Exhibit I
Dave Moskowitz

Memorandum Supporting Commission Action on Cold Water Refugia

To: Oregon Fish and Wildlife Commission
Fr: The Conservation Angler, Native Fish Society, Wild Fish Conservancy
Dt: June 6, 2018
Re: Consideration of Rules Protecting Columbia River Cold Water Refugia for Wild Salmon and Steelhead

The purpose of this memo is to outline a path forward to providing essential conservation measures for wild Columbia Basin steelhead and salmon which the Commission may implement under existing authority.

Summary:
1. Our organizations support development of a permanent rule protecting cold water refugia by 2019.
2. The Fish and Wildlife Commission should direct ODFW to draft a temporary rule for 2018.
3. Adequate information exists of the location, significance and use of cold water refugia by wild steelhead.
4. The Commission should direct ODFW to move forward regardless of the EPA process and progress.

Background:
Low numbers of several ESA-listed wild salmon and steelhead populations return to the Columbia and Snake River and face conditions adverse to their success in reaching their natal rivers. Re-building abundant wild runs should focus on restoring naturally spawning populations of wild fish. If wild salmon and steelhead populations are rebuilt, they may provide wild fish fisheries themselves. If they are merely ESA-recovered, wild salmon and steelhead populations will remain the limiting factor for fisheries targeting more abundant hatchery fish.

The adverse conditions include predation (from fishing, hatchery fish and marine mammals), harsh ecological conditions (water flows and water temperatures) and passage challenges at dams and fishways. Even though most wild fish may not be retained, the lethal and sub-lethal effects of encounters in the fisheries (both indirect and direct) can and does have an impact on their fitness, survival and productivity.

The Commission can provide a measure of protection to wild salmon and steelhead during their migration to natal rivers by establishing sanctuaries in areas of thermal refuge – via development of a permanent rulemaking, or establishing a temporary rule or existing rule amendment for 2018 Summer and Fall Fisheries in Oregon and concurrent waters.

Specific Requests:
1. That the Oregon Fish and Wildlife Commission direct ODFW to draft a temporary rule for 2018 to establish protective thermal refugia regulations in the Columbia River in waters under Oregon jurisdiction.

2. That the Commission directs ODFW to move forward with a permanent rulemaking for 2019 regardless of the EPA progress and process.

3. That the Commission work with Washington on rules for concurrent waters managed jointly.

Draft Motion by the Fish and Wildlife Commission

I move that the Oregon Fish and Wildlife Department, under the Commission's statutory and regulatory authority to prevent the serious depletion of wild salmon and steelhead in the Columbia and Snake River Basins, promulgate temporary rules establishing cold water refugia sanctuaries and any other time, area and manner regulations that may be necessary to protect ESA-listed wild salmon and steelhead in the Columbia River should biological and ecological conditions arise and develop where fishing presents an unreasonable conservation burden migrating and wild fish.

Rulemaking Rationale:

Point 1:
Steelhead migration is different than other salmon and their reliance on thermal gradients is well documented.

Point 2:
Steelhead and salmon using thermal gradients are vulnerable to fishing-related encounters.[1]

Point 3:
Areas where thermal gradients exist in the concurrently managed Columbia River are well known by anglers and fishers and are also definable and enforceable.

Point 4:
Current Oregon Administrative Rules Identify "sanctuaries" where commercial fishing is not permitted and these areas are well-defined and well understood by the public.

Point 5:
Columbia and Snake River Fisheries are a mixed-stock and often non-selective fishery. The failure to mark all hatchery fish, then base fisheries on hatchery abundance is harmful to wild fish. For example, on the Deschutes River counting unmarked hatchery steelhead can inflate the actual return of wild steelhead creating management problems regarding spawner escapement enumeration.

Point 6:
Abundance forecasts are based on marine and freshwater productivity assumptions that have changed. Climatic changes have affected marine productivity and freshwater habitat conditions which reduces forecast accuracy.

Point 7:
Adopted ESA Recovery Plans for the Snake River directly state that they will not recover spring chinook or Summer steelhead, yet marine and lower and mid-river fisheries continue to directly harvest these species. Without escapement criteria, recovery of ESA-protected fish is not possible.

Point 8:
Neither Oregon, Washington nor Idaho has river-specific management criteria regimes to secure river-specific abundance by natal river for wild steelhead, nor is there a plan to establish criteria or monitor attainment.

Point 9:
Neither Oregon, Washington nor Idaho has established measureable spawning escapement or egg deposition criteria for wild Steelhead, nor is there in place a plan to establish these criteria or monitor attainment.

Point 10:
The already-administratively designated river-mouth sanctuaries where commercial fishing is prohibited overlap closely with the proposed thermal refugia and tributary sanctuaries where recreational angling and some Tribal Treaty fishing would be prohibited, and they are well known to the public, easily identified and already described in existing administrative rule language.

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[1] Keefer, Matthew L., Christopher A. Peery, and Brett High Behavioral thermoregulation and associated mortality trade-offs in migrating adult steelhead (Oncorhynchus mykiss): variability among sympatric populations. 2009. Can. J. Fish. Aquat. Sci. 66: 1734–1747

Timing to Adopt a Temporary Rule for 2018:
The timing to amend existing temporary rules for 2018 is good and will allow consultation among ODFW staff, enforcement professionals, co-managers and the interested public. Formal and informal consultation on the rule language, where the proposed rules can be vetted and perfected, will result in the necessary regulatory framework in advance of the principle summer and fall fisheries. Authorized sport and tribal fisheries will adversely impact ESA-listed wild steelhead and salmon migrating through concurrent Columbia River waters and entering tributaries within Oregon's jurisdiction.

A Different Approach – Closed Permanently, Open when Conditions and Population Abundance Are Favorable:
The most reasonable approach would be to permanently close thermal refuges to protect salmon and steelhead, and use temporary rules to open them when wild salmon and steelhead runs and river conditions are favorable.

This approach would be prudent because:

1. It reduces management effort and customer confusion.

2. It anticipates variable water temperature changes due to climate change and river warming. Each year these variables change and make management difficult. For example, as in 2017, the water temperatures were high then cooled. It is likely these shifts in temperatures can change numerous times over the time frame spring through fall months and this may become an increasing problem related to flow and heating changes due to climate change.

3. It is important to include both A and B-run steelhead and salmon in this rule change for all are affected. Research shows chinook and A and B-run steelhead utilize these thermal refuges during migration and all are threatened species with the exception of mid-Columbia spring chinook (John Day) and mid-Columbia fall chinook (Hanford Reach and Deschutes River fall chinook). Using thermal refuge areas is an adaptive response by these fish and they know where these areas are located and use them when environmental conditions warrant it.

4. As indicated by the research the water temperature trigger is as low as the upper 50s. There may be no information on juvenile use of these areas but it would make sense that is also the case for river migrating juveniles to use these areas as the migrate down river and the lower temperatures may mean that non-native predators are less likely to use these thermal refuges, thus providing relief from pike minnow and bass predation. Regulating thermal refuges serves all options for fish use and variable river flow and temperature changes.

Coordination with the US Environmental Protection Agency (EPA) Cold Water Refugia process

While ODFW Staff recommend waiting for the EPA to complete its process, the Commission should not tie action to this federal process for several reasons:

1. There is no guarantee that EPA will maintain its current schedule.

2. The EPA has not considered the full suite of significant cold water refugia areas both below and above Bonneville Dam that are critical for salmon and steelhead migration.

3. The EPA plans to conduct complex and novel modeling exercises to attempt to "map" the migratory routes salmon and steelhead may take upstream from one refugia to another.

4. The EPA intends to outline strategies to restore, enhance and protect CWR in the future and this effort - whether advisory or regulatory – will absolutely require an entire process in and of itself.

Contact Information:

The Conservation Angler
David A. Moskowitz
Executive Director
3241 NE 73rd Avenue
Portland, OR 97213
971-235-8953
Theconservationangler@gmail.com

Wild Fish Conservancy
Kurt Beardslee
Executive Director
PO Box 402
Duvall, WA 98019
kurt@wildfishconservancy.org

Native Fish Society
Mark Sherwood
Executive Director
813 7th Street Ste. 200A
Oregon City, OR 97045
503.344.4218
mark@nativefishsociety.org

Wild Salmon Center
Guido R. Rahr
Executive Director
721 NW Ninth Avenue, Suite 300
Portland, OR 97209
503-222-1804
rahr@wildsalmoncenter.org

Attachments to this Memo:

1. **Annotated Scientific Literature Regarding Cold Water Refugia and Steelhead**
2. **Draft Rule Amendment** (Pending)

Annotated Notes:

Columbia River Migrating Steelhead use of Thermal Refuges and Mortality Tradeoffs.

Keefer, Matthew L., Christopher A. Peery, and Brett High Behavioral thermoregulation and associated mortality trade-offs in migrating adult steelhead (*Oncorhynchus mykiss*): variability among sympatric populations. 2009. Can. J. Fish. Aquat. Sci. 66: 1734–1747

Abstract: We used radiotelemetry to assess thermoregulatory behaviors for 14 populations (n = 3985) of adult summer steelhead (*Oncorhynchus mykiss*) as they passed through the Columbia River migration corridor. Steelhead use of small cool-water tributaries (''thermal refugia'') rapidly increased when the Columbia River reached a temperature threshold of about 19 8C. When main stem temperatures were warmest (i.e., >21 8C), more than 70% of the tagged fish used refugia sites and these fish had median refugia residence times of 3–4 weeks. Thermoregulatory responses were similar across populations, but there were large among-population differences in the incidence and duration of refugia use likely linked to population-specific migration timing patterns. In survival analyses using 1285 known-origin steelhead, fish that used thermal refugia were significantly less likely to survive to natal basins, were harvested at relatively high rates in refugia tributaries, and had greater unknown mortality in the main stem. These results highlight the trade-off between the presumed physiological benefits of thermal refugia use and a likely increase in harvest and other mortality risks that arise when preferred thermal habitats are severely constricted.

"In all environments, behavioral thermoregulation is adaptive and presumably results in beneficial fitness outcomes. However, the behavior has inherent mortality risks because fish often become spatially or temporally concentrated in otherwise marginal habitats.

"Such aggregations are vulnerable to a variety of threats, including predation, disease transmission, and human harvest.

"A dramatic fisheries example occurs in the lower Columbia River where thousands of adult summer steelhead (anadromous rainbow trout) (*Oncorhynchus mykiss*) move into small, cool-water tributaries as the main migration corridor warms (Keefer et al. 2004). Many steelhead use these thermal refugia for days to months during summer (High et al. 2006) and attract intensive recreational and tribal fisheries.

"Harvest from these aggregations is controversial because the steelhead are seeking refuge from stressful conditions and because most fish derive from upriver populations (i.e., from river basins distant from the harvest sites). These include dozens of genetically distinct steelhead populations (e.g., Brannon et al. 2004) and several metapopulations (Snake River, mid-Columbia River, and upper Columbia River) that are listed as threatened under the US Endangered Species Act (National Marine Fisheries Service 1997; Good et al. 2005).

"Despite likely impacts on protected fish, uncertainty about the demographics of the thermoregulating group has restricted management options.

Discussion

Behavioral thermoregulation

Steelhead

"The first study objective was to identify temperatures that provoked behavioral thermoregulation in adult steelhead. An apparent threshold for the initiation of refugia use was associated with Columbia River warming to ~19 8C (68F), when about a third of the telemetered migrants were recorded in coolwater tributary areas. By comparison, <10% were detected in refugia when main stem temperatures were between 14 and 18 8C (57.2 to 68F). With continued warming, the likelihood of thermoregulation rapidly increased, with >70% of the aggregate run using refugia at the warmest times (i.e., ‡21 8C) or ~70F.

"Typical refugia residence times were on the scale of hours to days at 19 8C (~67F) but increased to weeks and even months when temperatures were 20. 8C (~68.5F) and higher. Temperatures associated with the initiation of refugia use were relatively constant across populations, and large percentages of all groups used refugia when main stem temperatures were highest.

Fall Chinook

"Steelhead thermoregulatory behaviors differed substantially from those of Columbia River fall-run Chinook salmon (*Oncorhynchus tshawytscha*) that co-migrate with steelhead in August–October. In a concurrent study by Goniea et al. (2006), fall Chinook salmon experienced similar peak temperatures and used the same refugia as steelhead, but only 9% stayed more than 12 h and typical residence times were 3–5 days. A fall Chinook salmon thermoregulatory threshold was identified at about 20 8C (Goniea et al. 2006). Behavioral differences between these species reflect divergence in life history and migration timetables.

"The Chinook salmon are obligate fall spawners with a relatively narrow migration window (Dauble and Watson 1997), whereas steelhead have temporally plastic migrations in the seasons preceding spring spawning (Brannon et al. 2004; Quinn 2005).

Sockeye

"The migration schedule of a third Columbia River salmonid, sockeye salmon (*Oncorhynchus nerka*), overlaps the first half of the steelhead migration and presents a third strategy. Peak adult sockeye passage in the study reach is from mid-June to mid-July when mean daily temperatures are mostly 15–19 8C (Quinn et al. 1997), and the run rapidly passes through the lower river with little evidence of refugia use (Naughton et al. 2005). Instead, sockeye salmon often encounter high water temperatures at upriver sites closer to spawning grounds where extended migration delays (Major and Mighell 1967; Hyatt et al. 2003) and refugia use (Keefer et al. 2008*c*) have been reported at temperatures of 20–21 8C (68 - ~70F).

"The behaviors and migration schedules of the three species may reflect alternative evolutionary approaches to avoiding stressful or lethal Columbia River temperatures. Fall-spawning sockeye and fall Chinook salmon migrate mostly before (sockeye) or after (Chinook) historic peak main stem temperatures. Variations of these two patterns are repeated throughout the species' Pacific Rim ranges, with site-specific adaptations to long-term temperature and flow regimes (Groot and Margolis 1991; Myers et al. 1998; Hodgson and Quinn 2002).

"Historically, Columbia River summer steelhead may have used the same temperature avoidant strategies as both Chinook and sockeye salmon, as their passage distributions in the lower river were bimodal with a nadir in late summer during temperature peaks (Robards and Quinn 2002). However, with development of the Columbia River Hydrosystem, main stem temperatures have significantly increased and bimodality in the steelhead run has shifted to a relatively flat distribution that overlaps the warmest temperatures (Robards and Quinn 2002).

"Earlier spring warming, higher summer temperatures, and later fall cooling (e.g., Quinn et al. 1997) means that many more steelhead now encounter high water temperatures, and it is likely that a larger proportion of the run thermoregulates during migration compared with historically. It is not clear, however, whether the recent run timing shift can be explained by environmental changes and attendant behavioral responses by steelhead or if other factors (i.e., loss of native stocks and proliferation of hatchery fish (Busby et al. 1996)) are responsible.

"Importantly, neither the fitness consequences of cumulative temperature exposure during migration nor the potential for thermal refugia use to ameliorate temperature effects has been directly evaluated for steelhead in unregulated systems. This will be an important next step in the evaluation of the population-level effects of refugia use.

"For adults, potential negative temperature impacts include elevated physiological and energetic demands (Brett 1995; Lee et al. 2003; MacNutt et al. 2006), greater susceptibility to disease incidence and severity (e.g., Wagner et al. 2005), and higher prespawning mortality (Crossin et al. 2008; Keefer et al. 2008*c*).

"High temperature exposure also lowers reproductive success, egg viability, and the fitness of progeny (e.g., Flett et al. 1996; King et al. 2007). Behavioral thermoregulation during migration, like premature and multiphase migrations, may therefore have developed in response to selective constraints on adults and subsequent effects on juveniles (e.g., emergence timing, fry growth, and survival) (Dodson 1997; Quinn 2005).

"Variability among populations

In addressing the second objective, we found that the percentage of thermoregulating fish and the duration of thermoregulation significantly varied among study populations. Refugia use patterns strongly supported our first hypothesis, as the behavior appeared to be a function of population-specific migration timing and attendant among-population differences in encountered river temperatures. Relatively early and late-migrating populations encountered lower mean water temperatures in the study reach each year. These populations had fewer individuals use refugia sites, and those that did typically remained for relatively shorter periods. On average, the longest refugia use times were for populations with median migration dates in the last week of July or first week of August, coincident with mean Columbia River water temperatures reaching ~21 8C.

"A third group, the populations with the highest percentages of fish using refugia, had median passage dates in mid-August, or about the time of peak main stem temperatures. We did not attempt to untangle the effects of migration timing (i.e., date effects) from the effects of main stem temperature, as the two were strongly correlated in all years. However, it is possible that timing-related factors unassociated with water temperature, such as river discharge, photoperiod, or conspecific abundance, also affected steelhead behaviors.

"Migration timing distributions for the 14 study populations varied considerably, with median passage dates at Bonneville Dam ranging from mid-July to mid-September. The most temporally distinctive distribution was for the relatively late-migrating Clearwater River steelhead, which are part of a Snake River population complex that spends an additional year in the ocean. These larger fish are believed to have been historically abundant in the late mode of the Columbia River run (Busby et al. 1996; Brannon et al. 2004).

"Among-population timing differences presumably reflect selective pressures that parallel those for the among-species differences in migration timing. For example, it is likely that conditions in spawning tributaries influenced divergence in adult migration timing given the strong organizing effects of environmental conditions during spawning and subsequent juvenile life stages (Quinn et al. 2000; Waples et al. 2004).

"Migration distance and seasonal migration obstacles (e.g., falls, low flows, temperature barriers, etc.) in both the main stem and tributaries may also have shaped the divergent timing patterns. As additional data become available, it should be possible to better define migration timing distributions for the Columbia's many subbasin steelhead populations. We expect that more nuanced behavioral differences among groups will also be identified. Improving upon our relatively coarse-scale population analyses will be useful for predicting how many fish from either individual or aggregated populations will have thermoregulatory responses within a given year or at specific temperature criteria. Such data can be used to develop appropriate management plans for steelhead with conservation priority.

"The overall behavioral consistency among populations suggests exposure to a shared historic selective regime, perhaps during the postglacial period of salmon and steelhead recolonization of the interior basin (e.g., McPhail and Lindsey 1986; Waples et al. 2008). Such a regime potentially predated divergence among Columbia River steelhead populations. Steelhead also may have adapted similar thermoregulatory responses across populations through a process of parallel evolution (e.g., across-population exposure to extreme events or similarity in hydrologic regimes across spatially separated sites; Waples et al. 2004; Beechie et al. 2006).

"We note that there was substantial individual variability among steelhead from all identified populations. Some fish showed no thermoregulatory behavior despite migrating at the warmest times, while others remained in refugia for weeks to months after fall cooling (e.g., Keefer et al. 2008*a*). Similarly, some steelhead used multiple refugia sites with repeated entries and exits, while others showed high fidelity to single locations (see High et al. 2006). This variability echoes steelhead activities in winter when Columbia River fish hold for varying lengths of time, move up- and downstream past dams, and temporarily enter nonnatal tributaries (Keefer et al. 2008*a*).

"Behavioral plasticity across seasons results in mixed stock aggregations that are spatially distributed over long segments of the migration route. Taken together, these behaviors reflect either a remarkable evolutionary legacy of adaptation to stochastic environments (e.g., Hilborn et al. 2003; Dickerson et al. 2005; Wilbur and Rudolf 2006) or a more recent, less adaptive consequence of rapid demographic and environmental changes (e.g., Araki et al. 2008; Hutchings and Fraser 2008).

Mortality trade-offs

"Our third objective was to assess associations between refugia use and known-origin steelhead fate. The survival results strongly suggested that use of thermal refugia, a normally adaptive behavior, might carry a relatively high mortality risk in this system. The negative outcome is characteristic of an "ecological trap" where animals respond to a reliable evolutionary cue but then experience reduced survival or reproductive success (Coutant 1987; Schlaepfer et al. 2002; Robertson and Hutto 2006).

"The mortality appeared to be most directly related to fisheries inside refugia where reported harvest rates were about 13% for upper Columbia steelhead populations and ranged from 4%–17% for the various Snake River groups. Importantly, a portion of the negative thermoregulatory effect may have been indirect, particularly if steelhead in poor physical condition (i.e., with pathogens or relatively low energetic reserves) were more likely to use refugia sites.

"Unknown loss in the main stem was also higher for the thermoregulating group in most known-origin populations, likely reflecting unreported harvest near confluence areas and possible indirect effects on natural mortality. Overall, we believe that differences in overall mortality estimates between fish that did or did not use refugia may be conservative for two reasons. First, information returned with transmitters suggested that some ''non-thermoregulating'' fish harvested in the main stem were almost certainly caught in cool-water plumes from refugia tributaries (i.e., they were incorrectly identified as not using refugia). Second, several dozen known-origin fish were harvested in the main stem before they had an opportunity to enter refugia, a bias that would lead to underestimation of refugia effects.

"On balance, we expect that population-level risk of harvest inside thermal refugia is likely greatest for fish that enter the study reach during the peak of thermoregulatory behavior from late July through early September.

"Risk of main stem harvest is presumably highest for early and late migrants when fisheries effort is concentrated outside refugia. This early-season harvest hypothesis is supported by the escapement summaries for unknown-origin steelhead reported in Keefer et al. (2005), which showed that Hydrosystem survival was lowest for steelhead that passed Bonneville Dam in late May and June. Low survival during this period was related to both main stem harvest and unknown main stem mortality. Risks also clearly differed for wild and hatchery steelhead because some protection was afforded wild fish (i.e., mandatory release of rod-caught fish with intact adipose fins).

"However, relatively high percentages of wild fish in the sampled known-origin populations had unknown fates, indicating either illegal harvest, greater susceptibility to ''natural'' mortality, or possible handling mortality following catch and release (e.g., Bendock and Alexandersdottir 1993). The latter may be of special concern given the combined negative effects of fish handling and high water temperatures (Dempson et al. 2002; Cooke and Suski 2005).

"In the fourth objective, we tested for delayed mortality effects with the expectation that steelhead might be targeted after exiting refugia sites as temperatures decreased in the fall. However, we found little evidence that harvest rates in upstream reaches differed between steelhead that did and did not use the studied refugia. Unlike during the onset of high water temperatures, when fisheries in the study area efficiently shifted from main stem to refugia sites, there was no indication of a large-scale shift to main stem fisheries as temperatures decreased.

"The general lack of delayed effects may have been because fish were not spatially aggregated after exiting refugia or because there was no clear threshold temperature for refugia exit timing. The single statistically significant delayed effect was that Snake River fish that were barged as juveniles had lower upstream survival, consistent with a broader pattern of reduced homing and increased migration mortality for transported fish (Keefer et al. 2008*b*).

"In summary, migrations of Columbia River summer-run steelhead are spatially and temporally complex, in large part because adults encounter a wide range of environmental conditions that include water temperatures near both upper tolerance limits (21–25 8C) and annual minima (1–5 8C).

"Steelhead have adapted by migrating in phases, with bouts of upstream movement when conditions are favorable and holding or refuge seeking when conditions are stressful. During summer temperature peaks, cool-water habitats are spatially constricted and patchily distributed, resulting in dense adult aggregations in mid-migration.

"The refugia that steelhead used in this study were clustered along the margins of a relatively short (<100 rkm) section of the lower migration corridor, hundreds to more than 1000 km downstream from spawning grounds. Despite their small spatial extent, these few refugia sites were used by >75% of the tagged steelhead from some upriver populations, with many fish holding for weeks to months.

"The behaviors underscore the critical importance of thermal refugia in the Columbia River system where decades-long warming of the migration corridor (e.g., Quinn et al. 1997) is forecast to accelerate with regional climate change (Hamlet and Lettenmaier 1999; Battin et al. 2007).

"Despite the apparent survival costs, the presumed benefits of steelhead refugia use should not be discounted. Experiments with rainbow trout, Atlantic salmon (*Salmo salar*), and sockeye salmon have all shown that exposure to high water temperature can have large negative effects on fish performance, maturation, survival, and productivity (e.g., Pankhurst et al. 1996; King et al. 2007; Crossin et al. 2008). The recorded steelhead use of refugia almost certainly reduced these effects to varying degrees. The behaviors also presumably helped conserve energy needed to complete migration, compete for redd sites, and spawn (e.g., Berman and Quinn 1991; Newell and Quinn 2005).

"Future biotelemetry studies that monitor both migration behaviors and reproductive success (e.g., Mann and Peery 2005) or laboratory-based experiments that simulate thermal histories and monitor survival outcomes (e.g., Crossin et al. 2008) will provide a more complete cost–benefit accounting of steelhead refugia use. In the Columbia River system, where many important refugia have already been identified, managers must now balance demands for fisheries with more conservative restrictions in refugia sites to protect populations listed under the Endangered Species Act."

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Columbia River Salmon and Steelhead Fisheries
2017 Run Size Forecast and Return
Washington Department of Fish and Wildlife

Wild Steelhead

Run	**2017 Forecast**	**2017 Return**	**Deficit**	**Escapement Goal** Run	Natal River
Winter steelhead	11,900	9,448	2,452	None	None
Skamania Summer	4,100	1,236	2,864	None	None
A-Run Summer	33,000	27,909	5,091	None	None
B-run Summer	1,100	751	349	None	None
Totals:	**50,100**	**39,344**	**10,756**		

Wild Spring Chinook

Hood River	------	-------	------	Unknown	
Upper Columbia River	3,700	2,514	1,187	None	None
Snake R	15,100	6,261	8,839	None	None
Totals:	**18,800**	**8,775**	**10,025**		

Escapement goal by managed run and by natal stream is unknown

All wild steelhead and spring chinook populations are protected as threatened and endangered species.

Without escapement criteria by run and by natal river there can be no recovery of ESA protected species. Harvest management is an important factor for achieving measureable escapement criteria for wild and hatchery salmon and steelhead. The only conservation goal in 2017 was for B-run Dworshak Hatchery steelhead to provide adequate spawners for the purpose of achieving that hatchery's egg take criteria. Wild salmon and steelhead are not managed for spawner escapement and egg deposition criteria by species and natal stream through harvest management in the Columbia River basin.

Exhibit I

Cold Water Refugia Sanctuary Matrix

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	Threshold Criteria		
Actions	Run size	Water temp	Notes
Closed to all angling (1)	<50% (2) of recent ten-year average	>68.0 f (3)	(1) within CWR (2) Based on info from TAC, Joint State Staff reports (3) Measured at Mainstem CR & SR dams as reported by the COE or FPC
Angling allowed on day-on, day-off basis w/ rules below	>50% and up to 85% of recent TYA (4)	66.5-67.9 f	(4) TYA = ten year average
Angling Allowed within CWR w/ measures > rack rod > barbless hooks > Recovery box required	>85% of recent TYA	65.1-66.4 f	
No restrictions	>110% of recent TVA (*)	<65 f	* Provides rebuilding