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memorandum

date August 31, 2022

to Ryan Walker, Siskiyou County Farm Bureau

from Mike Podlech, Aquatic Ecologist

subject Review of CDFW Recommendations for the 2022 Readoption of Drought Emergency Regulations on the Scott River and Recommendations for Future Management During Extreme Drought Conditions

Purpose of Memorandum

On May 10, 2021, California Governor Newsom declared a drought emergency for 41 counties, including Siskiyou County. On August 30, 2021, the State Water Resources Control Board (State Water Board) adopted emergency regulations authorizing curtailments of diversions "where flows are insufficient to protect fish" within certain watersheds in the Klamath River basin, including the Scott River watershed. The stated purpose of the emergency regulation is to "prevent the diversion of water that would unreasonably interfere with an emergency minimum level of protection for commercially and culturally significant fall-run Chinook salmon and threatened Southern Oregon/Northern California Coast coho salmon" [*emphasis added*]. In September 2021, the State Water Board issued Orders WR 2021-0083-DWR and WR 2021-0084-DWR imposing curtailments on adjudicated groundwater rights and surface water right holders in the Scott River. The orders established monthly minimum instream flow targets based on input from the California Department of Fish and Wildlife (CDFW). According to a June 15, 2021 letter to the State Water Board, CDFW's minimum instream flow targets for the Scott River were "strongly influenced by the Klamath National Forest (KNF) adjudicated right to stream flow in the Scott River measured at the USGS gage at Fort Jones" (CDFW 2021).

On May 16, 2022, the State Water Board proposed to amend and readopt the emergency regulation for the Scott River. In addition to Chinook and coho salmon, the proposed regulation now includes protection of "culturally significant steelhead". In addition, the State Water Board proposed slightly

modified minimum flow requirements (i.e., reducing the target flow at the USGS Fort Jones gage from 125 cubic feet per second (cfs) to 90 cfs for the week of June 24-30).

At the request of the Siskiyou County Farm Bureau, I have conducted a review of the proposed State Water Board curtailment orders and regulations, pertinent CDFW communications and recommendations, available salmonid population monitoring data, and existing water conservation and salmonid protection and enhancement efforts in the Scott River watershed. Based on this review, I have concluded that: (1) the CDFW-recommended target flows are largely based on an arbitrary partitioning of outdated and minimally supported instream flow recommendations, (2) coho and Chinook salmon production during the 2021 drought was strong in the absence of curtailment orders, and (3) claims of curtailment benefits to salmonids are exaggerated and unsupported by available data. This memorandum summarizes my findings.

CDFW Curtailment Flow Justification

In its June 15, 2021 letter to the State Water Board summarizing its minimum flow recommendations, CDFW provided the following explanation of the basis for the Scott River curtailment target flows:

> "The Scott River recommendations are strongly influenced by the Klamath National Forest (KNF) adjudicated right to stream flow in the Scott River measured at the USGS gage at Fort Jones. The KNF flow amounts are deemed necessary through the Scott River decree *"to provide minimum subsistence-level fishery conditions including spawning, egg incubation, rearing, downstream migration and summer survival of anadromous fish and can be experienced only in critically dry years without resulting in depletion of fisheries resources"*.

This justification has since been reiterated in a number of subsequent communications, including the State Water Board's June 20, 2022 *Finding of Emergency and Informative Digest* (hereafter "Digest") published in support of its proposed rulemaking for the 2022 emergency regulation re-adoption. Given that the adjudicated KNF right continues to be cited as the justification for the Scott River minimum flow targets by CDFW and the State Water Board, it is important to understand the origins and scientific basis for that water right.

In 1974, the California Department of Fish and Game (CDFG, now CDFW) prepared a document titled *Report to the State Water Resources Control Board Summarizing the Position of the Department of Fish and Game on the Water Rights Adjudication of the Scott River Drainage, Siskiyou County, California* (hereafter "1974 Report"). The 1974 Report was prepared at the request of the State Water Board and provided a summary of the *Streamflow Needs for Anadromous Salmonids in the Scott River Basin, Siskiyou County*. It should be noted that the 1974 report "represents a brief summary of the findings, which are dealt with in more detail in a typewritten report filed at the Department of Fish and Game, Region 1 Headquarters in Redding, California." The more detailed report was not available for this review. Nevertheless, the summary report reviewed for this memorandum describes the methods used for the 1974 determination of streamflow needs. The following excerpts summarize pertinent aspects of the assessment methodology used to develop the CDFG (1974) minimum flow needs recommendations for select Scott Rover tributaries (emphasis added):

"For spawning, a single cross sectional profile was established through the 'best' or 'key' area over a potential spawning bar that was considered as representative of that stream section. Flows and resultant velocities for flows larger and smaller than the one measured on the field sampling date were determined by assuming and incorporating the power functional relationship between flow volume and mean velocity." (p. 10)

"For rearing, a single cross sectional profile was established through a deep-fast cover area, at the 'best' or 'key' use point. Similar data handling and assumptions were utilized for rearing flows as with spawning flows,..." (p. 13)

"Flow recommendations for the East and South Fork of the Scott River were not obtained by stream transect data because of generally high flows during the periods when the transects were taken. Judgmental reductions in the fraction of the mean annual flow required on the tributary streams for rearing and spawning were made for these larger streams. These fractions and resulting flows are tabulated on Table 5." (p. 15)

Table 5. Flow requirements for spawning and rearing in the Scott River and East and South Forks

Stream	Mean Annual Flow - CFS	Rearing	% Mean Annual Flow	Spawning - CFS: King Salmon	% Mean Annual Flow	Silver Salmon	% Mean Annual Flow	Site
South Fork	93.5± (a)	31	33.3	93	100	93	100	Callahan
East Fork	94.95 (b)	32	33.3	95	100	95	100	Callahan
Scott River	206.77 (c)	62	30.0	155	75	155	75	River mile 53
Scott River	638.50 (d)	192	30.0	426	67	426	67	U.S.G.S. Station near Fort Jones

(a) U.S.G.S. Records 10/58 - 9/60
(b) U.S.G.S. Records 10/58 - 9/68
(c) The sum of East Fork, South Fork, and Sugar Creek; does not include Wildcat Creek runoff.
(d) U.S.G.S. Records 10/58 - 9/68

CDFG's use of assumptions to extrapolate from single data points to develop spawning and rearing flow recommendations for tributary streams is highly questionable and would not be considered scientifically sound or defensible in current streamflow-habitat relationship analyses. Of even greater concern, however, is the use of judgement calls on the percentage of mean annual flow (MAF) to establish spawning and rearing flow requirements for the larger stream channels, including the mainstem Scott River at the Fort Jones USGS gage. These arbitrarily selected percentages of MAF are the basis for the final CDFG (1974) recommendations for a minimum spawning streamflow of 426 cfs (67% of MAF) at the USGS gage during the months of November through May and a minimum rearing streamflow of 192 cfs (30% of MAF) for the months of July through September (see table above). For the intervening transition months of

June and October, CDFG (1974) recommended an "incubation flow" of 284 cfs based on "2/3 of the spawning minimum, a ratio currently used by the Oregon Fish Commission biologists", or in other words, another arbitrarily selected ratio. It must be acknowledged that the CDFG minimum instream flow needs assessment was conducted almost 50 years ago and that its methods may have been consistent with standard practices at that time. However, considering that these results formed the basis for the adjudicated KNF rights (see below) that are now being used by CDFW and the State Water Board to justify the curtailment of water rights, it is important to recognize the scientific shortcomings of an assessment conducted half a century ago.

Table 1
Adjudicated Monthly Klamath National Forest 1st and 2nd Priority Rights, Total Right, and CDFG (1974) Minimum Instream Flow Recommendations (cfs)

	Scott Decree KNF – Priority 1	Scott Decree KNF – Priority 2	Scott Decree KNF - Total	CDFG – 1974 Minimum Flow
January	200	226	426	426
February	200	226	426	426
March	200	226	426	426
April	150	276	426	426
May	150	276	426	426
June 1 - 15	150	134	284	284
June 16 - 30	100	184	284	284
July 1 - 15	60	132	192	192
July 16 - 31	40	152	192	192
August	30	47	77	192
September	30	32	62	192
October	40	96	136	284
November	200	226	426	426
December	200	226	426	426

The 1980 Scott River Decree applied the CDFG-provided recommendations for the months of November through July but split these monthly flows into separate priority rights for KNF (see Table 1 above). According to the Decree, the first priority right is "to provide minimum subsistence-level fishery conditions including spawning, egg incubation, rearing, downstream migration and summer survival of anadromous fish and can be experienced only in critically dry years without resulting in depletion of fisheries resources", while the second priority right is for "incremental fish flows and for recreation, scenic, and aesthetic purposes." Notably, the Decree provides no biological justification that would explain the reasoning behind the first priority flow values selected as providing "minimum subsistence-level fishery conditions" versus the second priority "incremental fish flows". However, in 1976, prior to finalizing the Decree, the State Water Board prepared a document titled *Scott River Adjudication Proposed Principles for Allocating Water to the Various Claimants* (hereafter "Principles"). The Principles document describes the rationale for splitting the KNF right into two priorities as being based on the fact

that "the scope and extent of the rights of the Forest Service are far from certain" and that State Water Board staff therefore "attempted to find a solution which is fair and equitable to all concerned". Evidence of this approach is readily apparent in Table 1 above: The ratios used to split the CDFG recommendations into the two KNF priorities differ among seasons, with lower proportions being assigned to first priority "minimum subsistence-level fishery conditions" during the irrigation season than outside the irrigation season (e.g., compare 50 cfs shift in March and April priority allotments).

For the low flow season of August through October, it appears the Decree disregarded the CDFG (1974) recommendations entirely and instead selected mean monthly flow (MMF) values as the total KNF right and then split those values into the two priorities, with the majority of the split again being assigned to second priority.

In summary, CDFW's 2021 and 2022 drought curtailment flow recommendations are based, in large part, on the adjudicated KNF's first priority right flows that purportedly provide "minimum subsistence-level fishery conditions" during critically dry years. However, there is no evidence that KNF's first priority right flows were ever based on any biological rationale, but rather on an apparently arbitrary "fair and equitable" split of minimum flow recommendations developed by CDFG (1974) almost 50 years ago using significantly outdated and scientifically unsupported methods. In other words, the flow recommendations currently being used to justify the near-complete curtailment of water rights in the Scott River appear to be devoid of any scientifically supported biological justification.

Best Available Data

In 2004, CDFW published its *Recovery Strategy for California Coho Salmon* which identified the development of target instream flows for the Scott River as a priority recovery task that needed to be implemented to improve coho salmon rearing habitat, fish passage, and stream connectivity (CDFG 2004). In 2008, CDFW included the Scott River watershed on a list of 22 priority streams for instream flow assessments (CDFG 2008), and in 2014, the National Marine Fisheries Service (NMFS 2014) released its *Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon* which specifically calls for studies to determine instream flow needs and implementation of a flow needs plan as necessary recovery tasks for the Scott River watershed. Yet in 2022, the CDFG (1974) report published almost 50 years ago remains the only available study that attempts to define site-specific instream flow needs for salmonids in the Scott River watershed.

CDFW (2017) did prepare a "desktop" analysis five years ago that applied standard setting methods to develop interim flow criteria for the Scott River at the Fort Jones USGS gage based on historic hydrology and regional regression relationships, but did not consider basin-specific characteristics such as channel morphology, water temperature, bioenergetics, or the known distribution of important spawning and rearing habitats. Most importantly, this desktop analysis did not address the "emergency minimum level of protection" standard established by the State Water Board for critical drought years. Given the continued lack of a meaningful instream flow needs assessment, curtailment flow recommendations should be developed based on the valuable information provided by the extensive records of fish population and habitat utilization data available for the Scott River watershed. Some of the available

population trend habitat utilization data most relevant to flow management during critical drought periods are discussed below.

2022 Coho Salmon Smolt Outmigration Data

The primary focus of the Scott River curtailment flow targets is the summer low flow season. Due to spring outmigration of juvenile Chinook salmon, the only salmonid species that typically rear in the watershed through are coho salmon and steelhead. Unfortunately, summer population trends of these species have never been systematically monitored in the Scott River and thus only the yearly CDFW smolt outmigration studies provide information about over-summering success and survival.

In its June 24, 2022 final seasonal update of juvenile salmonid outmigration monitoring results, CDFW (2022) provided a preliminary estimate of 82,014 age 1+ coho salmon smolts having outmigrated from the Scott River in 2022. This marks the second highest smolt abundance in 19 years[1] of available data since 2003 (Figure 1). The highest abundance estimate recorded during that period was 95,815 age 1+ coho salmon in 2006. The pre-2022 average annual outmigration estimate is less than 10,000 (Morrow et al. 2021).

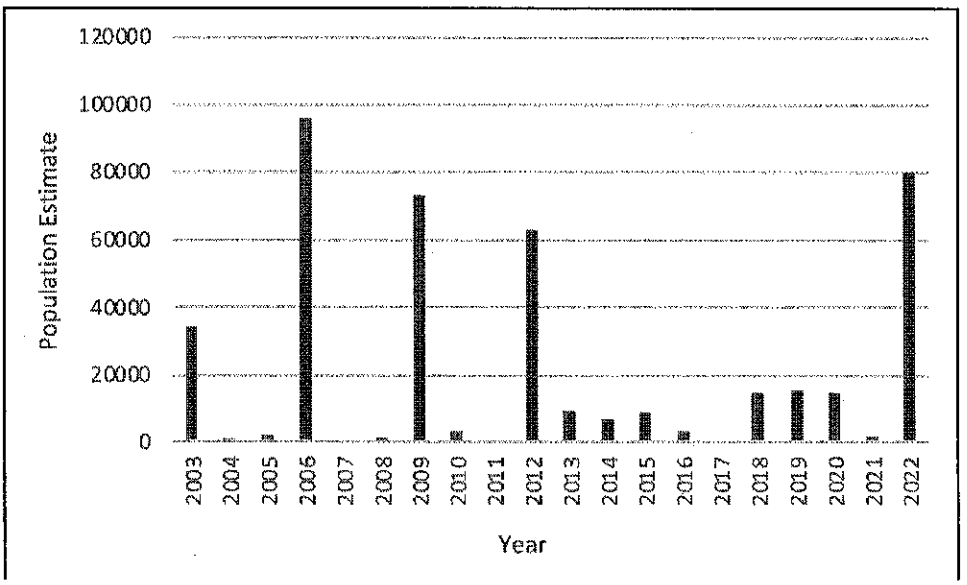

Figure 1. 2003-2022 age 1+ coho salmon estimates, Scott River. Estimate for 2003 was not corrected for a 7-day estimate; 2007 estimate is based on correlation with steelhead trapping efficiency; trap was not operated in 2017. Adapted from Morrow et al. (2021) and CDFW (2022).

Notably, the four highest estimates prior to 2022 all occurred within a single brood year (2003, 2006, 2009, and 2012) that has long been considered the strongest lineage in the watershed, while the 2022 estimate is for a brood year that had some of the lowest smolt abundance estimates in 2004 and 2007 (both less than 1,000 smolts) but had gradually been recovering through 2019 (Figure 2). The 2022 estimate represents a five-fold increase in smolt abundance over the 2019 estimate and continues this upward trend.

[1] No smolt outmigration data are available for 2017 (Morrow et al. 2021).

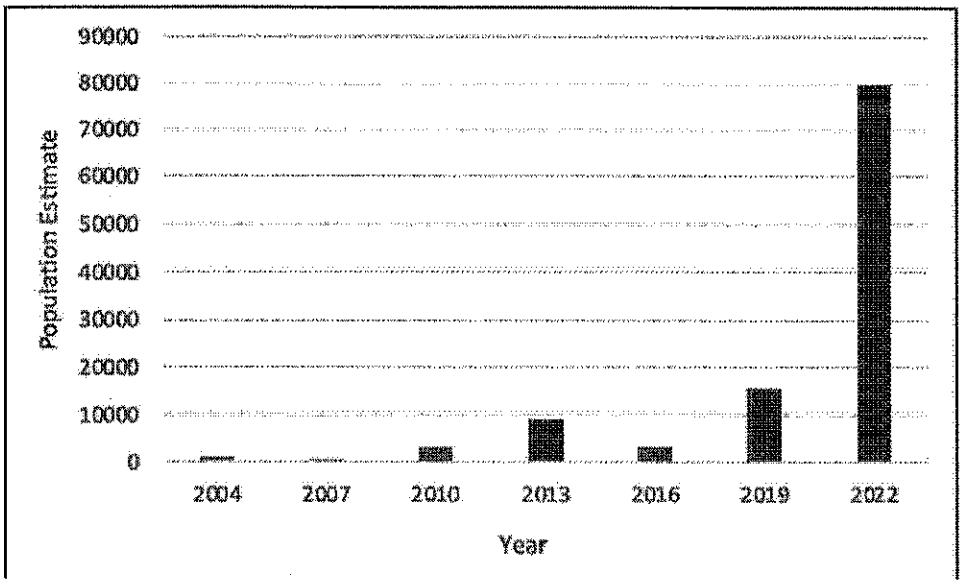

Figure 2. 2004-2022 age 1+ coho salmon estimates for brood year 2020, Scott River. 2007 estimate is based on correlation with steelhead trapping efficiency. Adapted from Morrow et al. (2021) and CDFW (2022).

Coho salmon smolts that outmigrated in 2022 are the offspring of 2020 brood year adults and reared in the Scott River watershed during 2021 critical drought conditions. The State Water Board's 2022 Digest (p. 24) suggests that 2021 curtailments have benefitted coho salmon and Chinook salmon outmigrants. Members of the public have claimed that the recent positive population trends are proof that curtailment "worked" and should therefore be re-adopted for 2022. These claims ignore the facts that (a) curtailments on the Scott River did not go into effect until September 10, 2021 at the end of the critical summer rearing period, and (b) streamflows at the USGS gage fluctuated between 8-9 cfs prior to September 10 and between 9-10 cfs after September 10 (Figure 3). The apparent gain of approximately 1 cfs at the gage after a near-record number of juvenile coho salmon successfully reared throughout the critical summer portion of an extreme drought year cannot in good faith be presented as a curtailment benefit.

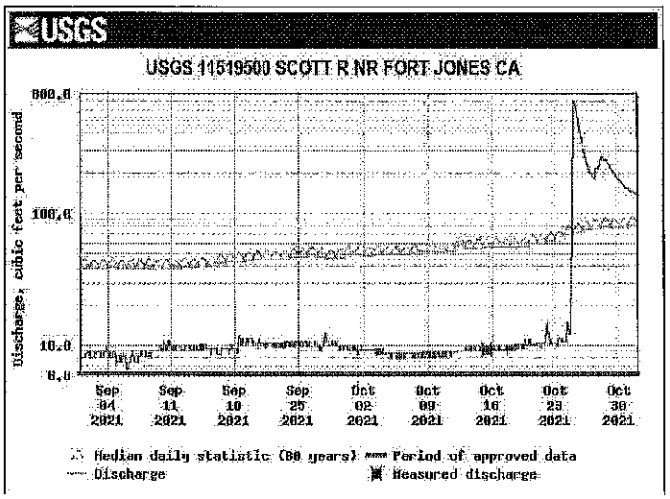

Figure 3. USGS Fort Jones gage streamflow, September 1 – October 31, 2021

Under the heading of "Benefits of the 2021 Regulation", the Digest (p. 24) briefly alludes to voluntary instream dedications and flow transactions in the spring and summer of 2021 and suggests that "high rearing and outmigration success despite the dry conditions, that is likely attributable to the combination of voluntary and regulatory efforts." With curtailment going into effect on September 10, 2021, it is difficult to envision what "regulatory efforts" led to the claimed rearing benefits of that regulation. Rather, 2021 showed that concerned local landowners, working with trusted local entities such as the Scott River Watershed Council and Siskiyou Resource Conservation District, are able to implement targeted solutions that, in the absence of curtailment regulations, successfully reared near-record numbers of juvenile coho salmon in a critical drought year by focusing on tributaries used for rearing. Regarding the Digest's claim that 2021 curtailment regulation benefitted outmigration of near-record numbers of coho salmon smolts and above-mean and -median numbers of age 0+ Chinook salmon (CDFW 2022), it should be noted that streamflows at the USGS gage during the January 26 – June 23, 2022 outmigrant trapping period naturally remained well above winter and spring curtailment flow targets. Simultaneously, prohibitions against "Inefficient Livestock Watering" had been suspended on January 21, 2022 and curtailment orders did not go into effect again until July 14, 2022. Again, it is exceedingly difficult to understand how curtailment benefited outmigration when curtailment was not in effect during outmigration.

Spatial Distribution of Chinook Salmon Spawning

Adult Chinook salmon spawning migrations have been monitored at the Scott River Fish Counting Facility (SRFCF) since 2008. The SRFCF is located roughly at the transition between the Scott River Canyon and the Scott River Valley portions of the watershed at River Mile 18 (the USGS Gage is at RM 21.) An important migration run metric monitored at the SRFCF is the spatial distribution of annual spawning as there is a lower risk of catastrophic loss due to potential redd scour when eggs are deposited throughout the watershed (Knechtle and Guidice 2021) rather than concentrated in the high energy mainstem canyon reach. During the period of 2008-2020, an average of 65% of the Chinook salmon run migrated into the Scott Valley (Knechtle and Guidice 2022). However, the three years (2015, 2018, 2020) with the lowest percent of fish spawning in the valley (18%, 32%, and 31%, respectively) coincided with some of the lowest mean October flows since 2008 (Knechtle and Guidice 2022). This apparent correlation has been referenced several times in drought emergency regulation communications as justification for curtailment flow targets and, more recently, to imply benefits of the 2021 regulation. The 2022 Digest (p. 16) describes the Chinook spawning distribution issue thus:

> "However, in three of the last five years prior to adoption of the Emergency Regulation (2015, 2018, and 2020) more than 68 percent of the Chinook salmon spawning occurred in mainstem canyon reaches downstream of the SRFCF (82%, 68%, and 69%, respectively), which corresponds with the three lowest October flow years to date (CDFW, 2021b). However, in the Fall of 2021, following the adoption of the Emergency Regulations and the implementation of a large groundwater forbearance agreement in the Scott, 29% of Chinook Salmon Spawning occurred downstream of the SRFCF and 71% occurred upstream, in more suitable spawning reaches (CDFW, 2022b)."

Apparently, the reader is supposed to interpret this as "bad conditions before curtailment, improved conditions with curtailment" and that restricting diversions and groundwater pumping leads to greater proportions of valley spawning in dry years. However, data presented by Knechtle and Guidice (2022)

clearly show that the timing of first significant storm events and concomitant increases in streamflow appear to have a greater influence on spawning distribution than water year types or diversions.

During two of four recent drought years (2015 and 2020), the onset of natural flow increases did not occur until late into the Chinook migration season and the majority of spawning occurred in the canyon reach. However, during extreme drought years 2014 and 2021, streamflow began increasing naturally in mid-October during the early part of the migration season and over 2/3 of the run spawned in the valley (Table 2). As noted above, streamflow at the USGS gage barely responded to the September 10, 2021 onset of curtailment and remained at approximately 10 cfs through October 21, at which point streamflow started to gradually increase up to a peak flow of approximately 700 cfs on October 25 as a result of significant rainfall. Knechtle and Guidice (2022) note that 92% of the cumulative annual 2021 migration occurred in a narrow 10-day period between October 21 and October 30, which directly corresponded with the precipitation event. To suggest that the majority of Chinook salmon spawning in 2021 occurred upstream of the SRFCF "following the adoption of the Emergency Regulations" is misleading and not supported by available data.

Table 2
Onset of Elevated Streamflows and Proportion of Chinook Salmon Spawning Upstream of SRFCF During Four Drought Years

Water Year	Start of rainy season	Valley spawning proportion
2014	late Oct	76%
2015	early Dec	18%
2020	mid Nov	31%
2021	late Oct	71%

Example of "What Can Happen" During a Drought Year

Another common theme in CDFW and State Water Board communications and public meetings related to the 2022 proposed re-adoption of curtailment is the suggestion that droughts lead to drastic decreases in coho salmon brood year abundance trends. For example, the Digest (p. 15) states:

> "Likewise, populations can suffer order of magnitude decreases following poor river conditions. Brood year 1 reduced in population size by over 90 percent following the 2013 drought, from 2,644 fish in 2013 to 250 fish in 2016."

A lack of significant precipitation in fall 2013 delayed the hydrologic connection of tributaries to the mainstem and prevented much of the record return of over 2,600 adult coho salmon from accessing natal spawning areas, resulting in extensive mainstem spawning. This condition was exacerbated by the severe drought conditions in summer 2014. However, the 2013-2014 drought conditions do not adequately explain the drastic decrease in coho salmon escapement between 2013 and 2016 that has been used repeated as partial justification for the need for curtailment. The following factors are far more likely to have caused the observed decrease in 2016 adult returns than "poor river conditions":

- The coho salmon smolt outmigration estimate for 2012 (i.e., the juvenile cohort that would return as adults in 2013) was 63,135 (Morrow et al. 2021), the third highest estimate prior to 2022 and now the fourth highest estimate recorded on the Scott River. By contrast, the smolt outmigration estimate for 2015 (i.e., the juvenile cohort that would return as adults in 2016) was only 8,758 (Morrow et al. 2021), an 86% decrease from the 2012 estimate. Assuming similar survival rates, fewer smolts would be expected to result in fewer returns.

- In and of itself, the large decrease in the 2015 smolt abundance compared to the 2012 estimate would seem to support the above suggestion that "poor river conditions" during the 2013-2014 adult spawning and juvenile rearing period (i.e., preceding the 2015 outmigration period) led to the subsequent decline in 2016 adult returns. However, that assumption is not supported by available data. A large-scale collaborative fish rescue effort implemented by CDFW and others in summer 2014 resulted in the capture of an estimated 116,000 juvenile coho salmon between June 3 and August 19, 2014, approximately 96% of which were relocated to suitable tributary habitat and 4% of which were transferred to holding tanks at Iron Gate Hatchery for later release back into the Scott River watershed (CDFW et al. 2015). So, what happened to over 100,000 coho salmon between the 2014 summer rearing season and the 2015 spring outmigration season? Stress from capture and relocation activities, over-crowding, and predation likely resulted in some mortality, but relocation sites monitored with snorkel surveys and water quality measurements were generally found to provide suitable conditions (Magranet 2015). As such, "poor river conditions" do not appear to have been the primary cause of low juvenile-to-smolt survival.

- During the winter/spring months preceding the 2012 outmigration of an estimated 63,135 coho salmon smolts, the peak flow recorded at the USGS gage for water year 2012 was approximately 5,100 cfs recorded on March 31, 2012. This streamflow was equivalent to the 46th highest annual peak flow recorded in 80 years of available records and occurred at the onset of peak coho salmon outmigration period. As such, this moderate (i.e., below-median) peak flow and subsequent receding flows would have provided highly favorable outmigration conditions at an appropriate time of year. In contrast, the winter/spring months preceding the 2015 outmigration of an estimated 8,758 coho salmon smolts after over 100,000 juveniles had been captured and relocated during the summer, the peak flow recorded at the USGS gage for water year 2015 was approximately 14,600 cfs and occurred on February 2, 2015. This streamflow was the 14th highest annual peak flow recorded in 80 years of available records and occurred approximately two months prior to the time when most juvenile coho have attained a large enough size to outmigrate and survive ocean entry. A secondary peak flow of approximately 5,000 cfs occurred in December 2014. It is highly conceivable that a substantial portion of juveniles were prematurely flushed from the system during high flows. Gallagher et al. (2012) evaluated an eleven-year (2000-2011) record of coho salmon adult, parr, and smolt abundance from three census watersheds in coastal Mendocino County and found that winter high streamflow was the main driver reducing parr-to-smolt survival. The scale and timing of the 2015 peak flow event is likely to have resulted in a significant reduction in the survival of over 100,000 rearing juveniles to less than 10,000 outmigrating smolts.

- Based on smolt trapping data, 60% of the 2012 coho salmon smolt population were captured in the trap during Julian weeks 15-21 (April 9-June 3). At that time of year, CDFW estimates age 1+ coho salmon from the Scott River to have attained fork lengths of at least 100 millimeters (mm) (Morrow et al. 2021). In contrast, 60% of the 2015 smolt population exited the basin during Julian weeks 7-8 (February 12-25) following the 14,600 cfs peak event. Based on CDFW estimates, age 1+ coho salmon may be as small as 40 mm in forklength this early in the season (Morrow et al. 2021). The positive correlation between smolt size upon ocean entry and survival to adulthood has been widely documented and the excessively early timing of the 2015 peak emigration likely resulted in the loss of a substantial number of smolts.

- The above hypothesis is supported by CDFW data that suggest that the effects of the early 2015 emigration/flushing timing were subsequently exacerbated by out-of-basin conditions. Knechtle and Giudice (2022) estimate the out-of-basin survival of the 2015 smolt outmigration at 2.85%. In contrast, smolt-to-adult survival following the 2012 outmigration was estimated at 4.19%.

- Knechtle and Giudice (2022) note that "the proportion of smolts that survive outside the Scott River watershed is largely driven by uncontrollable factors". It is widely understood that ocean conditions upon smolt entry are one of the uncontrollable factors that can disproportionately affect ocean growth, survival and adult return rates (e.g., Peterson et al. 2013). As many scientists and salmon managers have noted, variations in marine survival of salmon often correspond with periods of alternating cold and warm ocean conditions. Cold conditions are generally good for Chinook and coho salmon, whereas warm conditions are not (Peterson et al. 2013). NOAA Fisheries has been monitoring ocean conditions for their effects on juvenile salmon survival since 1996 and publishes an annual summary of *Ocean Ecosystem Indicators of Pacific Salmon Marine Survival in the Northern California Current.*[2] In 2012, NOAA Fisheries noted that "the Pacific Decadal Oscillation (PDO) has been negative, and cold ocean conditions have prevailed for most months from September 2007 through all of 2012." In contrast, the 2015 summary indicated that "[m]any of the ocean ecosystem indicators in 2015 suggest this being a relatively poor year for juvenile salmon survival. The PDO was strongly positive (warm) throughout 2015, coinciding with anomalously warm ocean conditions in the NE Pacific called 'The Blob' that began in the fall of 2013 and have persisted through 2015." The importance of ocean conditions on adult returns should not be ignored. Based on their analysis of 11 years of Life Cycle Monitoring Streams (LCMS) data, Gallagher et al. (2012) concluded that "[i]t appears that conditions in the marine environment have a greater influence on overall survival relative to freshwater" and noted that it was surprising that in their coastal study watersheds "summer low flows, summer high temperatures, and that many of the other seasonal physical variables we examined were not related to coho salmon freshwater survival".

The above data, when viewed in aggregate, provide a much more thorough picture of mostly external conditions that contributed to the observed 90% decline in adult coho salmon returns from 2013 to 2016 rather than the simplistic and unsupported claim of "poor river conditions" during drought.

[2] https://www.fisheries.noaa.gov/west-coast/science-data/ocean-ecosystem-indicators-pacific-salmon-marine-survival-northern

Conclusion and Recommendations

California is in the third consecutive year of severe drought conditions and in the midst of a "megadrought" that will likely present continued and increasing water management and fisheries protection challenges. A simplistic approach of "more water for fish is always better" will not address these challenges, neither for water rights holders nor for fish. In their study examining the potential to improve fish habitat conditions in the adjacent Shasta River watershed by better managing water quantity and quality, UC Davis researchers (Null et al. 2010) concluded: "*This study shows the importance of focusing on the limitations of specific river systems, rather than systematically increasing instream flow as a one size fits all restoration approach.*"

The available data clearly show that: (a) the September 2021 curtailment orders on the Scott River did little to affect streamflow at the USGS gage, and (b) in spring 2022, the watershed nevertheless produced the second highest number of coho salmon outmigrants observed in recent years in the midst of one of the most severe droughts on record. Similarly, the 2021 curtailment did not materially benefit adult Chinook salmon in the Scott River as the entire freshwater life cycle of that species was supported by natural hydrologic conditions from mid-October 2021 through spring 2022.

Although the importance of the Scott River watershed to the salmonid populations of the Klamath River basin is frequently highlighted by regulatory agencies and other stakeholders, and the need for scientifically supported instream flow needs determinations has been called for in multiple recovery plans and planning document, such an investigation has still not been completed. Instead, the current curtailment flow requirements are based on a "fair and equitable" partitioning of 50-year old instream flow needs recommendations developed with minimal site-specific data collections and extensive assumptions.

Since July 14, 2022, these largely unsupported flow targets are being used to justify the 100% curtailment of all surface water rights and the 30% reduction of agricultural groundwater users on the Scott River, yet streamflows at the USGS gage in August 2022 have mostly been less than 10 cfs, significantly below the curtailment target flow of 30 cfs. In fact, the USGS gage flows during much of August 2022 (8-9 cfs) have been approximately 1 cfs lower than August 2021 USGS flows (9-10 cfs). In other words, not even full curtailment can achieve the unrealistic curtailment targets. Although CDFW staff have documented greater persistence of hydrologic connectivity between tributaries and the mainstem in August 2022, it is unclear whether this represents a benefit as most rearing occurs within the tributaries and not in the mainstem.

Clearly, a more thoughtful and targeted approach is needed. Some potential approaches that should be considered are outlined below.

A. In the immediate short-term, CDFW and the State Water Board should abandon their efforts of managing water use in the Scott River based on unsupported and unattainable target flows measured at a single USGS gage located in the canyon of the Scott River. As noted above, collaborative and targeted actions by diverters in priority tributary reaches were implemented during the 2014 and 2021 drought years that supported large numbers of rearing juvenile salmonids. These collaborative efforts should be pursued and implemented to the largest extent

possible and managed by local entities such as the Scott River Water Trust and Siskiyou Resource Conservation District.

B. There is wide agreement on the importance of the Scott River basin for salmonids, especially coho salmon. If CDFW and the State Water Board are to effectively manage flows for fish, management decision must be based on site-specific and scientifically defensible instream flow needs assessments. Based on climate change predictions, the need for a meaningful and reliable environmental flow assessment consistent with modern methods will only become more urgent and should therefore be commissioned as soon as possible. Refer to Williams et al. (2019) for an excellent overview of current state-of-the-art environmental flow methods as well as discussions of the shortcomings of some methods that have frequently been used to date.

C. Gallagher et al. (2012) show that a lack of winter velocity refuge habitat is a primary limiting factor for juvenile coho salmon in coastal California streams, more so than summer base flows. Juvenile monitoring data from the Scott River in 2014-2015 appear to support the importance of this limiting factor. The implementation of large-scale large woody debris (LWD) augmentation projects, particularly within priority rearing tributaries, would provide for immediate benefits to salmonid populations in time for the next extreme flow events that are expected to increase in frequency and severity under the current climate change trajectory. LWD augmentation, beaver dams, and beaver dam analogs (BDA) have been shown repeatedly to provide velocity refuge, over-summering habitat, temperature moderation, channel aggradation, and increased groundwater recharge.

D. Adult Chinook salmon migration in the Scott River is a concern annually and is often dependent on receiving timely precipitation to provide access to prime spawning habitat in Scott Valley. The current channel geometry of the mainstem Scott River within reaches of Scott Valley is highly altered and the basin is no longer able to retain sufficient groundwater storage. A detailed assessment of geomorphic conditions and groundwater-surface water interchange should be conducted to evaluate potential large-scale restoration options such as those frequently implemented based on channel evolution model of Cluer and Thorne (2013). Options for elevating the streambed through large-scale distribution of tailings have been discussed in the past and their merit and feasibility should be investigated.

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