SOUTHERN OREGON–NORTHERN CALIFORNIA COASTAL CHINOOK SALMON
Oncorhynchus tshawytscha

Moderate Concern. Status Score = 3.1 out of 5.0. Southern Oregon-Northern California Coastal (SONCC) Chinook salmon in California are limited to a few watersheds but populations remain stable. They may be vulnerable to stochastic events due to small population size and limited range within California.

Description: Chinook salmon can be distinguished from other salmon species by the many black spots on their back, dorsal fins and both lobes of the caudal fin, as well as by the dark pigment along gums in the lower jaw. Morphological characteristics of SONCC Chinook salmon are as follows: fin ray counts are 10-14 (dorsal fin), 14-19 (pectoral fin), 10-11 (pelvic fin), and 13-16 (anal fin) (Snyder 1931, Schreck et al. 1986). Scales along the lateral line number 131-147. They are also characterized by 93-193 pyloric caeca, 13-18 branchiostegal rays and rough, widely-spaced gill rakers, 12-13 of which are on the lower half of the first gill arch.

Adult lengths can be greater than 140 cm SL, but usually fall between 75 and 80 cm SL. Smith River Chinook salmon regularly attain larger sizes, with a majority of fish retained by anglers ranging from 88 and 100cm SL (CDFW 2002, 2006, 2007). SONCC Chinook salmon range widely in size, but when compared to Sacramento River Chinook of the same length, are more rounded and heavier (Snyder 1931). Adult Chinook salmon in California can reach weights of 38.6 kg, but average between 9-10 kg. Sexually mature adults are uniformly colored in dark burgundy or olive brown. Males develop humped backs and hooked jaws and are usually darker than females. Chinook juveniles have 6-12 parr marks equal in width or wider than the spaces between them and an adipose fin with dark coloration along the upper edge only. Although some parr develop spots on the dorsal fin as they grow, most have clear dorsal fins.

Taxonomic Relationships: The SONCC Chinook salmon ESU is distinguished from other ESUs based on genetic analyses. Analysis of microsatellite loci and older allozyme datasets designated Chinook from the Klamath River and Blue Creek (lower Klamath River) into two clusters within the Klamath Basin (Myers et al. 1998). The SONCC Chinook salmon ESU contained genotypes from Blue Creek, which clustered with those from streams north of the Klamath River, including southern Oregon, based on microsatellite DNA. Southern Oregon Northern California Coastal Chinook salmon from the Smith River and Blue Creek also share morphological traits and age (3 years) of maturity (Snyder 1931). In Blue Creek, there is also a late fall-run which seems to be segregated from other fish (Gale et al. 1998). Although spring-run Chinook return to the Smith River, the relationship between these and fall-run SONCC Chinook is not well understood. Myers et al. (1998) regard the few spring-run Chinook in SONCC Chinook streams to be part of the ESU.

Life History: Most SONCC Chinook spawning adults migrate into rivers in the late fall, when increases in stream flow facilitate access into streams. Adults enter tributaries of the lower Klamath River from September through December and spawning occurs in the latter part of this period and into January (Leidy and Leidy 1984). In the Smith River, migration may start as early as late August and continue through early January. Run timing peaks are generally observed from late November to early December, depending on location (Larson 2013, Walkley and Garwood 2017) with spawning typically occurring between October and February. Chinook salmon enter Blue Creek in September and spawning peaks after fall rains, usually in November, but may continue through December, reflecting differences in reproductive maturity between earlier and later arrivals (Gale et al. 1998). Differences in reproductive behavior were observed for females in Smith River tributaries. The amount of time that a female spent on a redd decreased from 10-21 days to 5-10 days as the spawning season progressed and river conditions changed (Waldvogel 2006). SONCC Chinook age at spawning is variable by habitat and can change over time. Spawners in Blue Creek are primarily age-3 with a few age-4 and age-5 fish. A few grilse, reproductively mature age-2 fish, also return to spawn (Gale et al. 1998). In Mill Creek (Smith River), from 1993-2002, most spawners were age-3 (62%), but, from 1981-1992, 4 year-old females comprised the majority of spawners (66%, Waldvogel 2006).

Chinook salmon fry emerge in lower Klamath tributaries from February (Parish and Garwood 2016) through mid-April, some with yolk sacs still intact, and most migrate to the ocean in the same year (Leidy and Leidy 1984). In 1995-96, fry outmigration from Blue Creek began before mid-March, peaked in late April and late May, and continued into August (Gale et al. 1998). Fry grew to 103 mm FL throughout the period of outmigration (Gale et al. 1998). Early outmigrants generally traveled quickly into the estuary, though there is considerable variability in timing and residence times among CC Chinook watersheds. For example, Wallace (2003) found peak juvenile migration through the Klamath estuary occurred between June and July from 1997-1999. During this time, estuary residence was found to vary significantly from one year to the next (8 to 16 days in length) and was positively correlated with prevailing streamflow conditions (Wallace 2000). More recently, Wallace (2010) compiled juvenile outmigration data and found annual median travel times of captured coded-wire tagged Chinook from hatchery to estuary ranged from 30-34 days for Iron Gate Hatchery (IGH) fall Chinook, 10-32 days for Trinity River Hatchery (TRH) spring Chinook, and 23-75 days for TRH fall Chinook (Wallace 2010). Larger juveniles can spend months rearing in freshwater before outmigration (Sullivan 1989).

Zajanc (2000) found that estuary residence time for outmigrating individuals was variable, with late migrating individuals (August) rearing for longer periods than early outmigrants (June-July). In the Smith River, juvenile Chinook were observed in both low salinity zones (<5%) in the upper estuary with abundant cover from overhanging riparian vegetation (Quiñones and Mulligan 2005), while Parish and Garwood (2015, 2016) found Chinook YOY rearing in open, freshwater portions of the lower estuary lacking cover in spring. Estuarine residence times in the Smith River estuary were relatively short (eight to 40 days) compared with other Pacific coast estuaries (e.g., Nicholas and Hankin 1988), and individuals generally showed rapid growth during the early and late summer rearing periods, but not when temperatures were highest during mid-summer (Zajanc 2000).

Ocean survival of Chinook is likely enhanced by larger body size associated with longer periods of rearing in fresh water (Williams et al. 2016). Reedy (1995), Garwood and Larson (2014), and Parish and Garwood (2015) found that juvenile Chinook exhibit a strong stream-type life history on the Smith River to allow them to grow before undertaking taxing ocean migrations, with several months of freshwater rearing observed. Outmigration generally occurs from spring through the summer, but relatively high juvenile stream occupancy rates were observed as late as September. For example, 28% of juvenile outmigrants from Blue Creek in 1996 reared extensively in freshwater (McCain 1994) first, while only about 5% of juveniles rearing in Hurdygurdy Creek (Smith River) in 1987 and 1988 remained in the stream to rear after spring flows receded (McCain 1994). It is possible that high flows in the spring of 1988 shortened freshwater residency in that year. Juvenile Chinook salmon in tributaries of the Sixes River, Oregon, (northern range of SONCC Chinook) also displayed varying degrees of freshwater residency; some moved into the ocean within weeks of emergence, while others reared in freshwater from two months to more than one year (Reimers 1971). Scale aging revealed that most adults returning to spawn had reared in freshwater for two to six months as juveniles (Reimers 1971).

Once in the ocean, Chinook seem to follow defined migration routes to a cool pool of water offshore of the Klamath-Trinidad region (Harding 2015) and the food-rich waters of the North Pacific, but are capable of altering migration patterns to use regions with temperatures of 8°-12°C (Hinke et al. 2005), presumably to follow favored or abundant prey.

Habitat Requirements: SONCC Chinook generally use large cobbles and require sufficient flows to facilitate oxygen delivery to developing embryos. Most SONCC Chinook salmon spawn in the middle reaches of coastal tributaries, but in the Smith River, small tributaries are commonly used for spawning (Walkley and Garwood 2017). In Blue Creek, holding spawners favored deep pools and areas with runs and pocket water with fast flows (Gale et al. 1998). Adults have been observed spawning at depths ranging from a few centimeters to several meters, with water velocities of 15-190 cm/sec. However, preferred spawning habitat depths range from 25 to 100 cm, with water velocities from 30 to 80 cm/sec (Moyle 2002). Embryo survival is enhanced when water temperatures stay between 5°-13°C and oxygen levels are close to saturation (Healey 1991). Water temperature requirements of Chinook salmon are discussed in Moyle et al. (2008). Embryos incubating in optimal conditions generally hatch within 40-60 days (temperature dependent), but remain in the gravel as alevins for an additional 4-6 weeks, usually until the yolk sac is absorbed. Juveniles will continue to rear in streams throughout the summer if water temperatures remain < 20°C (Gale et al. 1998), though Parish and Garwood (2015) observed rearing Chinook in the Smith River at temperatures up to 23°C. Rearing habitats are generally characterized by shallow water in areas with overhanging riparian vegetation that provide cover, food and habitat complexity in stream reaches, though they will move to deep water to shoal and feed in streams and estuaries (J. Garwood, CDFW, pers. comm. 2017).

Distribution: Southern Oregon-Northern California Coastal Chinook salmon range from Cape Blanco, OR (near the Elk River) south to the Klamath River, including Klamath River tributaries from the mouth to the Trinity River confluence. In California, SONCC Chinook salmon were historically found in most small tributaries of the lower Klamath River that are within the ocean-influenced fog belt such as Hunter, Terwer, McGarvey, Tarup, Omagar, Blue, Surpur, Tectah, Johnson, Mettah, and Pine creeks (USFWS 1979). In 1999-2000, Gale and Randolph (2000) found Chinook in Hoppaw, Saugep, Waukell, Bear, Pecwan, and Roaches creeks, but not in Omagar and Surpur creeks. Southern Oregon-Northern California Coastal Chinook in California are currently found in only a few small lower Klamath tributaries (e.g., Blue Creek), Wilson Creek (Del Norte Co.) and the Smith River (J. Garwood, CDFW, pers. comm. 2017).

Chinook salmon from the Rogue River, OR, and Smith River, CA have different ocean migration patterns than Chinook salmon in ESUs to the south (Gale et al. 1998), with a greater tendency for adults in the ocean to stay north of Cape Blanco (Brodeur et al. 2004), while upper Klamath-Trinity rivers Chinook salmon stocks tend to associate with the California Current further south (Harding 2015).

Trends in Abundance: The majority of SONCC Chinook salmon originate from the Rogue River in Oregon, while individuals from the lower Klamath River tributaries and Smith River contribute to the population but to a lesser extent. Abundance of the fall-run appears stable, although populations in the Klamath basin have been adversely affected by land use practices, particularly logging. Spring-run Chinook salmon appear to have largely disappeared from this ESU (Moyle 2002). The numbers of spring-run Chinook adult in the Smith River were probably always low, with 0-38 fish counted on the South Fork from 1982-2016, and 0-17 fish counted on the Middle Fork from 1991-2016 in snorkel surveys (54 to 85 km surveyed, Parish 2016).

There is considerable natural variability in the number of fall-run Chinook observed from year to year in the ESU. Historically, some 2,000-3,000 adult Chinook salmon spawned in the lower Klamath River each year (Moyle 2002). In 1960, an estimated 4,000 Chinook salmon spawned in lower Klamath tributaries (USFWS 1979) while, in 1978-79, the number of spawners dropped to around 500 (USFWS 1979), and estimates of returning adults have fluctuated but generally been relatively low since. In 1995 and 1996, respectively, 236 and 807 fall Chinook salmon were observed in Blue Creek (Gale et al. 1998). A study of spawner survey methodology and effectiveness of Chinook in Blue Creek indicated that surveys generally only count about half the actual number of spawners, with spawner estimates in survey years (1995- 2009) ranging from 100-2,400 fish (Antonetti 2009).

More recently, the numbers of late fall-run Chinook spawning in Blue Creek from 1988 to 2009 followed an increasing trend (Quiñones at al. 2014). The time series is significantly correlated to hatchery returns, suggesting that numbers are supplemented by hatchery strays or that hatchery fish encounter similar ocean conditions as naturally produced fish of the same cohort. In 2011, spawning surveys indicated a record peak count of 1,561 late-fall Chinook (adults and jacks) in Blue Creek, with a total population estimate of 6,100 (± 876). This was the highest peak count of spawners recorded since surveys commenced in 1988 (Antonetti and Partee 2013, Figure 1).

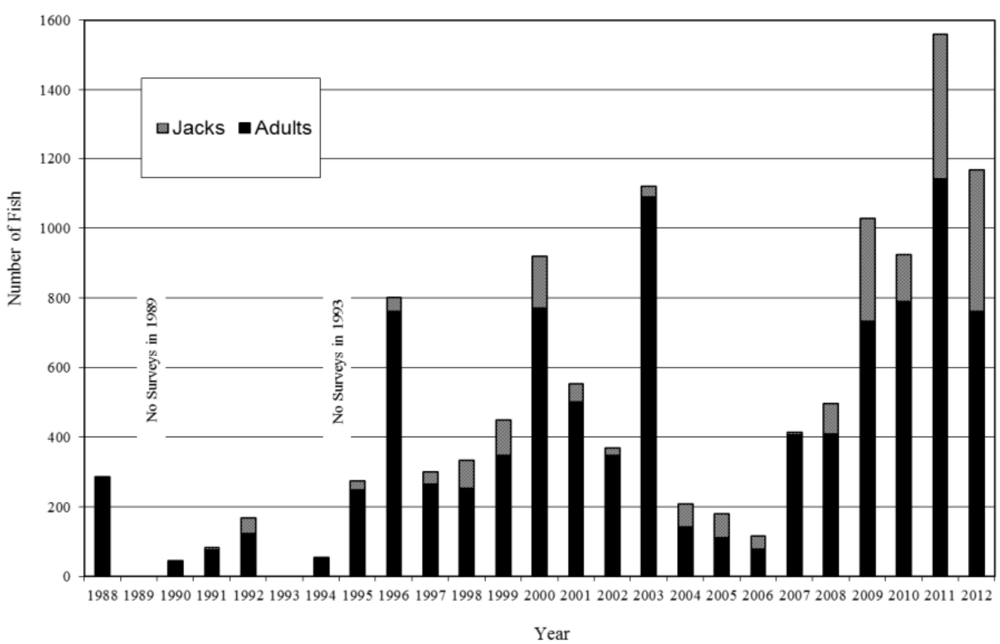

Figure 1. Annual peak count of late-fall Chinook salmon in Blue Creek, 1989-2012. From: Antonetti and Partee 2013. Fig. 5, page 18.

Annual abundance of adult Chinook salmon in the Smith River is estimated to range from 15,000-30,000 fish (Moyle 2002), but robust population estimates have historically not been established. However, using sonar technology, cross-referenced with Rowdy Creek weir fish counts, Larson (2013) estimated adult escapement in the Smith River Basin to range between 22,500 and 20,000 individuals during 2010-2011 and 2011-2012, respectively. Documented spawning redds (a proxy for adult returns) have varied over the last five years in the Smith River, with a peak during 2011-2012 (3,819, 95% CI: 2,777-4,860), a trough during 2013-2014 (516, 95% CI: 284-770) (Garwood and Larson 2014), and a rebound in 2014-2015 (1,715, 95% CI: 1,092-2,337) (Walkley and Garwood 2015). These estimates do not cover all potential Chinook spawning habitats because they were designed to estimate spawning coho (Garwood and Larson 2014). More recent redd estimates for the 2015-16 spawning season (Walkley and Garwood 2017) are similar to 2014-2015, with an estimated 2,000 redds, plus or minus about 1,000.

Forty-six percent of all Chinook redds were observed in Rowdy Creek, while 31percent were observed in Mill Creek during the 2015-16 spawning season (Walkley and Garwood 2017). Stream spatial structure of the population (e.g., proportion of area occupied by juvenile Chinook) in the Smith River watershed appeared relatively stable over the last several years, though summer occupancy dropped during 2014 (coincident with drought effects), and rebounded in 2015 (Walkley and Garwood 2015). There is no evidence of a declining trend in fall-run spawner abundance in the Smith River, and so populations are assumed to be stable.

Factors Affecting Status: SONCC Chinook salmon abundance in California appears to be mostly limited by habitat alteration, hatcheries and harvest. The ESU may also be vulnerable to stochastic events due to small population size and limited range.

Dams. The Smith River is undammed but, in the Klamath River, flow regulation by mainstem dams may affect migration timing and health of adults in the main-stem river prior to entering smaller tributaries. These dams may also negatively affect juveniles outmigrating from the system by reducing peaks of freshets or pulse flows after storm events. In addition, flows regulated by dams in the Klamath River mainstem can also adversely affect migrating Chinook salmon through exposure to high water temperatures that increase the incidence of disease (Belchik et al. 2004).

Agriculture. In the Smith River estuary, construction of dikes and reclamation of lands for agriculture and grazing have reduced the amount of juvenile rearing habitat by more than 40% (Quiñones and Mulligan 2005). Diversions of water for flower bulb cultivation, alfalfa production, pasture irrigation, and other purposes may affect salmon outmigration, depending on seasonal timing and volume of water diversions. Concern over long-term pesticide use, which has known toxicity to aquatic invertebrates, at lily bulb fields adjacent to the estuary has initiated limited water quality testing by the State Water Resources Control Board (Parish and Garwood 2015, Cal EPA 2017).

Grazing. Grazing of riparian areas by feral cattle has been identified as significant cause of habitat degradation in the lower Klamath in the vicinity of the Blue Creek drainage, causing stream bank sloughing and reduced riparian vegetation (Fiori and Beesley 2013). Cattle grazing along the Smith River estuary has also degraded stream banks and reduced or eliminated riparian vegetation (Quinones and Mulligan 2005). Numerous road and cattle crossings have been identified for fish passage restoration, particularly those in the lower watershed on Tyron and Morrison creeks near the Smith River estuary (Parish and Garwood 2015).

Transportation. Roads, including highways, have been identified as a major source of habitat loss in SONCC Chinook streams. However, road building is intimately associated with logging in the Klamath Mountains; see below.

Logging. The coastal watersheds of northern California have been heavily logged, beginning in the mid-19th century (USFWS 1979). Logging has altered most coastal streams by increasing solar input and water temperatures through reduced tree canopy cover, introduction of heavy loads of fine sediments that bury spawning gravels and fill pools, and increased surface runoff of precipitation, leading to increased frequency of flash flooding in streams. Removal of large trees has removed important sources of large woody debris, which provides cover for all life stages of salmonids. In many streams, extensive networks of logging roads (mostly unimproved) in north coastal drainages have blocked salmon spawning migrations. Improperly built stream crossings (culverts, bridges, cattle crossings, and other structures) have created fish passage barriers, impeding fish passage although, in recent decades, many passage impediments have been rectified. Road construction in lower Blue Creek has also altered stream morphology and reduced recruitment of large woody debris into the stream channel (Beesley and Fiori 2008). Roads have increased fine sediment delivery to streams in the Smith River basin (Six Rivers National Forest 2013).

Fire. Most lower Klamath and Smith River tributaries are within the marine fog belt, with cooler temperatures and higher fuel moisture that inhibit wildfires; however, in recent years, inland portions of the Smith River watershed have suffered catastrophic wildfires (e.g., Biscuit Fire in 2002 and Coon, Bear, Peak and Buckskin fires during the summer of 2015) that can potentially degrade tributary and main-stem habitats.

Estuary alteration. The capacity of the Smith River estuary to support juvenile salmon rearing has been greatly reduced due to prevailing land uses and associated habitat degradation. Specifically, levees, dikes, tide gates, and rip-rap have been used extensively in the estuary to control flooding and improve bank stability, and much of the emergent tidal wetlands have been eliminated as a result (Parish and Garwood 2015). Such modifications have disconnected the estuary from historically productive lateral habitats, such as sloughs, with negative consequences for juvenile salmonids that use these areas for rearing (Parish and Garwood 2015).

Harvest. Commercial, sport, and tribal fisheries have likely reduced SONCC Chinook salmon abundance in the past. However, recent regulations to protect Upper Klamath-Trinity rivers Chinook from overharvest (e.g., closure of fishery in 2006, 2008 by Pacific Fisheries Management Council) may have reduced harvest rates of SONCC Chinook salmon from the lower Klamath and Smith rivers in recent years. Mixed-stock commercial fisheries at sea do not currently have the ability to differentiate between Chinook of different ESUs or runs, and so inadvertent harvest of SONCC Chinook likely still occurs, though at unknown levels. Freshwater harvest rates of SONCC Chinook are also largely unknown and require further study.

Hatcheries. Although hatcheries are not operated in tributaries to the lower Klamath River, SONCC Chinook in the basin are likely interacting with salmon produced by hatcheries on the main-stem Klamath (Iron Gate Hatchery) and Trinity (Trinity River Hatchery) rivers. Hatchery-produced juvenile Chinook salmon migrate through the middle Klamath River in late summer (USFWS 2001), around the same time that wild SONCC Chinook are also outmigrating. Hatchery-produced adults may stray into lower Klamath tributaries, perhaps interbreeding with and altering the genetic makeup of wild SONCC Chinook salmon. Returns of adult Chinook salmon to Blue Creek was found to be significantly correlated with returns of adult Chinook salmon to Trinity River Hatchery, suggesting that hatchery strays are contributing to the population (Quiñones 2013). In the Smith River basin, about 50 female Chinook salmon are spawned each year by Rowdy Creek Hatchery which began operation in 1973. CDFW has a production goal of 100,000 smolts annually and requires that all individuals are marked with a fin clip (Garwood and Larson 2014). Smolts are released during spring and have been observed displacing other salmonids (e.g., steelhead trout) from estuarine habitats (Quiñones, pers. obs, 1997-2001). During the winter of 2011-2012, approximately 23% of all recovered Chinook salmon carcasses in the Smith River basin were of hatchery origin (Garwood and Larson 2014). Some Smith River tributaries also have > 5% straying rates from Chinook from the Rowdy Creek Fish Hatchery (Walkley and Garwood 2017). Numerous studies have shown that interactions between wild and hatchery origin salmonids can produce significant negative effects on wild fish (Reisenbichler and Rubin 1999, Araki et al. 2008, Chilcote et al. 2011).

Factor	Rating	Explanation
Major dams	Low	No dams on the Smith River, but Klamath River dams affect migration patterns and reduce habitat suitability.
Agriculture	Low	Agriculture is primary land use in Smith River estuary; wetland reclamation, diking, diversions, and pollutant and pesticide inputs; however, potential effects have not been studied.
Grazing	Medium	Cattle grazing in the Smith River estuary has led to habitat degradation; grazing in Blue Creek drainage has substantially impacted riparian and aquatic habitats.
Rural/ residential development	Medium	Rural development is increasing in north coastal California watersheds, contributing to habitat degradation, water diversion, and pollutant inputs into streams.
Urbanization	n/a	
Instream mining	n/a	
Mining	n/a	
Transportation	Medium	Primary sources of sediment inputs in SONCC watersheds.
Logging	Medium	Most watersheds have been heavily logged in the past; legacy effects remain in many watersheds.
Fire	Medium	Predicted increases in severe wildfires may lead to increased habitat degradation, especially outside fog belt.
Estuary alteration	Medium	Land reclamation, dikes, tide gates for agriculture in the Smith River estuary has significantly reduced juvenile rearing habitats.
Recreation	Low	Most small tributaries not heavily used by swimmers and boaters.
Harvest	Medium	Harvest at sea has presumably reduced Chinook numbers to a fraction of historical numbers; freshwater harvest likely less but requires more study.
Hatcheries	Medium	Hatchery fish probably negatively affect Klamath River populations; impacts to the main population in the Smith River may be minimal, though more research is required.
Alien species	Low	Few alien species reported for Klamath and Smith rivers.

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of populations of SONCC Chinook salmon in California. Factors were rated on a five-level ordinal scale where a factor rated “critical” could push a species to extinction in 3 generations or 10 years, whichever

is less; a factor rated “high” could push the species to extinction in 10 generations or 50 years whichever is less; a factor rated “medium” is unlikely to drive a species to extinction by itself but contributes to increased extinction risk; a factor rated “low” may reduce populations but extinction is unlikely as a result. Certainty of these judgments is moderate. See methods for explanation.

Effects of Climate Change: Moyle et al. (2013) rated SONCC fall-run Chinook as “highly vulnerable” to extinction in the next 100 years as the result of the added impacts from climate change, although uncertainty in this regard is high. Predicted climate change impacts to north coastal streams are expected to be less than those to inland waters in California, since the maritime climate and associated fog belt will likely offset air temperature increases. However, coastal areas have already experienced a 33% reduction in fog frequency since the early 20th century and further reduction is predicted to increase summer drought frequency and duration along the west coast (Johnstone and Dawson 2010). Predicted increases in air temperatures (up to 10°C by 2100; Dettinger 2005), in combination with reduced fog frequency and associated increases in evapotranspiration, may negatively impact juvenile rearing habitat (e.g., warmer water temperatures, lower stream flow). While prospects for long-term survival of Chinook salmon in many watersheds in California are poor, the Smith River watershed (Wild and Scenic River) presents perhaps one of the few basins with potential resilience to climate change based on its current high water quality, no dams or major diversions, lack of development, high summer base flow, and watershed protections (J. Garwood, CDFW, pers. comm. 2017).

Poor ocean conditions (e.g., reduced upwelling, higher temperatures), may also reduce ocean survival and limit gene flow between more northern populations and are expected to become more frequent off the coast of California in the future, to the detriment of all salmonids (Williams et al. 2016). Based on historical analyses of changing sea surface temperatures and survival, Sharma et al. (2013) estimated that a 1°C increase in average sea surface temperatures in the spring and early summer, while juvenile salmon transition from freshwater to salt, may result in 1-4% reductions in survival across their range. Such increases are well within the expected bounds of sea surface temperature increases due to climate change by 2100 (Mantua 2015). In addition, sea level rise will likely reduce rearing habitats in estuaries, unless similar habitats become available in upstream areas as estuaries ‘back up’ in response.

Status Summary Score = 3.1 out of 5.0. Moderate Concern. The SONCC Chinook salmon ESU in California is limited to a few watersheds that are impaired, to varying degrees, by habitat degradation associated with land and water use practices. This ESU was determined by NMFS on September 16, 1999 to not warrant listing under the Federal Endangered Species Act, although SONCC Chinook salmon are considered a Sensitive Species by the U.S. Forest Service. While there are no discernable declining trends in abundance of SONCC Chinook at this time, this ESU should be monitored closely and better information and surveys (e.g. Walkley and Garwood 2017) must be continued and expanded to help determine changes in spawner success, species distribution, and abundance over time for all salmonids.

Metric	Score	Justification
Area occupied	4	Blue Creek and Smith River are the principal populations, along with smaller populations in tributaries.
Estimated adult abundance	3	Between 5,000 and 50,000 spawners in the Smith is probable in most years; in 2011-2012, adult spawners were estimated at 20,000. <1,500 spawners in Klamath tributaries in most years.
Intervention dependence	4	California populations are largely self-sustaining but some supplementation by hatcheries is likely.
Tolerance	3	Multiple juvenile life histories and spawner age diversity demonstrate physiological tolerances.
Genetic risk	3	Limited hatchery operations in California, but some concern for hybridization with hatchery 'strays' from Rowdy Creek Fish Hatchery and other ESUs.
Climate change	2	Fall-run is least vulnerable to climate change as they spawn later in and scouring of redds is less likely to influence juveniles; sea level rise may negatively affect rearing in estuaries; Smith River likely to retain runs under worst-case scenarios through end of the century. Vulnerable to increasing temperatures, changes in flow regimes in tributaries, and variable ocean conditions.
Anthropogenic threats	3	Multiple threats rated as "Medium."
Average	3.1	22/7.
Certainty (1-4)	2	Least studied of Klamath River Chinook runs.

Table 2. Metrics for determining the status of SONCC Chinook salmon, where 1 is a major negative factor contributing to status, 5 is a factor with no or positive effects on status, and 2-4 are intermediate values. Certainty of these judgments is moderate. See methods for explanation.

Management Recommendations: The persistence of the two largest populations of SONCC Chinook salmon (in Smith River and Blue Creek in the lower Klamath River) suggests that conservation of this ESU within California is largely reliant upon protection of spawning and rearing habitats in these two watersheds. Increased protection of these populations would also facilitate recolonization of other degraded streams in the ESU, as habitats recover and are restored, potentially expanding the distribution and increasing the abundance of SONCC Chinook salmon. The Smith River, in particular, may be one of only a few rivers in California that has built in resiliency to a changing climate due to its uninterrupted flow, relatively intact watershed, little development, and cool temperatures. More monitoring and restoration funding should be allocated to its lower tributaries (such as Rowdy and Mill creeks) and especially the estuary, which is relied on by SONCC Chinook, SONCC coho, chum, and pink salmon as well as Northern California steelhead, coastal cutthroat trout, and myriad other native fishes.

It has been shown that interactions of wild Pacific salmon with hatchery-produced salmon can reduce both the overall fitness of a population (Araki et al. 2008), its local adaptability (Reisenbichler and Rubin 1999), reduce long-term resilience of the population, and increase threat of extinction (Chilcote et al. 2011, Johnson et al. 2012). The introduction of hatchery salmon from Rowdy Creek Hatchery on the Smith River may therefore be in conflict with the status of the Smith River as a 'stronghold' for wild salmon and should be re-evaluated.

To determine the status of Chinook salmon within this ESU, both population monitoring and genetic studies are needed to determine levels of introgression between wild and hatchery stocks and to determine the status of spring-run Chinook salmon within this ESU. Such studies may be of particular value in the Smith River drainage (the largest free-flowing river system in the state) which has been designated a National Recreation Area, and is included in the National Wild and Scenic River program. In 2016, a proposal to allow mining in the North Fork Smith River watershed in Oregon was defeated, and the state of Oregon voted to enact a twenty-year ban on mining in this critical watershed. Such protections that ban harmful mining that can endanger the entire watershed should be banned permanently. These designations imply that priority should be given to maintaining self-sustaining, wild populations of native salmonids and other organisms.

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