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Proposal to Develop Muskellunge Broodstock To Maintain Current Tiger Muskie Program In Washington

Current Program:

Sterile tiger muskies (muskellunge x northern pike) were first introduced into Washington in 1988. Over the past 18 years they have been planted into eleven different Washington waters. Currently, tiger muskie fingerlings are annually planted into seven waters totaling 11,700 surface acres. Though the program is small, it provides a uniquely popular trophy fishery for 16,000 (3% of licensed anglers) Washington anglers. The fishery provides an estimated 56,000 (3.5 days/angler/year) angler days of recreation and an associated economic value of $7,560,000 ($135/angler day) per year to the states economy. Annual cost to produce tiger muskies is very low.

For 18 years this fishery program has been dependent upon Minnesota Department Natural Resources (DNR) production of tiger muskie eggs. Recently, Minnesota DNR decided to terminate their tiger muskie egg production program in 2008. This termination will eliminate Washington Department of Fish and Wildlife's (WDFG) source of tiger muskie eggs. No other tiger muskie egg sources are available that pass aquatic nuisance species-free and disease-free certification. The future of WDFW's successful tiger muskie program is dependant on WDFW becoming self-sufficient through the development of an in-state muskellunge broodstock. Development of a muskellunge broodstock would allow WDFW to produce sterile tiger muskies, by crossing male northern pike with female muskellunge to maintain the current popular tiger muskie fisheries across the state.

Muskellunge Broodstock Development Plan

To develop a muskellunge broodstock, WDFW needs to obtain 10,000 Leech Lake strain muskellunge eyed eggs from Minnesota DNR. Hatching the eggs and rearing the fry would take place at WDFW's Columbia Basin Hatchery. Rearing of the muskies is contained within a fish culture system that is isolated with five separate water outflow screens. These recently installed screens prevent any downstream escapement into the hatchery outlet creek. Muskellunge would be planted in either October as 6-inch fingerlings or June as 10-inch fingerlings into Newman Lake and Silver Lake in Spokane County. These lakes are currently planted with tiger muskies and would switch to plants of only fertile muskellunge. These two waters would ultimately become the proposed muskellunge broodstock waters. There are no surface water connections between these two waters and any other waters. No fertile muskellunge would be planted anywhere else in the state.

Muskellunge will take 4 to 5 years to become sexually mature. If WDFW initiates the development of a muskellunge broodstock program in 2006, the first egg take will occur in 2010 or 2011. Prior to any transfer of eggs to Columbia Basin Hatchery, the

broodstock program will need to be certified disease-free. Sexually mature muskellunge would be captured with trap nets in early spring from the shallow bays of Newman and Silver Lakes. These eggs would be fertilized at the lakes with either muskellunge milt for broodstock replacement needs or northern pike milt from the Pend Oreille River or IDFG sources to produce sterile tiger muskies.

Muskellunge eggs for broodstock would be hatched and reared at Columbia Basin Hatchery in Moses Lake. At six inches in length, these muskellunge would later be coded-wire tagged and planted back into Newman and Silver Lakes in Spokane County as broodstock replacement. There is little chance that muskellunge would be able to naturally reproduce in these two waters. Hatchery plants of tiger muskies would be terminated in these two waters.

Hatching and fry rearing of sterile tiger muskies would take place at the Columbia Basin Hatchery. As 7-inch fingerlings, these sterile fish would be transferred to the Meseberg Hatchery and reared to 12 inches. In the spring, these fingerlings would be coded-wire tagged and planted into the five previously SEPA approved tiger muskie waters to maintain current stocking program. Those SEPA approved waters are: Mayfield Reservoir (Lewis Co.), Merwin Reservoir (Cowlitz Co.), Tapps Reservoir (Pierce Co.), Evergreen Reservoir (Grant Co.), and Curlew Lake (Ferry Co.).

Environmental Concerns:

Areas of concerns or risks associated with the muskellunge broodstock development are emigration/escapement, illegal introductions, reproduction, and predation.

Escapement/Emigration

Over the past 18 years limited numbers of tiger muskies have emigrated from the water in which that they were planted. This proposal does not change the plan to continue planting sterile tiger muskies into five of the seven currently planted waters. The Escapement/Emigration issue is particularly directed at Newman Lake and Silver Lake (the two proposed broodstock waters in Spokane County) and the Columbia Basin Hatchery in Moses Lake.

Both Newman Lake and Silver Lake have received annual plants of tiger muskies since 1992 and 2002 respectively. Newman Lake has a small outlet ditch that seeps into the ground in a wetland. There are no surface water connections to other waters. Silver Lake has a small outlet flow that also goes underground and does not connect to any other surface waters. These are the only waters where fertile muskellunge will be present. There have been several changes in the rearing protocol at the Columbia Basin Hatchery to accommodate the rearing of muskellunge. Previously, single screens were standard at the Columbia Basin Hatchery. Recently, an additional three isolating small mesh wedge-wire screens have been installed at this facility to prevent any escapement of live

muskies. The egg and fry culture building remains locked at all times to prevent public access.

Illegal Introductions

There is little concern that anglers would be able to or even try to illegally move muskellunge from the two broodstock waters to other state waters. A study on 8 lakes in Wisconsin found that the mean angler catch rate for muskies greater than 30 inches was 71.4 hours/muskie and ranged from 40 to 166.7 hours/muskie (Hanson 1986). Newman Lake and Silver Lake would be managed with a one-fish daily limit and a 44-inch minimum size limit. This would make it highly unlikely that an angler could catch sufficient muskellunge, have adequate numbers of both sexes, and possess sufficiently large livewells to transport these easily stressed large fish. Unlike bass, perch, crappie, and sunfish, which are capable of reproducing in most Washington waters, muskellunge have very stringent spawning requirements. There are few waters in Washington where muskellunge could successfully spawn, even if planted with the prescribed numbers of fish.

Reproduction

The main difference between tiger muskies and muskellunge is that the latter can reproduce, but only under pristine conditions. Due to their stringent habitat requirements, even in their natural range only about 20% of the muskellunge populations are self-sustaining (Dombeck et al. 1986). The remaining waters depend on plants of hatchery cultured muskellunge fingerlings. New muskellunge introductions rarely produce self-sustaining populations (Hess and Hartwell 1978). Annual recruitment of muskellunge is low to none, depending on presence of ideal spawning habitat. Standing crops of muskellunge under ideal conditions average less than 1 fish per surface acre, which is similar to our current densities of planted tiger muskie in Washington waters.

To reproduce, muskellunge require pristine oligotrophic waters with minimal shoreline and watershed development. They do not reproduce successfully in eutrophic waters or waters with low ph or low alkalinity. Muskellunge reproduction success is best in waters with rising springtime water levels on flooded near-shoreline areas (Becker 1983). Stable or declining water levels are very detrimental to spawning success (Dombeck et al. 1986). The critical factor that limits muskellunge reproductive success, differentiating them from other esocids, is that muskellunge have non-adhesive eggs that stay in direct contact with the bottom materials throughout embryonic development (Hess and Hartwell 1978). Survival of eggs and larvae requires that the shoreline spawning substrate have no or very low biological oxygen demand (BOD). BOD is created when nighttime plant growth respiration or organic detritus decay removes dissolved oxygen (DO) from the water (Dombeck et al. 1984). The critical location of this BOD is at the 10 mm area interface of the bottom substrate and the water. If the water in this interface area micro-stratifies and the DO drops below 4.0 ppm during egg incubation and larval fry development, the mortalities are total (Siefert et al. 1973; Dombeck et al. 1984; Zorn et al. 1998).

Washington has few waters that would meet these specific habitat requirements for successful reproduction. The waters that are directly or remotely connected to the Columbia Basin Hatchery do not have the potential for successful reproduction of muskellunge. These Columbia Basin waters do have high alkalinity and high ph. However, all of these waters are eutrophic or ultra-eutrophic, with developed and disturbed shorelines or watersheds. Also, these waters do not have rising springtime waters levels over flooded terrestrial shorelines where the bottom substrate has low BOD. These factors would outweigh the high alkalinity and high ph and make reproduction highly unlikely. For similar reasons, neither Newman Lake nor Silver Lake, the two proposed broodstock waters, has any potential for successful muskellunge reproduction.

Predation

Predation issues with muskellunge are nearly identical to those of tiger muskie, though quite different from northern pike, which can potentially achieve much higher population densities. Native northern pike populations in the mid-western U.S can achieve densities as high as 24 adult fish/acre (Pierce and Tomcko 2005), while adult muskellunge densities approaching 1 fish/acre are considered quite high (Cornelius and Margeneau 1999). Hansen (1986) reported a density of 0.3 adult muskellunge/acre for eight Wisconsin lakes, while Siler and Beyerle (1986) achieved an artificially high density of 0.84 adult muskellunge/acre through supplemental stocking and a 36-inch length limit.

Like tiger muskie, muskellunge target fusiform, soft-rayed fish species, although they are somewhat less selective with regard to consuming some species of spiny-rayed prey. Engstrom-Heg et al. (1986) demonstrated that when presented with soft-rayed prey and yellow perch, both tiger muskie and muskellunge generally ate the soft-rayed prey first, but muskellunge preyed upon perch more readily than tiger muskie. Supporting this finding, Bozek et al. (1999), in a study of 34 water bodies in Wisconsin, found that yellow perch made up 30% (by number) of muskellunge diet. However, other spiny-rayed fish such as walleye (0.9%), sunfish (7%), and black bass (2.9%) combined to make up a very small portion of the diet. A study conducted by Fayram et al. (2005) indicated that there was no evidence of strong interaction, through either competition or predation, between walleye and muskellunge.

Four of the seven waters stocked with tiger muskies in Washington have received studies focusing on their foraging habits. In the seven waters that contain tiger muskies, the target forage fish were suckers, northern pikeminnow, tench, carp, and sunfish. Caromile (WDFW, unpublished data) concluded that tiger muskies in Merwin and Mayfield lakes did not target chinook, coho, or steelhead fry or smolts, nor did they target kokanee, bull trout, and cutthroat. Instead, in both lakes northern pikeminnow was the primary prey species. In Curlew Lake, Baker and Bolding (WDFW, unpublished data) found that northern pikeminnow was the most abundantly consumed prey item by tiger muskie in summer and fall, accounting for 40% and 34% (by number) of the diet, respectively, but they were consumed at a lower rater in the spring (15% of diet). Rainbow trout accounted for 16% of the diet in the summer and 28% of the diet in fall, but were more

commonly eaten in the spring (40% of diet). Largemouth bass made up between 15-20% of the diet during all three seasons. Tiger muskie selected for northern pikeminnow, and to a lesser extent trout, in the summer and fall. However, in spring, rainbow trout were selected for while northern pikeminnow were selected against. Tiger muskie selected against largemouth bass during all three seasons, eating few in comparison to their relative abundance in the lake.

In Silver Lake, Baker and Bolding (WDFW, unpublished data) saw a similar pattern with regard to trout predation by tiger muskie, with most occurring in the spring and little to none in the summer and fall. Instead, during the warmer months, tiger muskies selected small pumpkinseed sunfish and largemouth bass as prey, most likely as a result of the relatively small size of the recently stocked tiger muskies (mean size = 28 inches) and their subsequent inability to consume the predominately 12-15 inch target forage population (tench).

While there is some predation on trout by tiger muskie in Washington waters, it is important to note that it is seasonally restricted to the cooler months when tiger muskie are likely feeding less actively. Also, these trout populations are artificially increased with hatchery stockings of catchable-sized trout, making them available for trout anglers as well as tiger muskies. Although no bioenergetics model for tiger muskie currently exist, one can make the logical assumption that tiger muskie metabolic demand increases with water temperature. Consequently, the number of trout eaten by tiger muskie is lower in comparison to the target forage species, which either compete directly with trout for food and habitat resources (e.g. northern pikeminnow and pumpkinseed sunfish) or prey on trout themselves (e.g. northern pikeminnow and largemouth bass).

It is also important to make a distinction between hatchery planted trout and salmon. While trout carry out their entire life cycle in freshwater (and are, therefore, exposed to predation from the standpoint of size, for much of their lives), salmon are by comparison, exposed to predation for a much shorter period of time. Adult chinook, coho, and steelhead are too large to be consumed by tiger muskie, while smolts are too small to be an attractive prey selection. Tiger muskie and other esocids target prey that are 20-30% of their own body length (Baker and Bolding, WDFW unpublished data: Bozek et al. 1999). Therefore, during the period when salmon and steelhead are at this preferred prey size and would be most vulnerable to predation from muskies, they are absent from fresh water, returning only after reaching sufficient size to make them invulnerable to esocid predation.

Muskellunge coexisted in their native range with popular gamefish such as walleye, smallmouth bass, largemouth bass, crappie, and sunfish species. Fisheries managers from Minnesota, Wisconsin, and Michigan have since successfully added chinook, coho, steelhead, and brown trout to waters containing muskellunge (R. F. Strand, Minnesota DNR, personal communication).

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