**Karuk Tribe**
**PO Box 1016**
**Happy Camp, CA 96039**

**Salmon River Restoration Council**
**25631 Sawyers Bar Road**
**Etna, CA 96027**

Wilbur Ross
Secretary of Commerce
1401 Constitution Avenue, N.W.
Washington, DC 20230

Dear Secretary Ross:

Petitioners Karuk Tribe and Salmon River Restoration Council request that the National Marine Fisheries Service (NMFS) reconsider its decision to deny a previous petition from Environmental Protection Information Center *et al.* to list as threatened or endangered the Upper Klamath-Trinity River (UKTR) Chinook Evolutionarily Significant Unit (ESU) (*Oncorhynchus tshawytscha)* or, alternatively, create a new ESU to describe Klamath Spring Chinook (Center for Biological Diversity et al. 2011). Based on recently published data, the Klamath-Trinity spring Chinook, currently considered part of the UKTR Chinook ESU, meets all the criteria of a unique ESU and necessitates an Endangered Species Act (ESA) listing to prevent extinction.

Because *O. tshawytscha* is an anadromous salmonid, the National Marine Fisheries Service has jurisdiction over this petition. Petitioners file this petition pursuant to § 553(e) of the Administrative Procedure Act ("APA"), 5 U.S.C. §§ 551-559 and § 1533(b)(3) of the Endangered Species Act, and 50 C.F.R. part 424.14, which grant interested parties the right to petition for issuance of a rule, and specifically to seek reconsideration of a prior determination where new information would lead a reasonable person conducting an impartial scientific review to conclude that delineation of a new ESU, Klamath-Trinity spring-run Chinook (herein referred to as KTS Chinook), and ESA listing is warranted.

Historically, KTS Chinook runs numbered in the hundreds of thousands (Moyle, Lusardi, and Samuel 2017). By the 1980s, KTS Chinook had been largely eliminated from much of their former habitats because the cold, clear water, and deep pools that they require were either absent or made inaccessible by dams (Hamilton et al. 2005). In recent years, KTS Chinook runs have plummeted with only 2,133 natural spawning salmon observed in 2016 (from the 2016 Klamath River Spring Chinook Mega Table maintained by California Department of Fish and Wildlife).

In 2011, Center for Biological Diversity (CBD) et al. filed a petition ("2011 Petition") to list as threatened or endangered the UKTR Chinook ESU or, alternatively, create a new ESU to describe Klamath spring-run Chinook (Center for Biological Diversity et al. 2011). The entire content of the 2011 petition is expressly incorporated into this petition by reference.

In April 2012, NMFS denied the 2011 petition, citing its own technical review. The rationale for this denial was predicated on the assertion that the differences between spring run and fall run fish within the UKTR Chinook ESU were not the result of "…an important component in the evolutionary legacy of the species. The concept of evolutionary legacy implies that there would need to be a monophyletic pattern of the evolutionary history of the two run-types within the UKTR" (Williams et al. 2011).

Recently published data demonstrate that NMFS' rationale for denying the previous petition was based on a misunderstanding of the underlying genetic mechanisms which give rise to the 'premature migration' (i.e. spring run) fish. This new information establishes the genetic uniqueness of KTS Chinook and refutes NMFS' prior assertion that the spring run life history is the result of polyphyletic pattern evolutionary history (Prince et al. 2017).

For the Karuk Tribe, the loss of KTS Chinook is culturally and spiritually devastating. It has a direct impact on tribal members' physical well-being and spiritual health. Historically, the annual return of spring Chinook salmon, or *ishyâat*, initiated a series of first salmon ceremonies that were performed by villages all along the Klamath River and were interconnected even between different Tribes (Salter 2003). The return of salmon signaled an end to winter and provided an ample supply of food for Yurok, Karuk, Hoopa, Klamath, Modoc, and Shasta villages. This abundance of salmon along with the bounty of the forests led some scholars to describe the Klamath River tribes as the 'wealthiest of all aboriginal Californians'(McEvoy 1986). With the decline of Klamath fisheries so too has the intrinsic wealth and prosperity of Klamath Basin tribes declined.

We argue here that new data describing the evolutionary history of seasonal runs of *O. tshawytscha* in the Klamath basin reveals the fact that KTS Chinook meet the criteria of an evolutionarily significant unit. This fact along with the consistently low number of naturally spawning KTS Chinook in the Klamath Basin leads us to petition for a reconsideration of the 2012 decision by NMFS to deny listing. Petitioners also request the designation of critical habitat for KTS Chinook as required by 16 U.S.C. 1533(b)(6)(C), 50 C.F.R. 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553).

The new information presented here makes a clear case for acknowledging the evolutionary significance of KTS Chinook and the dire need to list the species and designate critical habitat before this irreplaceable fish is lost to future generations.

Yootva,

Russell "Buster" Attebery
Chairman
Karuk Tribe

Karuna Greenberg
Restoration Director
Salmon River Restoration Council

**Contact Information for Petitioners:**

Karuk Tribe
PO Box 282
Orleans, CA 95556
Email contact: ctucker@karuk.us

Salmon River Restoration Council
25631 Sawyers Bar Rd
Sawyers Bar, CA 96027
Email contact: karuna@srrc.org

## I. Legal Background

### A. Definition of Evolutionarily Significant Unit

The Endangered Species Act (ESA) defines "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 USC § 1533(16), *see also California State Grange v. National Marine Fish,* 620 F.Supp 2d 1111, 1121 (ED Cal 2008). The ESA does not define the term "distinct population segment." *Grange* at 1121.

In 1991 the National Marine Fisheries Service ("NMFS") promulgated its *"Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon"* or "Evolutionarily Significant Unit ("ESU Policy." (56 Fed.Reg.58612 (Nov. 20, 1991)). The ESU Policy provides that a population of Pacific salmonids is considered to be an ESU, and therefore considered for listing under the ESA, if it meets the following two criteria:

(1) It must be substantially reproductively isolated from other nonspecific population units; and
(2) It must represent an important component in the evolutionary legacy of the species. Isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units. The second criterion would be met if the population contributes substantially to the ecological/genetic diversity of the species as a whole (Waples 1991). *Grange* at 1123-24.

NMFS uses all available lines of evidence in applying those criteria, including specifically data from DNA analyses ("...data from protein electrophoresis or DNA analysis can be very useful because they reflect levels of gene flow that have occurred over evolutionary time scales."), *ESU Policy,* 56 Fed. Reg. at 58518; *see also Definition of "Species" Under the Endangered Species Act: Application for Pacific Salmon,* NOAA Tech Memo NMFS F/NWC-194 (Waples 1991) at p.8 ("The existence of substantial electrophoretic or DNA differences from other conspecific populations would strongly suggest that evolutionarily important, adaptive differences also exist.")

The ESU Policy is an interpretation by NMFS of what constitutes a "distinct population segment," and is a "permissible agency construction of the ESA." *Grange* at 1124, citing *Alsea Valley Alliance v. Evans,* 161 F.Supp2d 1154, 1161 (D.Or. 2001).

### B. Listing ESU as Endangered DPS

When considering whether a species or subspecies, including an ESU, is endangered, NMFS must consider:

i. The present or threatened destruction, modification, or curtailment of its habitat or range;
ii. Overutilization for commercial, recreational, scientific, or educational purposes;
iii. Disease or predation;
iv. The inadequacy of existing regulatory mechanisms; or
v. Other natural or manmade factors affecting its continued existence.
16 U.S.C. § 1533(a)(1).

The species shall be listed where the best available data indicates that the species is endangered because of any one, or a combination of, those five factors. 50 CFR § 424.11(c).

Any interested person may submit a written petition to list a species or subspecies as threatened or endangered. 50 CFR § 424.14(a). While the regulations are unclear as to the procedure for petitioning for reconsideration of a prior petition to list based on newly available information, NMFS has proposed revised regulations relating to ESA petitions that reflect the agency's position. 80 Fed. Reg. 29289 (21 May 2015): 81 Fed. Reg. 23448 (April 21, 2016).

The newly proposed 50 CFR §424.14(g)(1)(iii) states that petitions filed after an adverse ruling will be considered only where "new information or analysis such that a reasonable person conducting an impartial scientific review would conclude that the action proposed in the petition may be warranted, despite the previous determination." 81 Fed. Reg. 23454-55. NMFS states further that the proposed §424.14(f) will "clarify" the Service's position that any supplemental petition will be considered with the previous petition, and they together will reset the statutory periods for response—constructively the same as filing a new petition. 80 Fed. Reg. 29289 (21 May 2015).

## II. Factual Background

Chinook salmon in the upper Klamath and Trinity Rivers are currently regulated and managed as a single ESU referred to as Upper Klamath Trinity River (UKTR) Chinook, with no distinction between seasonal runs. Thus the UKTR spring Chinook (which we refer to as KTS Chinook) is not a defined ESU, and is not listed as threatened or endangered. However, many references may be found in the literature to UKTR spring Chinook which highlight efforts or suggestions for managing it separately from its fall counterpart (West 1991) ("Klamath Fishery Management Council Report and Recommendations to the Pacific Fishery Management Council" 2003) (California Trout 2017). Despite this, water management, fisheries management, and other regulatory activities are generally conducted without consideration of potential impacts on the spring-run component of the UKTR Chinook population, instead considering impacts to UKTR Chinook generally. This approach is likely having an adverse impact on UKTR spring Chinook/KTS Chinook especially when hatchery practices are considered.

### A. Polyphyletic vs. Monophyletic Patterns of Evolutionary History

In an effort to explain differences in run timing observed in Chinook salmon populations, conservation geneticists offer two possible explanations for the evolution of spring, or "premature," migration patterns for salmonids: a monophyletic pattern of evolutionary history versus a polyphyletic pattern of evolutionary history. These models are based on a comparison of the DNA structure of fall and spring run individuals within the same watershed versus nearby watersheds using a variety of genetic techniques.

In evaluating whether to list seasonal runs as an ESU for purposes of the Endangered Species Act, NMFS considers which of these two evolutionary models apply to the given population. Because spring and fall run fish fitting the polyphyletic pattern evolved from a common ancestor based on environmental factors, the genetic material for both seasonal runs are contained in fish from both runs. The evolutionary changes necessary to give rise to the phenotype are relatively easy to reproduce since, according to this model, it has happened many times in closely related populations. NMFS has argued that even if spring run migrating subpopulations were extirpated by flow diversions, barriers, or other factors, the spring migration phenotype could easily re-emerge if appropriate habitat was later restored. On that basis, polyphyletic pattern fish runs typically do not meet NMFS guidance requirement to qualify as an ESU. According to Waples, "*Although the failure of most stock transfers indicates that local populations may be largely irreplaceable on human time frames, at least some patterns of Chinook salmon life history diversity appear to be evolutionarily replaceable, perhaps over time frames of a century or so. The evidence for repeated parallel evolution of run timing in Chinook salmon indicates that such a process is likely, provided that habitats capable of supporting alternative life-history trajectories are present and sufficient, robust source populations are maintained*" (Waples et al. 2004).

In contrast, seasonal fish runs that evolved via the monophyletic pattern evolved from a separate ancestor, and are genetically distinct from other fish runs in that river system. Thus if extirpated, monophyletic seasonal fish runs are likely gone forever, and thus warrant classification as an ESU, as well as the protections that result from such a listing.

Until now, most conservation geneticists considered most spring run Chinook populations to fit the polyphyletic model. This would mean that fish from a common ancestor evolve genetic differences due to the reproductive isolation and natural selection driven by the unique features of their respective watersheds. According to this explanation, these separate populations later evolved the early migration or 'spring run' phenotype independently from each other. In other words, the spring run phenotype evolved many times over in neighboring populations. The application of the polyphyletic model to these populations stems from studies that show that the genetic structures of spring and fall run individuals within a watershed are more genetically similar than spring run individuals from different watersheds. Examples of runs thought to be a product of this process include spring and fall run Chinook in the Rogue and Umpqua Rivers (Waples et al. 2004).

However, in some fish populations the DNA structure of fall and spring run individuals within the same watershed are less similar to one another than those in neighboring watersheds. These observations suggest an alternative explanation for the evolutionary basis for the early migration phenotype. In these cases, the difference in run timing is attributed to a monophyletic pattern of evolutionary history. Under this model the genetic changes that give rise to differences in run timing predate the genetic differences that arise as a consequence of geographic isolation. Until now, the only known examples of monophyletic based premature migration are among spring run and fall run Chinook salmon in the mid and interior Columbia and Snake River basins, and winter, spring and fall run Chinook populations in California's Central Valley. The fish in each of these seasonal runs are more closely related to each other than to Chinook salmon in any other basin, or to other Chinook salmon runs in the same tributary river (Meyers et al 1998; Banks et al 2000a; Garza et al 2007). Some researchers argue that the differences observed in the Central Valley spring and fall populations stem more from anthropogenic factors associated with hatchery management than with a true evolutionarily event.

In summary, conservation biologists consider most populations of spring Chinook salmon to be a product of polyphyletic evolution, except in a few rare exceptions where it's not.

In a memo summarizing the finding of the Biological Review Team (BRT) report on the 2011 Petition, the Science Director of the National Marine Fisheries Service Southwest Fisheries Science Center, Francisco Werner, noted that "One reviewer expressed the personal view that there is evidence for reproductive isolation and adaptive divergence between Klamath River spring-run and fall-run Chinook salmon and thus merit their own ESU. However, the reviewer found that spring-run Chinook salmon in the UKTR basin do not represent a unique component of the evolutionary legacy of the species, and therefore, do not meet one of the two requirements for recognition as an ESU under NMFS' ESU policy (the other requirement being long-term reproductive isolation resulting from an unique evolutionary event that is unlikely to re-evolve over ecological time-scales)"(Werner 2011). However, recently published work challenges the assertion that spring run Chinook does not meet the other requirement. The study shows that a unique evolutionary event was the cause for the spatial and temporal reproductive isolation that spring and fall run exhibit in the UKTR, and shows that spring run life type Chinook are unlikely to re-evolve over ecological time scales (Prince et al. 2017).

### B. 2011 Petition for Listing Spring Run Salmon

In 2011, Center for Biological Diversity (CBD) et al. filed an Endangered Species Act listing petition ("2011 Petition") with NMFS to address the dramatic declines of Klamath-Trinity Spring Chinook salmon. CBD *et al.* suggested 3 alternatives for NMFS to consider: 1) list spring run Chinook as a unique ESU; 2) list spring run Chinook as a distinct population segment (DPS) within the previously recognized UKTR Chinook ESU; or 3) list the entirety of the UKTR Chinook ESU (Center for Biological Diversity et al. 2011). The 2011 Petition is attached hereto and incorporated by reference.

In its initial response to the 2011 Petition, the NMFS Southwest Region (SWR) determined that "... the literature cited in the petition, and other literature and information available in our files, we found that the petition met the criteria in our implementing regulations at 50 CFR 424.14(b)(2) that are applicable to our 90-day review and determined that the petition presented substantial information indicating that the petitioned action may be warranted" (National Marine Fisheries Service 2011) (76 FR 20302; April 12, 2011).

In that 90-day finding, NMFS narrowed the scope of their further review. In particular, the agency explained that it would not consider Petitioners' second alternative for listing spring Chinook salmon in the UKTR ESU as a DPS. Instead, NMFS determined that the analysis would consider whether the spring run component of the UKTR Chinook constitutes its own ESU. NMFS noted that their Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon, "...explains that a Pacific salmon stock will be considered a distinct population segment, and hence a "species" under the ESA, if it represents an ESU of the biological species" (ESU Policy; 56 FR 68612; November 20, 1991).

### C. Biological Review Team Determination

After determining that the petition met the appropriate criteria for further review, NMFS convened a Biological Review Team (BRT) which considered the 2011 Petition and over 50 written comments from the public. Specifically, the BRT focused on two fundamental issues: 1) the extent to which the new information supports the current UKTR Chinook Salmon ESU delineation, or the separation of spring-run and fall-run Chinook salmon into separate ESUs, and 2) an assessment of the biological status of the supported ESU configuration using the viable salmonids population framework (Williams et al. 2011).

In the 2011 Petition, CBD et al. argued that the KTS Chinook evolved via the monophyletic pattern, and thus qualified for listings as an ESU. CBD pointed to new genetic data, and argued that KTS Chinook show genetic and life history divergence from fall run UKTR Chinook equal or greater than those of the Central Valley spring and fall run Chinook ESUs.

The BRT reviewed the new genetic data brought forth by CBD et al. The BRT did not agree based on the data that a monophyletic evolutionary model best described the prevalence of the KTS Chinook. Rather, the BRT argued that a polyphyletic evolutionary history best explained the 'premature' migration pattern observed within the UKTR Chinook ESU. While acknowledging some genetic differences between various UKTR Chinook runs, the BRT concluded that the genetic and life history differences of the KTS Chinook were not great enough to warrant the designation of ESU status. The BRT stated,

> *"The BRT concluded that the new information supports the ESU delineation of Myers et al. (1998) in which UKTR spring-run and fall-run Chinook salmon populations constitute a single ESU, and that the expression of the spring-run life-history variant is polyphyletic in origin in all of the populations for which data are available."*

The BRT went on to conclude that when considered as a whole population, UKTR Chinook were not threatened or endangered, stating:

*"As to the status of the UKTR Chinook Salmon ESU, the BRT found that the ESU is currently at low risk of extinction within the next 100 years"*(ibid.)

The results and conclusions of the BRT report was the basis of the 12 month finding published in the Federal Register on April 2, 2012 which rejected the 2011 Petition of CBD et al. to list KTS Chinook salmon (National Marine Fisheries Service 2011).

### D. Recent Technology, Data and Analysis

NMFS' 2011 conclusion was consistent with the large body of literature based on genetic analyses performed using microsatellites. While these studies often revealed genetic differences between geographically isolated populations, they failed to consistently demonstrate significant differentiation between premature and mature migrating phenotypes within a watershed (Kinziger et al. 2013; Waples 1991; Nielsen, Crow, and Fountain 1999). As a consequence, early migration phenotypes, including the KTS Chinook, have been largely grouped into the same ESU or DPS as mature migration phenotypes.

Until recent advances in genetic analysis, researchers were limited by the available technology in how they could study the genetic differences between closely related populations. Previously, researchers looked for relatively large differences in genetic structure, which often appear in genomic regions not influenced by environmental pressures and natural selection, because the available technology allowed only this sort of analysis. These genomic regions vary due to gene flow and genetic drift, as opposed to being driven by environmental pressures and natural selection. The weakness of this approach is that it lacks the molecular resolution necessary to detect evolutionarily significant adaptations which may stem from changes in sequence and structure in specific genomic regions, particularly in regions that encode genes.

Although the relatively large body of data is indeed consistent with the hypothesis that polyphyletic evolution explains premature run timing (at least in most cases), the evidence is also consistent with another explanation – that premature run timing is the result of a changes in genetic sequence or structure of specific regions of the genome that predates the polyphyletic changes brought on by geographic isolation. Until recently conservation geneticists lacked the tools necessary to fully explore the latter hypothesis. However, recent advances in technology now allow researchers to comb through genomes at a much higher resolution cheaply and quickly. Previously, researchers would rely on dozens or maybe hundreds of molecular markers to search for genetic differences between subpopulations. Today, researchers can quickly compare millions of genetic regions to look for differences.

Based on the technical limitations of genetic analysis, the previous approach to determining the evolutionary history of the premature migration phenotype was inferential. In other words, conservation geneticists inferred the evolutionary history of the phenotype based on demography not adaptation. The new technology now allows researchers to locate individual genomic regions that are the actual cause of evolutionary change, and reconstruct the evolutionary history of these regions directly. Direct reconstruction of the evolutionary history of the spring run Chinook versus fall run Chinook was performed and the findings recently published in a peer reviewed journal (Prince et al. 2017).

Prince et al. created a high-resolution genomic library from samples of spring and fall migrating adult Chinook and steelhead from several Pacific Northwest watersheds, including the Klamath. The researchers then created high-resolution restriction-site associated DNA (RAD) libraries, sequenced them, and aligned the sequences to a recent salmonid genome draft. The genomic libraries generated from individual fish where then compared using a probabilistic framework to discover small nuclear polymorphisms (SNPs). Although Prince et al. notes that the initial analysis was consistent with current

DPS and ESU delineations, the sheer volume of genomic positions they went on to compare (nearly 10 million) allowed a thorough comparison of premature and mature migrating individuals. This revealed several SNPs within a couple hundred thousand base pairs of one another. Further analysis revealed this region to be within the GREB1L gene. This result was then repeated in other populations including UKTR Chinook. Prince et al. notes that this finding makes biological sense in that this gene is implicated in foraging and fat storage in mammals. In salmon, premature migrating Chinook have a significantly higher fat content than mature migrating individuals, consistent with the fact that early migrating individuals are destined to climb higher into watersheds before spawning and thus need more stored energy.

Prince et al. went on to sequence the GREB1L region in all of their samples and created a gene tree based on parsimony. The tree revealed two monophyletic groups corresponding to migration phenotype. All samples, regardless of watershed of origin, separated into the appropriate migratory clade. In other words, Prince et al. found that all premature migrating individuals evaluated grouped together in the same monophyletic group. Thus, genetic differences in this single gene explain the difference between premature and mature migrating phenotypes. Although NMFS has argued that "some patterns of Chinook salmon life history diversity appear to be evolutionarily replaceable, perhaps over time frames of a century or so…"(Waples et al. 2004), premature migration clearly does not fall into this category as explained in greater detail below.

Without the advent of molecular tools that allow for the cheap and quick creation of detailed DNA libraries (collectively referred to as Next Generation Sequencing or NGS), the identification of a single gene that is responsible for such a complex phenotype would have been nearly impossible. Now that the technology is available and has been applied, however, the monophyletic nature and evolutionary significance of KTS Chinook must be acknowledged.

## III. Klamath-Trinity Spring Chinook is Its Own ESU

Myers et al. (1998) recommended that their determination, that spring-run and fall-run Chinook salmon populations in the UKTR ESU constitute a single ESU, should be revisited if substantial new genetic information from natural spring-run populations were to become available (Williams et al. 2011). This Petition presents precisely that genetic information for the Upper Klamath Trinity River system Chinook populations. For spring run and fall run populations of Chinook salmon to be considered separate ESUs, as defined by Waples (1991) and later elaborated on by Waples (1995), it must be shown that these populations are substantially reproductively isolated from other conspecific population units and that they represent an important component in the evolutionary legacy of the species. Prince et al. makes that demonstration.

It is well established that spring Chinook, by virtue of entering fresh water rivers during snow melt, reach spawning areas that are, generally, reproductively isolated from their fall run counterparts (Quinn 2005). Waples' concept of evolutionary legacy implies that there would need to be a monophyletic pattern of the evolutionary history of the two run-types within the UKTR. For spring run Chinook, Prince et al. demonstrate that the molecular basis for the spring run phenotype is associated with a defined allele that evolved long ago in Chinook evolutionary history. Prince et al. found evidence of only two allelic evolutionary events that produced a premature migration allele, one in Chinook and one in steelhead, even though the species diverged approximately 15 million years ago. This is in contrast to the assertion by the BRT review of the previous KTS Chinook petition which concluded, without the benefit of Prince et al.'s recent findings, that the spring run phenotype is polyphyletic in origin and evolved independently in many locations.

Prince's recently published data clearly demonstrate that contrary to prevailing dogma, Klamath-Trinity

Spring Chinook exhibit a monophyletic pattern of evolutionary history, and meet Waples' and NMFS' criteria for a separate ESU.

As previously noted, the criteria for an ESU designation are that 1) it must be substantially reproductively isolated from other nonspecific population units; and 2) it must represent an important component in the evolutionary legacy of the species.

Prince et al. 2017 demonstrates that KTS Chinook are an important component in the evolutionary legacy of UKTR Chinook and that the reproductive isolation between spring and fall run populations is strong enough to permit evolutionarily important differences to accrue.

## IV. Klamath-Trinity Spring Chinook are at Risk of Extinction

Historically, spring run Chinook may have been as or more abundant than fall run Chinook in the Klamath basin. Hundreds of thousands of fish spread into tributaries throughout the basin, including rivers as far inland as the Sprague and Williamson in Oregon (Moyle 2002). Tribal oral histories, historic photographs, early scientific reports, and first-hand accounts of the earliest non-native explorers of the Klamath Basin all describe prolific runs of both fall and spring run Chinook salmon migrating into the Klamath headwaters upstream of Upper Klamath Lake (Hamilton et al. 2005).

In some Klamath tributaries, it is generally held that spring run Chinook far outnumbered their fall run counterparts (Moyle 2002). Wales (1951) reported that only 8% of the historic salmon returns to the Shasta sub-basin were fall run Chinook (Wales 1951).

KTS Chinook suffered precipitous population declines in the 19th century in large part because of hydraulic gold mining, the construction of diversion dams, water diversions, and fishing (Snyder 1931). The large run in the Shasta River disappeared coincidentally with the construction of Dwinnell Dam in 1926 (Moyle et al. 1995). Dwinnell continues to divert nearly one third of the flow from the Shasta River and block all fish passage (Lestelle 2012). In the mid to late 20th century, the populations further declined as a result of hydropower dam construction projects (for example the Trinity and Iron Gate Dams) and, in 1964, historic precipitation led to catastrophic landslides of clear cut mountainsides dumping millions of cubic yards of sediment in streams and destroying spawning and rearing habitat (Campbell and Moyle 1991). By the 1980s, KTS Chinook had been largely eliminated from much of their former habitats because the cold, clear water and deep pools that they require were either absent or inaccessible.

In the Klamath River drainage above the Trinity River confluence, only remaining viable population of spring run Chinook is in the Salmon River; it has annual runs of 150-1500 fish (Campbell and Moyle 1991). Similarly in the Trinity sub-basin, a vestigial run of non-hatchery spring Chinook remains in the South Fork Trinity. Numbering as high as 10,000 fish in 1963, the population declined precipitously after the 1964 floods, and in 2015 only 20 fish spawned in the South Fork ("The Watershed Research and Training Center" 2017).

In recent years, California Department of Fish and Wildlife has collaborated with federal and Tribal agencies along with local watershed groups to maintain a Klamath Basin Spring Chinook Megatable, which tabulates and presents spawning and harvest data. The total number of natural spawners since 1990 ranges from 2,133 in 2016 to 35,827 in 2003 with an average of 9,983. Three out of the six worst years on record were 2014 (4,215), 2015 (2,638) and 2016 (2,133), and 2017 is shaping up to have even lower numbers. (The most recent version of Mega Table available by request from California Department of Fish and Wildlife Arcata Office). When you consider the fact that the majority of the Trinity sub-basin fish counted as natural spawners are of hatchery origin, these numbers are even more dismal. This year, the data from the Salmon River snorkel surveys were reported to be the second lowest recorded numbers since thorough surveys began in 1990, coming in at 110 KTS Chinook spawners (Houston 2017). Clearly, since NMFS denied the 2011 Petition, conditions for KTS Chinook have only deteriorated.

It is relevant to note that KTS Chinook population numbers are very similar to that of ESA listed Southern Oregon Northern California Coho (Moyle, Lusardi, and Samuel 2017) which have been listed as threatened since 1997.

16 U.S.C. § 1533(a)(1) describes the factors that the Secretary shall consider when determining whether or not to list a species. Any of the listed factors may provide cause for listing. KTS Chinook are, or have been, affected by *all* the factors listed:

*(A) the present or threatened destruction, modification, or curtailment of its habitat or range*

Historically, KTS Chinook over summered and spawned in the Williamson, Sprague, and Wood River systems of southern Oregon (Hamilton et al. 2005). The construction of a complex of hydropower dams between 1917 and 1962 created a barrier to fish passage near the California/Oregon border, effectively denying salmonids access to approximately half the Klamath Basin ("Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report" 2012).

Similarly, Dwinnell Dam on the Shasta River prevents fish passage to reaches of the Upper Shasta River that would accommodate KTS Chinook (Lestelle 2012). Young's dam and numerous other diversions coupled with ground water pumping effectively dewaters KTS Chinook habitat in the Scott River. Lewiston Dam on the Trinity River similarly blocks KTS Chinook access to the Trinity River headwaters.

*(B) over utilization for commercial, recreational, scientific, or educational purposes;*

From 1877 to the early 1900s, as many as six canneries operated on the Lower Klamath River, impacting all runs of Chinook salmon (Snyder 1931).

*(C) disease or predation*;

In 2014 and 2015, 81% and 90% of juvenile Chinook salmon sampled were infected with the lethal parasite *Ceratonova shasta*. These high rates of infection were the result of poor water quality, low flows, and prolonged absence of flushing flows necessary to scour the river bed (Hillemeier et al. 2017). These observations led Tribes and conservation groups to file suit against the Bureau of Reclamation and National Marine Fisheries Service resulting in re-consultation on the Klamath Irrigation Project operations plan. In the absence of a meta-population in the Upper Klamath Basin the KTS Chinook experience predation at higher rates than would have existed prior to the extirpation of the Upper Klamath spring Chinook runs.

*(D) the inadequacy of existing regulatory mechanisms; or*

Currently, since KTS Chinook are considered part of the same ESU as UKTR fall Chinook, there is no recovery plan or management plan in place to enable the recovery of this ESU. This despite the fact that spring Chinook are a California Department of Fish and Wildlife Species of Special Concern and qualified to be added to the state and federal lists of threatened or endangered fish (Moyle et al. 2008). They are also considered a Sensitive Species by the Pacific Southwest Region of the US Forest Service. Additionally, the harvest of UKTR spring Chinook is not managed despite the acknowledgement that spring and fall run Chinook are "temporally and spatially separated"(Termini 2016).
Fisheries managers have expressed the need to manage KTS Chinook. In 2003, the Klamath Fisheries Management Council reported to the Pacific Fisheries Management Council that, "The KFMC intends to

develop management recommendations for the PFMC aimed at the conservation of Klamath spring Chinook while preserving meaningful harvest opportunities for both ocean and river fisheries. This unique stock has contributed significantly to both ocean and river fisheries without the benefits of management. Concerns have been raised to the KFMC that the status of spring Chinook, once believed to be the dominant race among Klamath Chinook, is presently depressed and largely sustained by hatchery production. In order to ensure the viability of this stock, the KFMC, working with its Technical Advisory Team and member agencies, is developing information useful for identifying management objectives for Klamath spring Chinook." ("Klamath Fishery Management Council Report and Recommendations to the Pacific Fishery Management Council" 2003). These management objectives were never set.

*(E) other natural or manmade factors affecting its continued existence*

As noted above, a century of dams and diversions has been a leading cause of KTS Chinook declines.

The current population of KTS Chinook represents less than 3% of their historic abundance (Moyle, Lusardi, and Samuel 2017). Since the previous 2011 Petition was filed, conditions for KTS Chinook have only gotten worse. There is no meaningful disagreement among fisheries experts that if KTS Chinook were considered as a separate ESU, KTS Chinook meet all the criteria for listing under the Endangered Species Act.

## Bibliography


California Trout, ed. 2017. "Upper Klamath-Trinity Rivers Spring-Run Chinook Salmon." California Trout. http://caltrout.org/wp-content/uploads/2017/05/UKTR-spring-run-Chinook-final.pdf.

Campbell, A., and Peter B. Moyle. 1991. "Historical and Recent Population Sizes of Spring-Run Chinook Salmon in California." Workshop. Arcata, CA: American Fisheries Society.

Center for Biological Diversity, Oregon Wild, Environmental Protection Information Center, and The Larch Company. 2011. "Petition to List Upper Klamath Chinook Salmon (Oncorhynchus Tshawytscha) as a Threatened or Endangered Species," January 27, 2011.

Hamilton, John B., Gary L. Curtis, Scott M. Snedaker, and David K. White. 2005. "Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams—A Synthesis of the Historical Evidence." *Fisheries* 30 (4):10–20. https://doi.org/10.1577/1548-8446(2005)30[10:DOAFIT]2.0.CO;2.

Hillemeier, Dave, Michael Belchik, Toz Soto, S. Craig Tucker, and Sean Ledwin. 2017. "Measures to Reduce Ceratonva Shasta Infection of Klamath River Salmonids: A Guidance Document." Yurok Tribe, Yurok Tribe, Karuk Tribe, Hoopa Valley Tribe.

Houston, Will. 2017. "Klamath Salmon Hit 2nd Lowest Recorded Population Size in 20 Years." *Eureka Times-Standard*, July 31, 2017. http://www.times-standard.com/article/NJ/20170731/NEWS/170739982.

Kinziger, Andrew P., Michael Hellmair, David G. Hankin, and John Carlos Garza. 2013. "Contemporary Population Structure in Klamath River Basin Chinook Salmon Revealed by Analysis of Microsatellite Genetic Data." *Transactions of the American Fisheries Society* 142 (5):1347–57. https://doi.org/10.1080/00028487.2013.806351.

"Klamath Facilities Removal Final Environmental Impact Statement/Environmental Impact Report." 2012. United States Department of Interior.

"Klamath Fishery Management Council Report and Recommendations to the Pacific Fishery Management Council." 2003. Supplemental. Klamath Fisheries Management Council. https://www.pcouncil.org/bb/2003/0303/B5c_Supp_KFMC_Report_March2003BB.pdf.

Lestelle, Larry. 2012. "Effects of Dwinnel Dam on Shasta River Salmon and Considerations for Prioritizing Recovery Actions." Karuk Tribe.

McEvoy, Arthur F. 1986. *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980*. Cambridge University Press.

Moyle, Peter B. 2002. *Inland Fishes of California*. University of California Press.

Moyle, Peter B., Rob Lusardi, and Patrick Samuel. 2017. "SOS II: Fish in Hot Water." San Francisco, CA: California Trout. http://caltrout.org/sos/.

National Marine Fisheries Service. 2011. "Listing Endangered and Threatened Species; 90-Day Finding on a Petition to List Chinook Salmon" 76 (April):2032.

Nielsen, J. L., K. D. Crow, and M. C. Fountain. 1999. "Microsatellite Diversity and Conservation of a Relic Trout Population: McCloud River Redband Trout." *Molecular Ecology* 8:S129–42. https://doi.org/10.1046/j.1365-294X.1999.00817.x.

Prince, Daniel J., Sean M O'Rourke, Tasha Q Thompson, Omar A Ali, Hanna s Lyman, Ismail K Saglam, Thomas J Hotaling, Adrian P Spidle, and Michael R Miller. 2017. "The Evolutionary Basis of Premature Migration in Pacific Salmon Highlights the Utility of Genomics for Informing Conservation." *Science Advances*, August.

Quinn, T.P. 2005. *The Behavior and Ecology of Pacific Salmon and Trout*. Bathesda, Maryland: American Fisheries Society.

Salter, John. 2003. "The Effect of the Klamath Hydroelectric Project onTraditional Resource Uses and Cultural Patterns of the Karuk People within the Klamath River Corridor." http://mkwc.org/old/publications/fisheries/Karuk%20White%20Paper.pdf.

Termini, Valerie. 2016. "Notice of Proposed Changes in Regulations." California Fish and Game Commission. http://www.fgc.ca.gov/regulations/2017/7_50_kt_ntc.pdf.

"The Watershed Research and Training Center." n.d. Accessed August 7, 2017. https://thewatershedcenter.com/projects-in-action/save-our-spring-chinook/.

Wales, J.H. 1951. "The Decline of the Shasta River King Salmon Run." California Department of Fish and Game.

Waples, Robin. 1991. "Definition of 'Species' Under the Endangered Species Act: Application to Pacific Salmon." National Marine Fisheries Service. http://docs.lib.noaa.gov/noaa_documents/NMFS/TM_NMFS_FNWC/TM_NMFS_FNWC_194_files/TM_NMFS_FNWC_194.htm.

Waples, Robin, David .J. Teel, James M. Myers, and Anne R. Marshall. 2004. "Life-History Divergence in Chinook Salmon; Historic Contingency and Parallel Evolution." *Evolution* 58 (2):386–403. https://doi.org/10.1111/j.0014-3820.2004.tb01654.x.
Werner, Francisco. 2011. "Finding of Upper Klamath Trinity River Chinook Salmon Biological Review Team," December 27, 2011.
West, J.R. 1991. "A Proposed Strategy to Recover Endemic Spring-Run Chinook Salmon Populations and Their Habitats in Teh Klamath River Basin." USDA Forest Service, Klamath National Forest.
Williams, T.H., J.C. Garza, N. Hetrick, M.S. Lindley, M.S. Mohr, J.M. Myers, R.O. O'Farrell, R.M. Quinones, and D.J. Teel. 2011. "Upper Klamath and Trinity River Chinook Salmon Biological Review Team Report."