — are considered the sister group to the rest of the family.

The char genus — *Salvelinus* — separated from its close relative *Oncorhynchus* (the salmon genus composed of several familiar species such as the Chinook) around 26-29 million years ago, or possibly less. This was about the time of the start of the Neogene, a geological period characterized by cooling conditions, in large part driven by tectonic activity and ensuing shifts in oceanic currents.

Thus, divergence in the char genus occurred later than other salmonids, most likely in the Pliocene-Holocene, less than 6 million years ago. Although tracing the evolutionary background of *Salvelinus* is challenging, recent studies provide some insight into the abiotic and biotic factors that contributed to its wide range. For although members of a relatively small genus, the species of char have occupied habitats throughout the cool waters of the Northern Hemisphere.

Strongly influenced by changing climatic conditions — particularly the beginning of the Pleistocene epoch, but in other cycles as well — population numbers undoubtedly fluctuated, with char occupying newly available habitats during warming periods and contracting to refugia during cold. Hybridization, local extinctions, competition for resources, and alterations in water bodies, including their boundaries and pathways, all contributed to a truly dynamic evolutionary path. It was one that would challenge future researchers and lend itself well to genetic as well as morphological and ecological studies. Investigative approaches would sometimes result in disagreement on relationships and time of species' divergence in what could be considered the most dynamic of all salmonid groups.

The Bull Trout and the Dolly Varden are believed by some researchers to have maintained their population numbers outside of the boundaries of the latest glaciation (the Wisconsin) that in the Pacific Northwest extended southward to what would become Puget Sound. It is possible that the Bull Trout may have evolved during this second half of the Pleistocene, persisting for a time in the Columbia River drainages as the ice advanced.

As the glaciers expanded southward, to survive, plants and animals moved in conjunction, sometimes occupying small niches in refugia within the glacial boundaries, but often finding a suitable environment at lower latitudes, where dispersal might take place far from their ancient home. Ice blocked a northward migration, while evolution, at times flexible but also lagging behind such rapid alterations, placed demands on organisms that challenged their ability to respond. In this scenario, a

genus with "phenotypic plasticity" — that is, the ability to respond morphologically without genetic alterations — and with members already tolerant of cold water, as the glaciers melted and withdrew *Salvelinus* was poised to benefit from newly opened, unoccupied habitats. Nothing was static in this environment; movement was inevitable.

However, this promising scenario of melting glaciers and newly available freshwater streams and lakes does not imply that *Salvelinus* species were adapted to all water bodies. They continued to prefer the cold marginal waters, even in more southerly locations. And research indicates that it was here, at the edge of the glaciers, that the char, including the Bull Trout, thrived. Colonization by an interior population, away from the coast, most likely occurred at the boundary between melting ice and outflow in the northerly reaches of the ancient Columbia River. From a small lineage, other so-called "founder" populations arose, occupying edges of their original ranges. In time, the post-glacial distribution of *Salvelinus* species would range from desert lakes, which may have served as refugia during the glacial maximum, to icy northern rivers. The newly formed Salish Sea provided such an opportunity, and along with its salmon cousins, char such as the Bull Trout and the Dolly Varden were undoubtedly quick to take advantage of the icy-cold waters.

Several thousand years into the future, new techniques for studying post-glacial char species' connections, including those of the Bull Trout, would provide an unprecedented challenge to scientists researching fish evolution. Relationships, colonization, evolutionary pressures, influence of terrain and water bodies — all such factors and more would prove difficult to tease out. Different methods, both genetic and morphological, would often lead to contradictory results, while advances provided encouragement that progress in understanding was being made.

One of the indicators of difficulties in char studies was the disagreement over the *number* of species. The fish may have known who their relatives were, but the scientists who studied them exhibited some confusion. In North America alone scientists would "identify" as many as 45 species: today the number is five. These include not only the Bull Trout and Dolly Varden, but also the Arctic Char and two more southerly species that contribute to a coast-to-coast range of the genus. The Arctic Char is the most widespread of the *Salvelinus:* this is a species that can withstand freezing temperatures at a latitude of 82 degrees north on Ellesmere Island, the most northerly location of any freshwater fish on the planet. To the south, the Brook Trout (*Salvelinus fontinalis*) at one time thrived in the mountainous streams of South Carolina.

One problem (among others) facing researchers is whether to define a specific geographic group as a subspecies. Genetic studies often differentiate populations resident in specific river drainages, while at the same time, char at locations nearer the stream's source may be closely related. Bottlenecks in isolated populations may reduce genetic diversity or result in extirpation, while connected systems provide opportunities for diversification.

The difficulties in separating char species (at one time as many as 24 subspecies were described for Arctic Char) might be expected in a genus that has adapted and advanced northward in a period measured in thousands of years rather than millions since the ending of the glacial maximum. And overall, *Salvelinus* evolution is very recent, driven in part by changes driven in lockstep with melting ice.

Char Symposium

The challenge of understanding char diversity goes beyond the "young" genus itself; the potential for application to fish diversification and evolutionary processes is evident, with implications across

various fields. For *Salvelinus*, the benefits of convening and exchanging information resulted in the first "Char Symposium," held in Winnipeg, Manitoba, in 1981. Since that first meeting, eight more have been held, with the most recent in Nikko, Japan (2023). Such gatherings consist of several days of presentations, covering subjects such as evolution, conservation, lifestyle, post glacial migrations, fisheries management, and aquaculture. As with many symposiums, connections are made, and lectures are published. Such a symposium serves as a venue for disseminating information and encouraging communication and collaboration. With more than 100 people typically present, the breadth of subjects covered is indicative of the range of interests of the attendees.

Although the majority of publications concern the Arctic Char, information presented at the symposium concerning Bull Trout can be directly relevant to conservation efforts. Other subjects include research into the various Bull Trout lifestyles, such as non-migratory populations.

Listing — 1999

On November 1, 1999, under the auspices of the Endangered Species Act (ESA) of 1973, the United States Fish and Wildlife Service (USFWS) listed all populations of Bull Trout as threatened within the coterminous United States. This followed a ruling the preceding year that had determined three populations — Klamath River, Columbia River, and Jarbidge River — as threatened.

The efforts to list Bull Trout as endangered began in 1992 with a filing of a petition by the Alliance for the Wild Rockies (AWR), the Friends of the Wild Swan (FOWS), and the Swan View Coalition, all organizations headquartered in Montana. The motivation to list the Bull Trout was based upon data revealing serious declines in lakes and rivers that had been considered the most robust for the species. Flathead Lake and Lake Pend Orielle populations were considered imperiled, with redd counts dropping by two-thirds or more in the region, and Bull Trout was also rare in the extensive Clark Fork River system. In the mainstem of the Bitterroot River the species was considered extirpated.

It is interesting to note that the petitioners represented a wide range of interests, from conservationists to anglers to businesses. The submittal describes the life history of the Bull Trout and the many known threats to sustainability while expressing concern over poor management by regulatory organizations. The Bull Trout was disappearing, and nothing was in place to halt the decline.

The petition includes data, is specific in naming populations, comments on redd surveys, and in general, presents the case for listing.

However, following submittal of this well-documented petition, no response was forthcoming for six years. The USFWS indicated that data was "insufficient." Meanwhile, Bull Trout numbers continued to fall throughout the species' range.

In legal terms, the Bull Trout had fallen into a "warranted" category but was also "precluded," a ranking system that critics of the USFWS claim is a delaying tactic. In 1994, the USFWS determined that Bull Trout was likely to continue its decline, naming timber harvest as the number one culprit. That year, a lawsuit was filed by the AWR and FOWS to force the USFWS to release a "twelve-month finding" that included a status review. When finally released, this document declared the bull trout as "moderately" threatened, reducing the priority ranking, in contrast to a higher ranking issued earlier. Back-and-forth reviews and reassignments of priority eventually led to a court decision that placed the USFWS at fault for its inconsistencies in analysis and findings. In 1997, the agency acknowledged that the Bull Trout consisted of five populations and proposed listing two of them. Back to court, but while rulings indicated that the Puget Sound population, including the Olympic Peninsula, warranted listing, in June of 1998 the

announcement of threatened status of the only proposed populations was made — the Columbia and the Klamath rivers. However, in 1999, all populations were listed as threatened. In part this may have been a reaction to an emergency "endangered" listing for the Jarbidge River population in northern Nevada, another group in decline that had recently been subjected to runoff from an unauthorized road project in Elko County.

In 1999, all Bull Trout in the coterminous United States were finally listed.

After Listing

As required by the Endangered Species Act (ESA), following listing of the Bull Trout throughout its range a Recovery Plan was prepared. In 2004, five years after listing, a draft plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout was published; this plan was subject to public review. This document was published after a Management Plan issued by the Washington Department of Fish and Wildlife in 2000. One of the most disconcerting statements in this plan was the "unknown" status of most bull trout stocks in Washington — 80 such stocks were designated. The plan was prepared with the acknowledgement of providing guidance under a Wild Salmonid Policy, and consistency with federal recovery plans. In the introduction to the Management Plan, the priority for recovery is designated as resource protection. The goal is to reach stock levels of sufficient numbers to support fisheries.

A call for recruitment and population increases of native char to rivers and streams they once inhabited is made, but if this approach is deemed improbable, *supplementation* may be employed. In other words, hatchery reproduction.

Today, with a "threatened" designation, recreational fishing can and does continue for Bull Trout, although most often it is at a reduced level. On the Strait Bull Trout falls under the "catch and release" ruling while in many lakes and reservoirs this char can be retained under "game fish" rules. Emergency declarations can halt fishing, while exceptions to rules may be granted for activities such as commercial fishing that take Bull Trout as bycatch.

Data - the Strive Towards Recovery

The Federal Register filing that lists the Bull Trout identifies three river basins in the Strait; these are the Elwha, the Angeles Basin, which includes creeks such as Morris, Ennis, Siebert, and Bagley, and the Dungeness River, with five subpopulations defined for the three systems. Acknowledging the threat from habitat alterations and isolation by dams on the Elwha, the data available at the time for that drainage was very sparse, with native char (including both Bull Trout and Dolly Varden) typically counted as incidental observations in surveys for other salmonid species. For example, in 1994 an electrofishing effort in the Dungeness directed at Steelhead (*Oncorhynchus mykiss*) collected six char specimens, later determined to consist of 4-5 Bull Trout. In 1996, five were collected in the lower Dungeness. Also prior to listing, a few "native char" were observed in the Elwha. Surveys in 1996 provided data suggesting "strength" in the upper Dungeness. However, as made clear in the Federal Register document, three subpopulations in the Strait of Juan de Fuca area were of "unknown" status due to insufficient data. Bull Trout had never been a priority species for surveys but listing the entire U.S. range of a fish that was so diverse in its lifestyle would result both in documentation such as a Recovery Plan, as well as ensuing increased quantification efforts.

A study undertaken on Bull Trout in the Dungeness River from 2003-2006 employed multiple tracking methods. These included radio tags planted into 51 fish and tracked for up to 2.5 years. Of these fish, 27 percent were determined to be anadromous, a finding that contributed much to the knowledge of that Bull Trout lifestyle in the Strait. Additionally, aerial tracking, as well as spawning and snorkeling surveys were also included in the study. Five objectives specified for these programs reveal the efforts that would of necessity be implemented to understand a sparsely quantified species. Broad categories such as identifying spawning areas, increasing knowledge of migrations, and evaluating habitat use, all relatively unknown in three core areas — the lower and middle Dungeness, and the Gray Wolf rivers. Additionally, researching and prioritizing restoration projects within the Olympic National Forest was an important part of the effort.

There was much to be learned, and tagging provided the opportunity for following individual fish as they moved up-and-down the rivers, into the sea (for some), and back. Among other observations, it was learned that most anadromous Bull Trout returned to saltwater from May to August. The other tagged fish were fluvial, residing in freshwater, sometimes moving between the Dungeness and Gray Wolf. Multiple spawning migrations were observed, with the fish returning downstream following spawning.

Spawning surveys were undertaken in the two rivers for three years with a total of 78 recorded surveys. Most spawning took place from September through November.

One of the most interesting findings was that the majority of tagged fish spawned in the Gray Wolf; 31 redds were identified in 2004. Such an observation contributed to knowledge of spawning habitat, such as the tendency to utilize side channels, where gravels are abundant.

The study notes the heavily modified nature of the lower Dungeness River while in contrast, the Gray Wolf River, which is located mainly in Olympic National Park and designated wilderness, is relatively untouched. Results confirmed the Bull Trout's preference for clear, pristine waters with clean gravel substrate, and noted the benefit of protective structures such as log jams, some placed in the river for previous restoration projects. Such quantitative data contributed greatly to the knowledge of Bull Trout movements and preferences, confirming in large measure what was known of the species' requirements, while at the same time providing a baseline for going forward in determining the status and planning for the recovery, as directed by the ESA, of this threatened fish.

More surveys have been undertaken since this initial effort following the listing of the Bull Trout in 1999. Acoustic monitoring continues in the Dungeness, with data being acquired through at least 2024. Two snorkeling surveys were undertaken in 2021 and 2022 from the mouth of the Dungeness to barriers present on both that river and the Gray Wolf. Those surveys resulted in a count of 220 Bull Trout in the Dungeness and 130 in the Gray Wolf. Additionally, DNA work has been undertaken; results for this research indicated Dolly Varden is also present in the basin.

Filling gaps in data, the importance of these studies is clear. It is difficult to plan for a species' restoration and to stop a freefall to extinction, if knowledge of distribution and requirements, revealed through increased data on a complex lifestyle, is lacking. Such information is important both to mitigation efforts and the goal of halting destructive practices for not only Bull Trout but other fish species as well.

At the Edge of the Ice

Research in laboratory settings and in the field offers insight into the dynamics of char populations and evolution. Because of its northerly distribution, the Arctic Char provides an excellent opportunity to

study recent char colonization of large and small lakes and river connectivity as well. Such investigations provide insight into the response of species such as the Bull Trout to the recession of the ice following glacial maximums. Newly available habitats would have contributed not only to dispersion but to morphological and genetic alterations to species of cold waters at the glacial boundaries.

One such study of the Arctic Char was undertaken near the Brooks Range in Alaska. There, Arctic Char had colonized postglacial lakes with varying hydrology. Populations resident in these lakes, and connecting rivers as well, were the subjects of genetic studies, with the goal of understanding behavior and life history, fitness, morphology, and other factors that contribute to adaptation to specific environments. Colonization of the lakes is recent, perhaps only 10,000 years ago, and yet they are not uniform, varying in abiotic and biotic characteristics alike. Connectivity also varies, with some connected by water pathways and others isolated. It could be expected that Arctic Char in these diverse habitats would differ in response to demands and possibilities. Lakes would be colonized at different times, where productivity would at the very least suggest larger fish in such an environment. This response is not necessarily genetic but rather due to the "phenotypic plasticity" of char, referring to the ability to respond to environmental changes without accompanying genetic alterations. Larger size does not imply genetic difference but rather reflects this plasticity of the char genus.

One of the most important conclusions from this Alaskan lake study is that both morphological and genetic response can vary widely across a spatially small terrain. Eventual evolutionary response is driven not only by time and divergence, but on biotic factors such as predators and habitat changes due to warming and other responses over time.

As with the variable forms of Arctic Char present in the northern latitudes, the Bull Trout may well have exhibited morphologies coupled with genetic differences. While a single species is recognized today, other forms may have come and gone in the relatively recent past, including the populations that colonized the present and older rivers of the Olympic Peninsula. The species' evolutionary requirement for cold, clear, water may have placed constraints on movement, but the availability of suitable habitat as the glaciers melted provided an unmatched opportunity for a fish on the move.

The Origins of Bull Trout in the Strait of Juan de Fuca

What can the studies of the more northerly Arctic Char tell us about the colonization path and the population dynamics of the related Bull Trout? During the latest glacial maximum, the Bull Trout and other fish species were blocked by ice from entry into what would become the Salish Sea, including the Strait of Juan de Fuca. Known as the Vashon Stade, approximately 16,900 years ago the ice reached as far south as the Black River valley to its junction with the Chehalis River. An ice dam blocked northward freshwater outflow, resulting in a southward flow over what is known as the "Black Hills Spillway." Via the Chehalis River the freshwater reached the Pacific. The river valley, however, was not connected to the Columbia River.

As the ice began its retreat small lakes formed along the glacial boundary, much like the lake terrain in the Alaskan study mentioned above. Fish colonization of these lakes may have been facilitated via the freshwater passage still available to the south. The formation of large lakes, including one known as Lake Russell would have offered more habitat.

At times, the ice retreated very quickly, and by 15,900 years ago the front had reached the Strait, opening Puget Sound to the ocean. The movement of fish species, particularly those that could adopt an

anadromous lifestyle would have been greatly facilitated via salt water, while freshwater rivers, now formed and reaching the sea became available to those species of cold, flowing waters.

It seems possible that Bull Trout would have expanded their range as the ice retreated after the glacial maximum; sometimes very rapidly. Large and small lakes alike formed near glacial edges, while newly available rivers, flowing to deglaciated land, provided connections and the cold water preferred by char and other glacially adapted species would have been an open invitation to colonization.

At least one route other than Black River drainage suggests itself for Bull Trout migration to the Strait. Radio-tagging studies in Puget Sound reveal that anadromous individuals sometimes migrate distances from one river mouth to another and back that measure as much as 75 miles; this is undertaken in a single season. Rivers that empty into the Pacific dot the Washington coast, with some originating in the coastal range and others with sources in the Olympic Mountains. The Columbia River mouth is 60 miles from the Chehalis River; a short 35 miles north of the Chehalis, the Quinault River reaches the ocean at Taholah. Such distances would certainly have been within the migratory capabilities of Bull Trout. The shoreline lay further west during the glacial maximum, but as the ice melted a local incursion of the sea took place. And with it an opportunity for colonization. Fish species, including the Bull Trout, often behave quickly in response to new habitats. An instructive modern example is the movement of Bull Trout up the Elwha River after dam removal. The first of the salmonids to arrive above the Glines Canyon Dam site, tagged fish were located 40 miles from the river mouth by 2017, just five years after dam removal. Clearly, this is a species with the ability to quickly take advantage of newly opened waters.

Today the Bull Trout occupies a broad territory with distinct populations in the interior west and a coastal group the ranges from the Klamath Basin in Oregon to the northern waters of the Salish Sea, including the Strait of Juan de Fuca. There it exhibits the variable lifestyles of a highly adapted fish, an ice age creature that undoubtedly persisted in southern refugia, while being poised for a quick northern occupation as the planet warmed.

The Bull Trout has been described as a "voracious" fish, one quick to take advantage of any prey within its realm. This is a human perception that could be applied to our own species; even the word itself means "to devour," a recognizable trait. In the past this perceived (and sometimes grudgingly admired) Bull Trout feeding behavior resulted in "killing" programs in which Bull Trout was targeted by large-scale commercial fisheries in the early 20th century to bounties and poisoning as recently as 1990. Even the federal government got into the act through designated funding. Only nine years later this species would be listed by that same government as "threatened."

Excuses for ignorance no longer hold. The Bull Trout might be considered more the "canary in the coal mine" rather than a mindless, devouring predator. This fish may have a cosmopolitan diet, but it is very particular in its habitat preferences. Perhaps it is adaptable to a warming world, a question that is asked about so many fish species. But at the present time this long-lived trout requires cold, pristine waters. The question is: can that need be met? Or must the species be consigned to hatchery production where water is cooled, and fish are released to an environment where they may or may not survive.