Central Coast Forest Association

Protecting our land and our rights

January 26, 2005

California Fish and Game Commission
1416 Ninth Street
Sacramento, California, 95814
Attention: Mr. Jim Kellogg, President

Subject: **Comments on CDF&G December, 2004 *Review* of CCFA, Big Creek Lumber Co. June 17, 2004 Petition to redefine the southern extent of the Central California Coho Salmon ESU**

The Central Coast Forest Association (CCFA) and Big Creek Lumber Company (Big Creek) jointly submit the enclosed response to the California Fish and Game Commission concerning the CDFG *Review* of our June 17, 2004 petition. We are disappointed with the lack of understanding of our work as displayed by the comments of CDFG's *Review.* Even though it was in the hands of CDFG for six months, the understanding of its substance represented by the *Review* is at best, quite cursory. W e are at a disadvantage having received the *Review* on January 13, 2005 leaving us a mere nine working days in which to respond in order to meet the Commissions schedule; however we have attempted to answer fully each of the criticisms raised in the *Review.*

These comments are submitted on behalf of Big Creek, the McCrary family, owners of Big Creek Lumber Co. and all CCFA members and other concerned forestland owners as well as forestry professionals of the Santa Cruz Mountains area. Our scientific findings are fully documented in the enclosed report and will be presented to your Commission at the scheduled hearing on Feb. 3, 2003

Sincerely,

Big Creek Lumber Co. and Central Coast Forest Association

Homer T. McCrary
Vice President

Robert G. Briggs,
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Cc: Mike Chrisman, Secretary, Resources Agency
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Comments on the CDFG December 2004 Response to the CCFA and Big Creek Lumber Co. June 17, 2004 Petition to the CFGC To Redefine the Southern Boundary of the Central California Coast Coho ESU

Submitted by Big Creek Lumber Co. and the Central Coast Forest Association to the California Fish and Game Commission
January 26, 2004

Please cite this petition as follows:

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Executive Summary

All the arguments made in the CDFG (2004a) are repeated verbatim in the following pages together with our responses. A summary is provided below:

NOAA Fisheries SCL Argument	Relevant Facts
▪ Salmonid bones in the archaeological record are difficult to identify.	> Yet the most qualified researchers (plus second opinions) found no unidentifiable salmonid bones in Santa Cruz County or Santa Mateo County (see pages 9-10).
▪ Salmonid bones do not preserve well in the archaeological record.	> Yet they actually preserve especially well on the Central Coast and can be recognized from microscopic fragments (see pages 9-10).
▪ More sampling is necessary for the archaeological record alone to be definitive evidence.	> Yet zero coho bones have been found so far (consistent with the historical record and the early scientific literature), the archaeological record could never be definitive, and more sampling is always preferred (see page 11).
▪ An unidentified salmonid bone recovered from an archaeological site south of Big Sur could be a coho bone.	> Yet it is probably a steelhead bone or could be any other salmonid species (see page 11-12).
▪ Stream flows on the San Lorenzo River and Lagunitas Creek over the last 21 years indicate natural coho habitat suitability is the same north and south of San Francisco.	> Yet even a preliminary examination reveals how different these streams really are (see pages 13-15).
▪ The climates in Marin County and Santa Cruz County are the same.	> Yet NOAA data show the two climates are significantly different (see pages 15-17).
▪ Coho specimens were purportedly collected in 1895 at some Santa Cruz streams.	> Yet the identification of the species was anonymously changed, the chain of custody was broken, and the specimens are documented as unreliable. Nevertheless, even if they were fully verified, they are not evidence of a native population (see pages 17-19).
▪ Captain Wakeman reported coho salmon south of San Francisco in 1870.	> Yet he was gravely unqualified and made a number of revealing errors in his report (see pages 19-20)
▪ 1.4 million coho eggs were spawned from 518 coho females collected from Scotts Creek in 1909.	> Yet the reality is no such thing occurred and the 1.4 million eggs were mostly imported Chinook salmon eggs (see pages 21-22).
▪ Shapovalov and Taft (1954) implied that coho salmon were native south of San Francisco.	> Yet they never mentioned it (see pages 22).
▪ There is no evidence that coho salmon have been maintained by hatchery input.	> Yet there is (see pages 24-25).

▪ No coho were planted for 13 years starting in 1915 and they did not become extirpated.	> Yet records are incomplete, there is no reason to believe that they would have become extirpated in those 13 years, and they were heavily planted during other times when they *were* likely to become extirpated (see pages 26).
▪ Deforestation is harmful to coho.	> Yet deforestation has not been an issue in these watersheds for the greater part of a century (see pages 28-30).
▪ Recent declines in coho abundance are attributable to habitat degradation caused by land-use practices, urbanization, and reduced stream flows.	> Yet the causes of coho declines elsewhere are inapplicable south of San Francisco as there is no evidence of habitat degradation (especially not "urbanization") in Scotts and Waddell Creeks (see pages 30).
▪ The petitioners did not review the entire literature on coho salmon genetics.	> Yet all available genetic data do not and cannot demonstrate that coho south of San Francisco are or are not native (see page 32-34).

Introduction

The California Department of Fish and Game (CDFG) Response to the CCFA/Big Creek petition (Alvarado et al. 2004) purports to be based on the latest scientific information, however the CDFG (2004a) selectively ignored scientific data, obfuscated the facts and rejected our petition on the basis of clichés, old fisherman's tall tales, political activist propaganda and fabricated arguments (CDFG 2004a).

Our people (CCFA and Big Creek) many of whom reside, hold property and make a living in the Central Coast forests have conducted serious scientific and historical research into the local coho salmon for several years. Some of us draw on a lifetime in the forests next to the streams with the background of many generations of conscientious forbearers who have charted our paths.

Although our research work is still ongoing, it reveals a pattern of facts that have been ignored by the CDFG and that raise serious doubt as to the native origin of Central Coast coho. Our multidisciplinary investigation includes archeological records, original early ichthyological surveys, historical records and geomorphological data. Each of these sources independently substantiates the absence of coho in these streams prior to the 1906 well-publicized, artificial introduction of the species and subsequent hatchery maintenance. The historical record unequivocally shows that the Santa Cruz County Brookdale Fish Hatchery and the US Fish Commission arranged to introduce exotic coho into Central Coast streams, with which they intended to start colonies of a new species, yet no mention of these records appears in the CDFG (2004a) Response. Nor does the Response (CDFG 2004a) mention our discovery of a plethora of pre-1900 scientific surveys of coastal fish, all of which place the coho spawning habitat north of San Francisco and report no evidence of coho in Central Coast streams. Why were these important records and information sources ignored in the CDFG (2004a) Response?

No single study is absolutely conclusive, but the preponderance of evidence tells a consistent story. Coho did not populate these streams until human intervention created the populations that the CDFG wishes to protect and "restore" under the CESA.

The listing of coho in Central Coast streams was based on unsubstantiated claims of thousands of adult coho returning to Central Coast streams each year during the 1800s. Not an iota of valid scientific, archeological or historical proof of this claim was offered nor has it been added in this latest Response to our petition (CDFG 2004a). Rather, invalid references were cited liberally. For instance, the only citation in the CDFG status review (Anderson 1995, pg. 12) relevant to the 1800s distribution and abundance of coho south of San Francisco is the actual petition to list coho south of San Francisco (Hope 1993). Although he does not cite any valid evidence, the petition author, Dave Hope (staff member of the Santa Cruz County planning department) partly attributes claims of enormous coho populations in Central Coast streams in the 1800s to his own personal observations. These observations would have predated Hope's birth by at least half a century.

Some of our recent discoveries that are mentioned in the CDFG Response (2004a) include the undated, misidentified, mishandled, 1895 juvenile coho specimens found at the California Academy of Science. In this instance, it was Big Creek and CCFA, not the CDFG who inspected the specimens and records, researched, photographed, took tissue samples for genetic study and attempted to trace the scrambled labels, history and records of custody. If the CDFG case for retaining the listing depends on these data, it is strained beyond reason. These questionable specimens do not meet the minimum standards of either scientific data or legal evidence.

Since the CDFG's case for listing these fish depends entirely on the possibility of this one questionable instance of an ephemeral population of juvenile coho, fatuous, unscientific hearsay and includes no valid evidence of substantial permanent colonies, we ask, what exactly are you restoring? Not surprisingly, the CDFG has not determined specific delisting targets for streams south of San Francisco (CDFG 2004b). Which data are you going to use as the basis for determining specific delisting targets?

The CDFG Response to our petition is a repetition of several types of errors and distortions. Erroneous comments seem to be of three types:

1. comments based upon unsubstantiated untruths,
2. comments based on strained (apparently preconceived) interpretations of inapplicable or unacceptable reports,
3. comments based on implied statements not actually in the petition or the result of the CDFG having misunderstood or misrepresented the information presented in the petition

In this discussion, we point out many of the more egregious of these distortions, but the message is perhaps broader than the specifics. The CDFG has applied no scientific competence in understanding and analyzing our petition and, as we have reluctantly concluded, appear to have no intention of doing so.

Some specific problems with the CDFG Response to our petition (CDFG 2004a) are set forth below.

Review of Individual Arguments

CDFG (2004a) introductory comments

> The information in the petition was reviewed thoroughly and the major references cited in the petition were obtained and analyzed.
>
> CDFG 2004, pg. 1

If the major references cited in our petition were obtained and analyzed, strangely, they were not discussed at all by the CDFG (2004a) in this Response. All scientific and historical references in our petition documenting the absence of coho prior to their introduction were ignored. Similarly, all scientific and historical references documenting the introduction of coho as a new species in 1906 were also entirely ignored by the CDFG (2004a).

All relevant, reliable early coho salmon distribution literature stated that coho salmon were only found north of San Francisco (Hallock 1877; Jordan 1892a, b, 1894, 1904a, b, 1907; Jordan and Evermann 1896, 1902, 1905; Jordan and Gilbert 1876-1919; Jordan et al. 1882, Appendix I). Interestingly, although these references were discussed at length in our petition, the CDFG (2004a) had no comments about them.

Actual stream surveys were made in this early historical period. An article in the California Fish and Game Quarterly (Thompson 1922, pg. 165) stated, "In 1880, at the time Dr. Jordan made his survey of our coast fisheries … Other surveys occurred in 1889 to 1892, 1904, and 1908." Shebley and Gillis (1911) noted that Frank A. Shebley made field surveys of local Santa Cruz County streams to locate the Brookdale Hatchery and the Scotts Creek egg-taking station. Leinald (1906) reported that Shebley made stream surveys in Santa Cruz County to locate fry release sites from the Brookdale Hatchery. Streig (1991) stated that in 1902 Santa Cruz County hired Frank A. Shebley and Dr. Charles H. Gilbert to locate the hatchery site. Coho salmon were not found during these early surveys. The early presence/absence literature provides independent evidence that supports the scientific hypothesis that coho salmon are not native, not indigenous, to streams south of San Francisco (see Appendix I).

Newspaper as well as hunting and fishing journal articles help illuminate the initial coho salmon hatchery efforts at the Brookdale Hatchery and the early presence/absence of coho salmon in Santa Cruz County (B. 1909; Mountain Echo 1905, 1906, 1907; Santa Cruz Morning Sentinel 1905, 1906; Welch 1907). Evidently, the Brookdale Hatchery importations of Baker Lake coho were specifically intended to introduce a new species.

A Santa Cruz County newspaper article (Mountain Echo, pg. 3December 16, 1905) titled "Our County Fish Hatchery" stated, "Superintendent Frank Shebley… expects to receive ... silver [coho] salmon eggs from the U.S. Government hatchery in the state of Washington. It is believed

if raised and planted here they will frequent our streams and thus give us another valuable game fish."

The "Santa Cruz Morning Sentinel" (March 7, 1906, pg. 1) stated, "Dr Shebley has 50,000 silver [coho] salmon eggs from Baker Lake Washington which will be hatched out in a short while."

If coho salmon were already present, why would Shebley (and the Federal Government) not have used this local source for coho salmon eggs instead of going to the trouble and expense of importing coho salmon eggs from Washington State? Shebley only would have needed about 20-30 female coho salmon to yield 50,000 eggs. The fact that no coho salmon eggs were reported taken at the Scotts Creek egg-taking station prior to 1929 while millions of steelhead eggs were taken is relevant in this regard.

Reporting on the 50,000 coho salmon eggs that were received from the federal Baker Lake Hatchery in Washington, an article in "The Mountain Echo" (March 24, 1906, pg. 3) stated, "If they thrive here as hoped they will provide a valuable addition to the piscatorial tribe of our Santa Cruz waters."

Welch, editor "Forest and Stream Journal" (July 13, 1907, pg. 76) reported that, "**During 1906 Mr. Shebley hatched and liberated in the streams of the county upward of … 50,000 silver** [coho] **salmon** [fry]**. The hatching of the silver** [coho] **salmon is an experiment that is being considered by Mr. Shebley in connection with the United States Fish Commission, with the hope of introducing into the streams of the county a new species of fish ... it is to be hoped that the silver** [coho] **salmon … return to the streams of the county to spawn thus adding a new species of both game and food fish to the already well supplied waters of** [Monterey] **bay** [emphasis added]."

The soft literature strongly suggests that coho salmon were not present in Santa Cruz County streams prior to their introduction in 1906, reinforcing the early presence/absence literature discussed above.

The NMFS status review (Bryant 1994) and the CDFG status review (Anderson 1995) summarized the history of coho salmon hatchery planting in Santa Cruz County but missed these critical early stocking records.

> Coho salmon in streams south of San Francisco were listed by the Commission as endangered under CESA on December 31, 1995. The scientific evidence at the time indicated a listing of endangered was warranted. To date, the Department has been updating and reviewing the available scientific information regarding coho salmon both north and south of San Francisco. This information was used in the Department's analysis of the petition and formulation of the recommendation to the Commission.
>
> CDFG 2004, pg. 1

Not one single reference was cited in the CDFG status review (Anderson 1995) leading to this listing which presented any evidence that permanent coho populations were present and abundant south of San Francisco prior to their documented artificial introduction in 1906. Apparently, the CDFG was unaware of this 1906 documented importation of coho salmon from Washington state until it was brought to their attention by us (McCrary 2003). The discussion of the historical distribution and abundance of coho south of San Francisco by Anderson (1995) was limited to phony citations, personal communications, irrelevant population figures since the 1930s, and Hope (1993) who suggests he personally observed enormous coho populations in the 1800s.

CDFG (2004a) comments regarding archaeological data

> The petitioner's conclusion that coho salmon are not native to the streams south of San Francisco is based primarily on archeological evidence that shows the absence of identified coho salmon remains in prehistoric Native American middens, and their assertion that there were no credible surveys reporting coho salmon in those streams prior to 1906.
>
> CDFG 2004, pg. 2

Our conclusion is not based "primarily" on any one type or source of information. Our petition is a multidisciplinary investigation that incorporates archaeological, historical, biological, and geomorphological data to arrive at a rational synoptic conclusion.

> In a study commissioned by the CCFA, Gobalet (2003) reported finding no identifiable coho salmon remains in Native American middens south of San Francisco.
>
> CDFG 2004, pg. 2

Obviously the circuitous implication here is that we unduly influenced the results of Gobalet et al. (2004). Far from commissioning Gobalet's study, a member of CCFA and resident of Waddell Creek helped Gobalet, out of a mutual interest in the subject, by paying the hourly wages of one of Gobalet's interns. Gobalet was not under contract with, or obligated to CCFA in any way. No member of CCFA had any influence over the methods, results, or conclusions of Gobalet's work. Interestingly, the only other place we have seen this misstatement is in a document authored by a local Sierra Club political activist.

Gobalet's research first came to the attention of many Central Coast residents by way of his 1995 article in the Journal of the American Fisheries Society (Gobalet and Jones 1995) wherein Gobalet and Jones had already observed a lack of coho bones in the Central Coast archaeological record suggesting their prehistoric absence from Central Coast drainages. Gobalet's recent, more thorough examinations have confirmed his earlier findings.

> Gobalet (2003) and Gobalet et al. (2004) report many reasons why they found little evidence of coho salmon remains, including the difficulty of identifying salmonid bones to species and the fact that salmonid bones do not preserve well, as evidenced by the low percentage observed from the middens studied (Gobalet 2003). Also, the fish may have been prepared where they were caught.
>
> CDFG 2004, pg. 2

First Gobalet et al. (2004) did not find "little evidence" of coho salmon remains south of San Francisco. Rather, they found no evidence of coho salmon remains south of San Francisco.

Second, Gobalet et al. (2004) do not attribute the lack of coho salmon remains to any of these reasons.

Third, Gobalet et al. (2004) mention, "It is challenging to distinguish between the skeletal elements of members of the genus *Oncorhynchus*." However they do not claim this is a reason for their absence from the archaeological record. In fact, they point out that, "Coastal archaeological sites in San Mateo and Santa Cruz counties were given particular scrutiny because of legal issues regarding the status of endangered coho salmon." While distinguishing these skeletal elements may be challenging it is by no means impossible and K. W. Gobalet is the most qualified expert in the world to make these determinations. As stated by Gobalet et al. (2004), "Undeniably these determinants are an art that comes with experience." Gobalet et al. (2004) even solicited additional opinions from G. R. Smith (University of Michigan, Ann Arbor) for steelhead bones found at two of the Santa Cruz sites. Wherever species identifications were not definitive the materials were only identified as belonging to the genus *Oncorhynchus*. Conclusively, there were zero of these unidentifiable salmonid bones found in Santa Cruz County or San Mateo County.

Fourth, while Gobalet et al. (2004) mention that salmonid elements "might not preserve well," Gobalet et al. (2004) are clear that even microscopic salmonid fragments can be easily recognized. Certainly salmonid bones preserve well enough for steelhead to have been recovered from Northern California and 25 localities south of San Francisco, and for coho to have been recovered from San Francisco Bay and Northern California. Also, according to local California State Parks archaeologist, M. Hylkema, (who is most familiar with our local archaeology), a high percentage of alkali elements (sea shells) neutralizes the acidic character of most Central Coast archaeological sites thereby preserving animal and fish bones especially well. In other words, for the most part our Central Coast archaeological sites are ideally suited for the preservation and recovery of coho remains had they been here. To suggest that a low percentage of remains constitutes proof they do not preserve well is exclusively the CDFG's own contrivance.

Fifth, mentioning that the fish may have been prepared where they were caught is irrelevant, careless and uncited speculation by the CDFG (2004a). Local Native Americans primarily carried fish back to their villages whole where the fish were prepared and generally either dried on racks or baked in hearths or earth ovens (M. Hylkema, personal communication to F. Alvarado, 2005).

Finally, Gobalet et al. (2004) do indeed suggest reasons for the low abundance of salmonid bones found, including the difficulty of catching winter-run fish, the periodic extirpation of local populations due to droughts, errors in the ethnographic record, and varied archaeological techniques:

> "Both steelhead and coho are winter-run fish, and are therefore harder to capture than salmonids that undergo spawning migrations during periods of lower water (Moyle 2002). Additionally, since this region is at the southern edge of the coho salmon range, local populations would be subject to periodic extirpation in drought years (Brown et al. 1994). Archaeological remains of steelhead or salmon would presumably become increasingly rare the farther south one sampled" (Gobalet et al. 2004).
>
> "The rarity of salmonids in archaeological materials suggest that the ethnographic record overstated the importance of salmonids to the Native Americans of California" (Gobalet et al. 2004).
>
> "We agree with Rostlund (1952) that early descriptive accounts cannot be taken too literally... Monks (1987) argued that archaeologists inappropriately overemphasized salmon use, and Butler (2000) argued that salmon usage was likely far more variable than archaeologists commonly believe" (Gobalet et al. 2004).
>
> "To enhance confidence that the archaeological record is thoroughly evaluated and reflects the species present in the local stream, it is important to use methods (fine-mesh screen, water screening) conducive to recovering bones of tiny fishes or other microconstituents" (Gobalet et al. 2004).

> Finding salmonid bones in archeological middens is problematic, even where salmonids are [sic] plentiful. In the Central Valley, where large runs of Chinook salmon were documented (Yoshiyama et al. 1996, 1998) and where the ethnographic record indicates that the salmon fishery was of considerable importance to the native populations of the region (Yoshiyama et al. 2001), native communities may have consumed, per capita, as high as 365 pounds of Chinook salmon per year (Yoshiyama 1999, as cited in Gobalet et al. 2004). However, the archeological record does not reflect this: in the Sacramento River drainage, only 9.2% of the recovered archeological elements were from salmonids, and in the San Joaquin drainage, only two salmonid bones were found among 9,169 elements. This translates to a total salmonid contribution of 6.3% of the 29,265 bones from the entire Central Valley (Gobalet et al. 2004).
>
> CDFG 2004, pg. 2

In regards to the low abundance of salmonid bones found in the Central Valley or anywhere else Gobalet et al. (2004) are very explicit. "In a review like this, the reporting of identifications to the genus level and the use of comparative percentages results in some species having a low representation. Salmonid centra are easily recognizable even as microscopic fragments, which further reinforces the salmonids' lack of abundance in the archaeological materials" (Gobalet et al. 2004).

The CDFG's misunderstanding here lies in their assumption that salmonids are and therefore were plentiful in the Central Valley. Gobalet et al. (2004) respond directly to claims made by Yoshiyama et al. to that effect: "The ignorance of ethnographers regarding fish species, however, has contributed to the confusion about the fishery (Siefkin 1999). The finding of only two Chinook salmon elements in the entire San Joaquin drainage brings into question whether or not the Chinook salmon runs in the San Joaquin and Kings rivers, reported by Yoshiyama et al. (2001a), were significant to Native Americans." Also, excavations at those sites were not necessarily performed with fish bones and other microconstituents in mind.

> Gobalet et al. (2004) postulate that the frequency of coho salmon elements found in the archeological record of the San Francisco Bay area (14 out of 105,000 elements) should match those on the coastal side in San Mateo and Santa Cruz counties, therefore, one would need to find 7,506 elements before a single coho salmon bone could be expected.
>
> CDFG 2004, pg. 2

The ratio 1:7,506 assumes that, were coho native, their remains would exist in the archaeological record in coastal San Mateo and Santa Cruz County at the same frequency as in the San Francisco Bay area, an assumption we feel is unreasonable given the disparity between sites (latitude, photoperiod, geology, climate, and hydrology), varying excavation techniques, etc. Nevertheless, the ratio 1:7,506 is negatively skewed as it was derived by comparing the number of coho elements found at only 3 sites against the number of total fish elements recovered from 46 sites (43 of which did not yield coho elements). An attempt at a more appropriate ratio can made by dividing the total number of fish elements recovered from a single site by the number of coho elements recovered from that same site. For the 3 sites where coho elements were recovered, ratios range from 1:56 to 1:12,270 , elucidating the vast scale of variability between sites. Ultimately, given the limited dataset, a meaningful ratio for the purpose of determining an expected frequency of coho elements cannot be ascertained due to the limitations associated with high-variability, small-sample statistics.

> Interestingly, even though coho salmon remains were not specifically identified in the midden sites south of San Francisco, Gobalet at al. (2004) mentions the possibility that the salmon bones identified from a Monterey County site at Big Creek (south of Big Sur) are those of coho salmon which would place them further south than their current range.
>
> CDFG 2004, pg. 2

As with every instance in which Gobalet et al. (2004) could not determine the species of a particular salmonid remain, the possibility exists that they are any one of the species of Pacific salmonid including chum salmon which are known to occasionally stray into Central Coast streams.

Regardless, even if scarce coho salmon elements were found south of San Francisco this would not constitute proof that coho salmon are native south of San Francisco. Such remains could have resulted from ephemeral colonies established by strays or they may have even been imported. As Gobalet et al. (2004) pointed out, "[transport of marine species up to 80km] has precedence among the Native Americans of California (Gobalet 1992b), but trade of dried fish or vertebrae as curiosity items cannot be ruled out."

> Regarding the amount of coho salmon evidence found, Gobalet et al.(2004) state, "Because of this paucity of materials, far more sampling is required to use the archeological record as definitive evidence for the absence of coho salmon from this section of coast."
>
> CDFG 2004, pg. 2

As with any other scientific inquiry more quality data is always desired. However, "No coho salmon were found south of San Francisco on the California coast" and thus far the archaeological data are consistent with the prehistoric and early historic absence of coho salmon populations south of San Francisco. Although the archaeological record could never be definitive evidence either way for the reasons stated above, the archaeological record, as it stands, is completely incompatible with the CDFG's outlandish and unsubstantiated historical populations figures. If the CDFG is correct that coho salmon south of San Francisco have declined by over 98% from historical levels (Anderson 1995, pg. iv), they most certainly would be overwhelmingly represented even in the current limited archaeological record.

> Also, Gobalet (2003) in his concluding statement in the report commissioned by [sic] petitioners states, "We must, however, be cautious because the absence of evidence is not evidence of absence."
>
> CDFG 2004, pg. 2

Once again, we did not commission any of Gobalet's work. The intentions of the CDFG (2004a) in mentioning this twice is transparent.

We presented a multidisciplinary body of evidence that is not dependent on any single source or discipline to confirm its hypothesis. There is a preponderance of historic and scientific evidence indicating that permanent coho salmon populations were not here prior to their introduction and hatchery maintenance, and this is consistent with all archaeological data.

The CDFG should likewise be cautious because the absence of evidence is not evidence of presence either.

> The petitioner's assertion that the archeological evidence indicates that coho salmon populations were not present prehistorically in the coastal streams south of San Francisco is not supported by the available information and not supported by the archaeologist that performed the investigations.
>
> CDFG 2004, pg. 6

This statement by the CDFG (2004a) confirms their ignorance of the subject matter. First, the archaeological evidence does indicate an absence of coho salmon south of San Francisco since no coho salmon remains have been found south of San Francisco on the California coast. While archaeological data is rarely "definitive" it is consistent with a multidisciplinary preponderance of evidence. Tellingly, despite the CDFG's confusion, the lead author, K. W. Gobalet, is not an archaeologist. Rather, he is a fish biologist that reviewed the archaeological record as excavated by an array of archaeologists. This is an inescapably obvious fact to anyone that actually read the study.

CDFG (2004a) comments regarding the natural environmental conditions in the Santa Cruz Mountains

> The petition states that because of the climatic and physical instability of the habitat south of San Francisco, coho salmon could not survive other than ephemerally[1]. However, these conditions are not significantly different from north of San Francisco where there are known populations of native coho salmon. The Department found no evidence that the streams south of San Francisco Bay were more "flashy," as claimed, than streams north of the bay. Using stream gauge data (USGS 2004) the Department compared two similar streams, Lagunitas Creek and the San Lorenzo River. Lagunitas Creek is a known coho salmon bearing stream north of San Francisco Bay in Marin County, whereas the San Lorenzo River is south of San Francisco Bay in Santa Cruz County. As stated in the petition, the San Lorenzo River fluctuates from drought to flood conditions preventing perennial habitation of coho salmon. However, a comparison of the two streams shows very little variance in the amplitude of flow over a 20 year period (Figure 1). This time period was chosen to include both drought and flood years and the availability of comparable data (USGS 2004).

First, the CDFG (2004a) tortured comparison of limited stream flow records from single gauging stations on two different streams about 70-100 miles apart in very different terrain is an overly

simplistic farce and an obvious red herring. The devastating nature of Santa Cruz Mountain streams to coho survivability is a function of the interaction between stream flows, stream gradients, topography, and the unique geomorphology of the Santa Cruz Mountains. "Without erosion and landsliding, portions of the Santa Cruz Mountains would be twice the height of Mt. Everest, taller than any range known to have existed during Earth's history" (Spittler 1998). Stream flows alone cannot reveal the violently dynamic nature of the coastal streams of the Santa Cruz Mountains. Regardless of the stream flow dynamics of Lagunitas Creek, it is well documented by competent knowledgeable scientists, as well as CDFG staff, that the primary threat to coho populations south of San Francisco are naturally occurring stochastic events that are very capable of extirpating a single generation or even an entire population of coho (Appendix IV).

Second, it is not necessary or contingent upon us to provide an extensive climatologic and geomorphologic comparison of the Santa Cruz Mountains and Marin County. Such a study would be a monumental effort that is frankly beyond the scope of our resources and time. Nevertheless we are confident that such a study would find significant differences in terms of the ability of these habitats to naturally support permanent coho populations. Suffice it to say, only a very brief preliminary investigation into the science of Lagunitas Creek is needed to discredit the CDFG (2004a) comparison:

- Coho salmon are found primarily in the tributaries of Lagunitas Creek (Andrew and Cronin 1998), thus stream flows for the mainstem are largely inapplicable.
- The Marin Municipal Water District (MMWD) operates four dams on the mainstem of Lagunitas Creek including the Lagunitas Dam constructed in 1872 (Bratovich and Kelley 1988). On the contrary, there are no dams on the mainstem of the San Lorenzo River. Similarly, Scotts Creek and Waddell Creek have only had a few small temporary dams with capacities of less than 1 acre-foot, whereas the five Lagunitas Creek system dams range from 390 to 39,700 acre-foot capacities (Bratovich and Kelley 1988). Therefore the Lagunitas Creek system including stream flows and sediment levels is an inherently artificial system and any stream flow comparison to Santa Cruz County creeks is meaningless.
- "The MMWD reservoirs have altered flows in Lagunitas Creek by reducing peak winter storm flows and, with releases from Kent Lake, increasing summer low flows" (Andrew et al. 2000).
- In an October 1979 agreement with the CDFG, the MMWD agreed to release minimum flows in winter and summer to maintain salmon and steelhead resources in Lagunitas Creek (Andrew et al. 2000).
- Bratovich and Kelley (1988) concluded that Lagunitas Creek coho survival from egg deposition through fry emergence was relatively high and that "[m]ost of the redd substrate [in Lagunitas Creek] contained relatively small amounts of fine sediment" (Bratovich and Kelley 1988). Conversely, the CDFG (Anderson 1995) characterized the spawning habitat of Scott and Waddell Creeks as less than optimal small gravels with high sand and silt content (Appendix IV).

Essentially, the CDFG (2004a) superficial comparison of stream flows on these two creeks is a meaningless distraction from the overwhelming preponderance of evidence presented in our petition, most of which the CDFG ignored.

> Further, the Department was unable to discern a dramatic difference in climate north and south of San Francisco Bay. The Department looked at a variety of information, such as yearly rainfall and 24 hour precipitation events (USGS 2004, CDEC 2004, NOAA 2004), yet found no clear evidence to substantiate the petitioner's claim that the climate and conditions differed substantially between north and south of San Francisco Bay.

First, if the CDFG (2004a) actually looked at such data they have not presented them. Second, by computing the probability of precipitation (using data from the National Oceanic and Atmospheric Administration) for the Kentfield station in Marin County and the Ben Lomond station in Santa Cruz County we can see a distinct difference in patterns of precipitation between the two counties. These two stations represent the greatest precipitation recorded in their respective counties. Figure 1 shows how Marin County is significantly more likely to receive more than 1 inch of rain in a single day from May through September. In other words, while both counties may experience droughts, the microclimates of Santa Cruz County are such that periods of low rainfall tend to be harsher in Santa Cruz County than in Marin County. This should not come as a surprise as Santa Cruz County is about 100 miles to the south of Marin County.

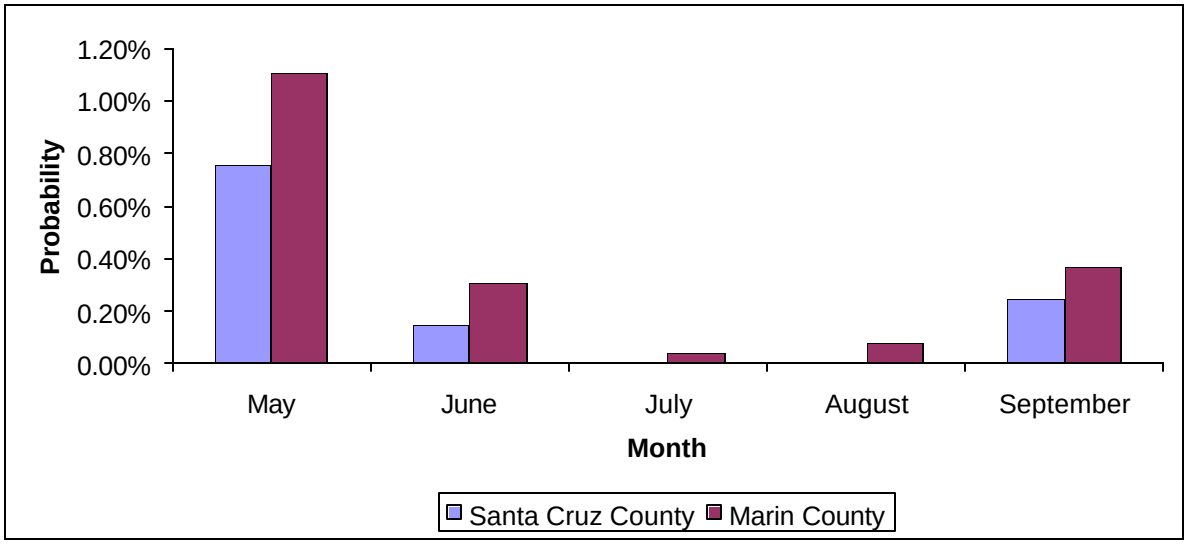

Figure 1: Probability of receiving more than 1 inch of precipitation in a single day for Santa Cruz and Marin counties from the end of spring to the beginning of fall. Precipitation probability was calculated using precipitation records for the Ben Lomond No. 4 station in Santa Cruz County (1937-2004) and the Kentfield station in Marin County (1931-2004). Both these stations represent the highest precipitation records for their respective counties. See Appendix III. Source: (NOAA 2004).

On the other hand, Santa Cruz County is significantly more likely to receive more than 4 inches of rain in a single day throughout the winter and spring. In other words, Santa Cruz County gets bigger storms more often (Figure 2).

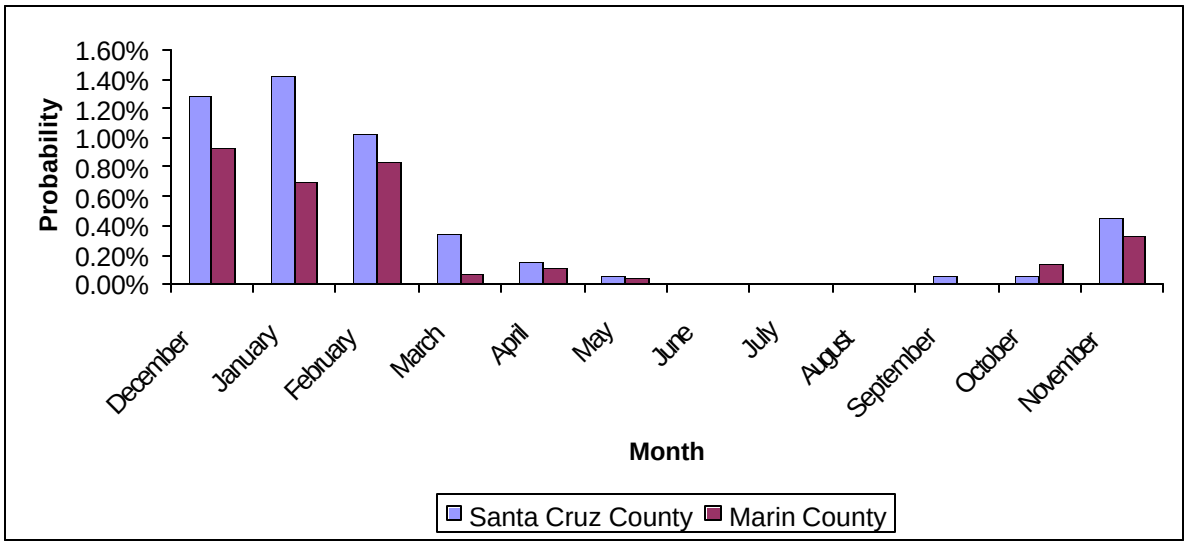

Figure 2: Probability of receiving more than 4 inches of precipitation in a single day for Santa Cruz and Marin counties. Precipitation probability was calculated using precipitation records for the Ben Lomond No. 4 station in Santa Cruz County (1937-2004) and the Kentfield station in Marin County (1931-2004). Both these stations represent the highest precipitation records for their respective counties. See Appendix III. Source: (NOAA 2004).

Nevertheless, on average, Marin County receives the same or more daily and monthly precipitation throughout the year (including the dry season) than Santa Cruz County (Figures 3 and 4). This means streams in Marin County are better supplied throughout the year and yet are not subject to the degree of precipitation extremes experienced in Santa Cruz County.

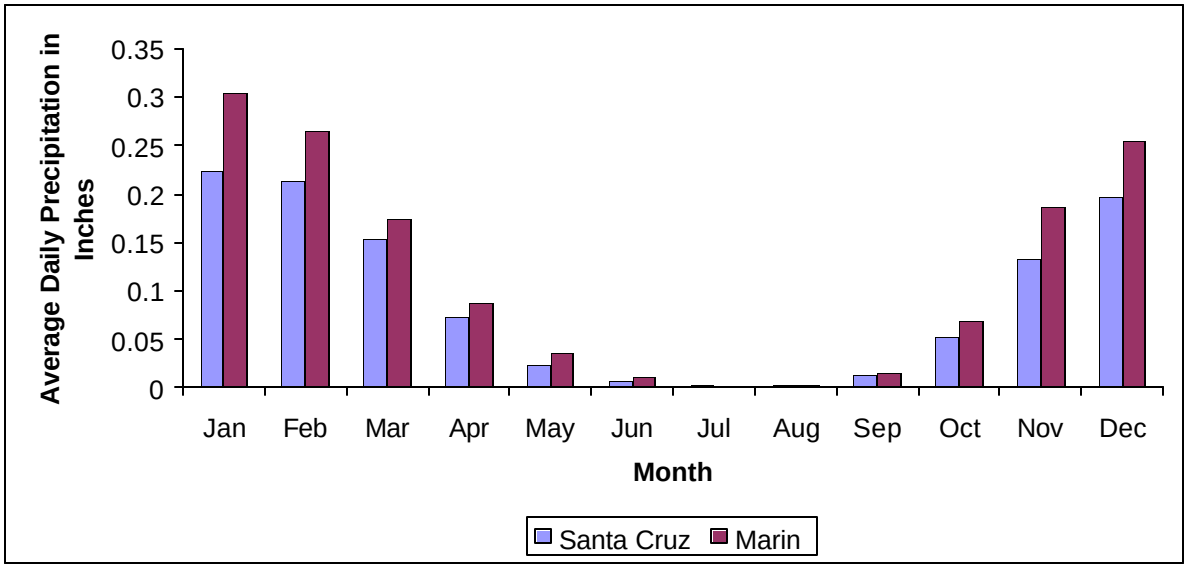

Figure 3: Average daily precipitation for Santa Cruz County and Marin County. Every record available for every station for each county was used. Source: (NOAA 2004).

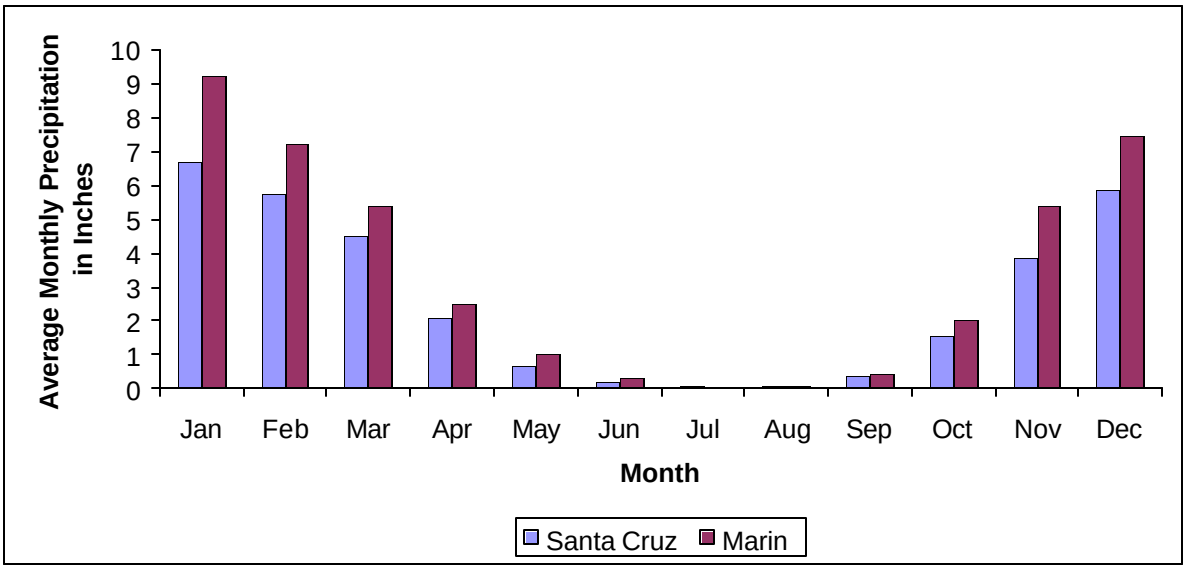

Figure 4: Average monthly precipitation for Santa Cruz County and Marin County. Every complete monthly record available for every station for each county was used. Months that were missing any daily records were excluded. Source: (NOAA 2004).

Lastly, we are not the first to observe a unique dynamic between climate and geomorphology in the Santa Cruz Mountains that is especially detrimental to the specific life history of coho salmon. Appendix IV provides quotations from scientific observers (including NOAA Fisheries and CDFG scientists) to the same effect.

CDFG (2004a) comments regarding the early scientific and historical record

> The petition states there are no credible surveys reporting coho salmon in the streams south of San Francisco prior to the 1906 acceptance of 50,000 coho salmon eggs at Brookdale Hatchery on the San Lorenzo River in Santa Cruz County (Bowers 1906). However, specimens of coho salmon from Scott and Waddell creeks have been identified in the California Academy of Sciences (CAS) ichthyology collection from the year 1895 (CAS 2004).
>
> CDFG 2004, pg. 3

Fifteen pertinent fish specimens were reportedly collected at two Santa Cruz County streams in 1895 by a Stanford University expedition (Rutter and Scofield 1895; Rutter and Seale 1895) presumably working under the auspices of D.S. Jordan and/or C. H. Gilbert (president of Stanford and the Chairman of the Stanford Zoology Department, respectively). Three additional fish were apparently collected at two other Santa Cruz County streams although these are undated (Rutter and Pierson; Rutter and Scofield). The Stanford accession register and two original Stanford labels identify the fish as chum and Chinook specimens, not coho. At least some of the specimens have a more recent second label identifying them as coho with no date,

signature, or other way to trace their accountability. If the specimens are the same fish as originally collected, they were also identified as chum and Chinook specimens in the California Academy of Sciences database until 1999 when the database entry was anonymously changed to coho (D. Catania, personal communication to F. Alvarado, 2004).

The initial inconsistent species identifications, the unattributed second identity labels, and the broken chain of custody raises serious questions about the reliability of these specimens, particularly as they are the only piece of evidence which, at first glance, appear to contradict a multidisciplinary array of sources. In addition, an excerpt from an early Stanford Ichthyological Bulletin (Bohlke 1953) adds further doubt as to the veracity of these specimens:

> "The early morning of April 18, 1906, saw much damage to the Stanford buildings as a result of the San Francisco earthquake (the San Andreas fault is only four miles west of the campus). The fish collections took their share of the damage. More than 1,000 jars and bottles were broken although the majority survived intact. The wreckage lay on the floor, kept wet with water from hoses manned day and night by Professors Snyder and Starks, until new bottles and alcohol could be secured. An effort was made to match specimens and data, this work being done by each member of the entire ichthyological group who had most actively been working on the specimens concerned. As a result much was saved that might have been lost, although there were numerous instances in which the material had to be discarded. In others, some doubt could not be avoided. A small printed label stating 'Bottle broken during earthquake' was inserted in each bottle. Unfortunately, according to Prof. J. O. Snyder, a careless curatorial assistant later removed these labels from about half of the jars bearing them" (Bohlke 1953).

Conclusions drawn solely from these undependable specimens are not scientifically conclusive, nor could they stand as legal evidence. To ignore the multiple dubious aspects of these specimens can only be wishful thinking. Most importantly, even if these specimens were valid, they are not by themselves evidence of a native population of coho south of San Francisco. Ephemeral (temporary) salmon colonies established by strays are not uncommon, particularly just beyond the fringes of a biogeographic range boundary (Nickelson and Lawson 1998; Sandercock 1991).

Furthermore, there is anecdotal evidence that private breeders were already well established by the time the first public fish hatcheries were created and made exotic fish introductions in the latter part of the nineteenth century. By 1870 the California Acclimitization Society was operating a fish hatchery in San Francisco although very little is known of their operations (Leitritz 1970). Within ten years the Santa Cruz Organization for the Propagation and Protection of Fish planted 10,000 fish from the McCloud River in Santa Cruz County streams (Santa Cruz Morning Sentinel 1878). Also, in the 1880s a private fish farm on Butano Creek, just north of Santa Cruz County, was raising native and exotic fish (ESA 2004). Unfortunately, the extent and description of private fish cultural activities in California before 1900 is not well documented.

To reiterate, these specimens are extremely dubious. Furthermore, even if they were somehow determined legitimate, they still would not be conclusive evidence of a native population of coho south of San Francisco.

> Further, as late as 1870, commercial harvest of coho salmon occurred on Pescadero and San Gregorio creeks in San Mateo County (Skinner 1962).
>
> CDFG 2004, pg. 4

In a 1962 California Department of Fish and Game document, "An Historical Review of the Fish and Wildlife Resources of the San Francisco Bay Area," Skinner summarized Captain Edgar (Ned) Wakeman's 1870 report to the California Commissioners of Fisheries. No other sources pertaining to the historical presence of coho salmon were offered by Skinner (1962).

The California Fish Commission, located in San Francisco, employed Captain Wakeman in 1870 to examine and report on the extent and condition of the fisheries of the San Francisco Bay as well as some of the neighboring coastal streams (Redding et al. 1872). As a result of employing Captain Wakeman, the California Commission obtained a highly suspect report of enormously abundant coho salmon in San Gregorio Creek and Pescadero Creek. Several facts come to bear on Wakeman's account:

1. Wakeman was not formally educated past the age of twelve (Wakeman and Wakeman-Curtis 1878).
2. Wakeman's appointment was not based on skill but rather was gratuitously granted (Alvarado 2003).
3. Wakeman's report was apparently not based on direct personal observations. According to the CDFG, "[t]he inference from his description is that the streams had once been very productive of silver [coho] salmon and steelhead trout but at the time of his survey were greatly degraded" (Skinner 1962).
4. Wakeman's account included inexplicable contradictions and serious inaccuracies:
    - Wakeman described Purisima Creek as a "fine clear water trout stream" and in the same breath gave accounts of the same stream as "wholly unfit for use, [the polluted water] not only kills the fish, but is dangerous to the cattle" (Redding et al. ibid.).
    - Wakeman claimed that "From October to March, a wagonload of these beautiful fish, weighing from two to thirty pounds, are taken daily" from Pescadero Creek were probably secondhand fish stories. First, thirty pounds, even for a steelhead, is a very generous figure. Second, a typical farm wagon of the time was capable of hauling well over 1000 pounds of fish. If Wakeman's accounts were accurate, one spawning season would yield 150,000 pounds of fish. With an average weight of 10 pounds per fish, this stream would have had to support a run of at least 15,000 fish, a ludicrous figure. As a matter of comparison, yearly fish trap counts of steelhead at the Mad River Fish Hatchery have averaged just over 3,000 fish, while coho salmon counts at the Trinity River Fish Hatchery have averaged fewer than 4000 fish (CDFG 2003).

- Wakeman went on to claim that these "beautiful fish" were sold locally at seventy-five cents per pound (Redding et al. ibid.). First, at this rate local fishermen would have been grossing over $100,000 per fishing season making the business of selling fish locally outrageously lucrative. Second, why would local residents pay a third to half the average daily wage at the time for a pound of fish they supposedly could easily catch themselves? Third, the following excerpt taken from the California Fish Commission's eighteenth biennial report published thirty-four years after Wakeman's survey illustrates the absurdity of his claims: "During the months of April, May and June, the fishermen on the Sacramento River received as high as 7 cents per pound for their [salmon] catch. …during the spring and summer of 1903, [on the east coast] the Sacramento River salmon has established a market value of its own selling from 30 to 40 cents per pound" (Van Arsdale and Gerber 1904). Fourth, taking inflation into consideration, $0.75 for a pound of salmon in 1870 would be the equivalent of $14.98 in 2003 (Halfhill 2003) or nearly $450.00 for a 30 pound salmon. During the 2003 salmon season, wild salmon were selling in Santa Cruz for $3 to $7 per pound.
- Wakeman reported that the coho salmon frequenting San Gregorio Creek and Pescadero Creek return to sea after spawning (Redding et al. ibid.). Coho die shortly after spawning.

5. Several quotes by Mark Twain, who knew Wakeman personally, shed light on Wakeman's dubious credibility (Appendix II).

> Historical museum records from 1895 indicate that coho salmon were present in several streams south of San Francisco and there is documentation that commercial harvest of coho salmon was on-going as late as 1870 on two San Mateo County streams. These and other evidence demonstrate that coho salmon were present prior to 1906, which is the date of the first known planting of hatchery coho salmon south of San Francisco.
>
> CDFG 2004, pg. 7

These two unreliable sources (1895 speciemens and Wakeman's account) thoroughly discredited above are the only evidence the CDFG (Anderson 1995; CDFG 2004a) has ever presented that coho salmon are native to coastal streams south of San Francisco. Furthermore these sources give no indication of historical coho abundance or population trends. However, the CDFG (2004a) has chosen to rely on a couple of unsupportable, incongruous sources, in lieu of a preponderance of complementary evidence. Despite their assurances, when all available data are critically reviewed, the prehistoric presence of permanent populations of coho salmon south of San Francisco is untenable, at best.

We understand that when an assumption has become the prevailing paradigm, particularly when that assumption has led to a state and federal endangered species listing, it can be very difficult and even controversial to correct the record. We hope this state of affairs will not hinder the

California Fish and Game Commission in reaching a rational conclusion regarding the history of coho salmon south of San Francisco.

> Streig (1991) reported that coho salmon eggs were harvested from an estimated 518 females at the Scott Creek egg taking station in 1909. It is highly unlikely that these fish could have been produced from the 50,000 eggs delivered and raised at Brookdale Hatchery on the San Lorenzo River in 1906, even if all of the fry were planted in Scott Creek. Applying an egg-to-fry survival rate of 75% (average egg-to-fry survival rate of coho salmon raised at Iron Gate Hatchery); a fry-to-smolt survival rate of 9.7% (highest reported value by Sandercock 1991); and a smolt-to-adult survival rate of 7.7% (highest reported value by Shapovalov and Taft 1954) yields an estimate of about 280 adults to Scott Creek, far less than the estimated 1,036 fish that returned in 1909.
>
> CDFG 2004, pg. 4

The truth is 518 females were never harvested in 1909 in Scotts Creek or at anytime, anywhere south of San Francisco. There are no records to show that 518 coho salmon females (1.4 million eggs) were spawned in 1909 and Streig (1991) cited no references to indicate where this information came from. However, according to the 1909-1910 Biennial Report of the California Board of Fish and Game Commissioners (Van Sicklen et al. 1910), 1,400,000 "salmon" eggs were hatched at the Brookdale Hatchery. Apparently Streig (1991) assumed these were coho.

Indeed the California Fish and Game Commission did hatch 1,400,000 "salmon" at the Brookdale Hatchery in 1909, but they were <u>not</u> local coho. The truth is the U.S. Bureau of Fisheries shipped 1,000,000 Chinook salmon eggs, 200,000 coho salmon eggs, and 13,680 rainbow trout eggs to the Brookdale Fish Hatchery that same season (Bowers 1911). This equals 1,200,000 "salmon" (mostly Chinook salmon) that were <u>not</u> coho collected from any Santa Cruz stream. Furthermore, as the Brookdale Hatchery was operating fish traps on Soquel Creek and on the San Lorenzo River, the remaining 200,000 of these "salmon" eggs were undoubtedly obtained mostly from returning Chinook salmon of the 2,332,440 planted in 1906 and 1907 (Bowers 1907, 1908).

This is the epitome of the CDFG's inability to differentiate between fact and fiction or between science and hearsay. Besides this imaginary 1909 egg take, there are no records of coho salmon eggs being collected at this station or any other south of San Francisco prior to 1929[1]. On the

[1] The CDFG (2004, pg. 13, Table 2) would like to believe that in 1912-13 and 1914-15 the Brookdale Hatchery planted coho fry of Scotts Creek origin in Santa Cruz County. If these fish were of Scotts Creek origin <u>there is no evidence to show this</u>. The CDFG seems to have leaped to this conclusion. Furthermore according to the CDFG's Table 1 (CDFG, 2004, pg. 12) no coho were spawned from Scotts Creek between 1910 and 1921. How can any "scientist" make such an obvious contradiction? Also, the CDFG (2004, pg. 13, Table 2) indicates the Brookdale Hatchery planted coho "eggs" south of San Francisco between 1906 and 1910. It is ridiculous to suggest the Brookdale Hatchery planted "eggs," especially when it is documented these eggs were hatched at the Brookdale Hatchery.

other hand, there are records to show that millions of *steelhead* eggs were collected at Scotts Creek during this same time (Anderson 1995). If coho were abundant locally why were coho eggs not collected at Scotts Creek for at least the first 20 years of operations? Why did the Brookdale Hatchery continue to import coho eggs from northern waters?

> Finally, Shapovalov and Taft (1954) state that the only introduced fish found in Waddell Creek was striped bass, implying that coho salmon were native to the drainage.
>
> CDFG 2004, pg. 4

Shapovalov and Taft's brief discussion of the introduced or native fish fauna of Waddell Creek is a discussion of fish "besides the steelhead and silver [coho] salmon" (Shapovalov and Taft 1954, pg. 26). The origin of the coho salmon and steelhead was obviously unimportant to them as they fail to mention the fact that coho were imported from Prairie Creek, hatched at the Brookdale Hatchery and heavily planted in local streams including Waddell and Scotts Creeks immediately before and throughout the course of their study (Figure 5).

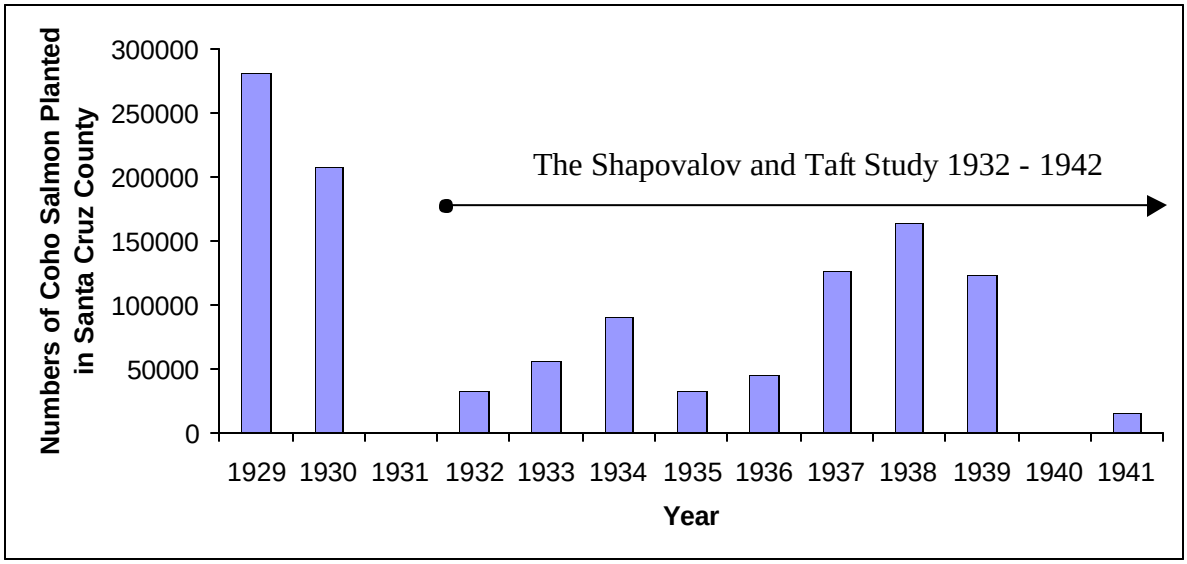

Figure 5: Numbers of Coho Salmon Planted in Santa Cruz County Streams Prior To and During the Shapovalov and Taft Study. Of the 1,171,153 coho salmon planted between 1929 and 1941, 320,977 were imported from Prairie Creek and the Eel River. Source: (Baker et al. 1998; Shapovalov and Taft 1954).

Some longtime local residents remember the large coho plants in 1929 and 1930 (Figure 1) being arranged specifically in preparation for the Shapovalov and Taft study (Hulda Hoover MacLean, personal communication to R. O. Briggs) and probably also in response to a severe drought that began in 1928. Although Shapovalov and Taft did not mention these hatchery plants, they definitely took place.

CDFG (2004a) comments regarding the influence of hatchery activities

> Numerous coho salmon artificial production facilities have operated in the area south of San Francisco since the early 1900s.
>
> CDFG 2004, pg. 4

As stated above, by 1870 the California Acclimitization Society was operating a fish hatchery in San Francisco (Leitritz 1970) and there is no reason to assume they did not plant any fish just south of there. Certainly, we know the Santa Cruz Organization for the Propagation and Protection of Fish was planting exotic fish into Santa Cruz County streams prior to 1900 (Santa Cruz Morning Sentinel 1878). Also, in the 1880s a private fish farm on Butano Creek, just north of Santa Cruz County, was raising native and exotic fish (ESA 2004). Although, the extent and description of private fish cultural activities in California before 1900 is not well documented, we know there was considerable fish cultural activity prior to 1900 that cannot be ruled out.

> Between 1905 and 1953 the Brookdale Hatchery raised coho salmon on the San Lorenzo River.
>
> CDFG 2004, pg. 4

Wrong. The brookdale hatchery was built in 1905 but only raised coho salmon 19 out of the 49 years that it operated. Furthermore, at least 60% of those were imported stocks (Baker et al. 1998; Bowers 1907, 1908, 1909, 1910, 1911).

> Big Creek Hatchery was operated on Big Creek, a tributary to Scott Creek, between 1927 and 1952, until destroyed by flood.
>
> CDFG 2004, pg. 4

Again, the CDFG has their facts wrong. The Big Creek hatchery was operated from 1927 through 1939. The storm that destroyed the hatchery lasted from February 25 to March 1, 1940 (Leitritz 1970). How can the CDFG be relied upon to perform a critical analysis of this issue with this level of ignorance or disregard of basic historical facts.

> The current Monterey Bay Salmon and Trout Program [sic] began operating the Kingfisher Flat Hatchery on Scott Creek near the site of the original Big Creek Hatchery in 1972.
>
> CDFG 2004, pg. 4

The number and caliber of inaccuracies in the CDFG's Response to our petition is astounding. The Kingfisher Flat Hatchery otherwise known as the new Big Creek Hatchery (with which the CDFG has always been contractually related) was built in 1982. The Monterey Salmon and Trout Project was founded in 1976 in response to a severe drought in the mid-1970s. This

naturally occurring drought prevented all coho-bearing creeks in the southern portion of Santa Cruz County (including the San Lorenzo River) from breaking the sandbars at their mouths for three consecutive years, thereby extirpating all coho salmon from those streams. A single storm cell in January 1977 caused the coastal coho-bearing creeks in northern Santa Cruz County and San Mateo County (including Scotts and Waddell Creeks) to open for only 5 days thereby allowing one year class of coho to enter those streams, thus preventing a complete extinction of coho south of San Francisco (D. Streig, personal communication to F. Alvarado, 2005). These events were naturally occurring, they were not the result of any land use activity, and they were not a unprecedented incident.

> The petitioners do not provide any evidence that supports their assertion that coho salmon have been maintained in streams south of San Francisco by hatchery input.
>
> CDFG 2004, pg. 7

This is categorically false. The majority of the following information was presented in our petition (Alvarado et al. 2004, pg. 49) and is given here nearly verbatim:

The most likely times since their introduction for coho salmon to have succumbed to stochastic extirpation would have been during one of the two most severe California droughts of the last century. These droughts occurred in the early 1930s and the mid 1970s. It is estimated that both of these droughts were severe enough to have a recurrence interval of over 100 years (Paulson et al. 1990). Although, they were mild in comparison to prehistoric droughts, without anthropogenic intervention they would probably have been capable of stressing local coho populations to the point of extirpation. Coincidentally, during the 1928-34 drought coho salmon were heavily planted in Santa Cruz County (Anderson 1995; Bryant 1994; Streig 1991, 1993)[2]. The 1970s drought nearly extirpated all coho south of San Francisco and led to the creation of the Monterey Bay Salmon and Trout Project (discussed above). Similarly, prior to recent years, residents and anglers took it upon themselves to manually open the sandbars at the mouths of our creeks to allow returning anadromous fish to spawn. This action is now strictly prohibited by the CDFG.

Also, from 1960 to 1980 the California Current was in a cool and productive cycle. Kaczynski (1998) estimated that coho salmon marine survival during this time period ranged from 4.4% to 12.7%. A reduction of fish plantings during this time period intuitively indicates that in the last 100 years coho were re-supplied when it was deemed necessary.

Essentially, favorable ocean conditions in addition to human intervention (intentional and inadvertent) compensated for at least two major stochastic circumstances that would otherwise have extirpated introduced coho populations within the last century.

> We know of no data that support [or refutes] the assertion that coho salmon have been maintained in streams south of San

[2] Shapovalov and Taft (1954) documented very low stream flows on Waddell Creek during these drought years.

> Francisco by hatchery input. Mainly this is because there is little **[sic]** data available to evaluate the hatchery contribution to natural abundance.
>
> CDFG 2004, pg. 4, 7

What is the purpose of a fish hatchery if not to maintain, supplement, and introduce fish populations? Is the CDFG (2004a) suggesting that coho south of San Francisco were not threatened by the same factors in the past as they are now (naturally occurring stochastic events)? Is the CDFG (2004a) suggesting that hatchery plants of the past have not assisted local coho populations in times of need?

By definition, a stochastic event (floods and droughts that devastate coho populations) is randomly occurring. Likewise, other variables key to coho survival such as ocean conditions can fluctuate dramatically. Therefore, in marginal territory coho may survive without assistance for many years only to be assaulted by a combination variables on a bad year(s). One can reasonably assume that over the last 100 years the CDFG planted coho when local populations most needed it (just as they have in recent memory). If there are few data available to evaluate the hatchery output it is only the CDFG we have to blame as it is they who are responsible for the vast majority of these hatchery plants. Only the CDFG is accountable for these records or lack thereof. Certainly it is absurd to list a species on the basis of a lack of data.

> Only about 1.6 million very early life stage plantings are recorded over a 26 year period. Mortality in these early life stage plants would likely have been very high because of the small size of the fish.
>
> CDFG 2004, pg. 4

First, coho salmon were established in the Great Lakes after a single plant of 850,000 in 1966. Second, the CDFG (2004a) has conveniently ignored the following decade (1931-1941) at which time another 600,000 coho (mostly of exotic origin) were planted, most likely in response to a severe drought at that time.

> From the available data, we are not able to tell whether this level of sporadic production maintained the existing natural populations or not.
>
> CDFG 2004, pg. 4

The strength of our hypothesis does not hinge on a nonexistent year-to-year analysis of hatchery production versus population trends, especially when the data for such an analysis have not been maintained by the CDFG. Suffice it to say that while the precise degree of influence hatchery production has had cannot be ascertained, the fact that hatchery production has had the effect of augmenting local populations is indisputable.

> However, Figure 2 shows that recent hatchery output has been extremely variable and declining.
>
> CDFG 2004, pg. 4

As explained in our petition and as stated by J. Smith (a fish biologist that's been studying the coho in these creeks for over twenty years) and D. Streig (a fish biologist and manager of the Kingfisher Flat Hatchery since its inception), coho south of San Francisco are and always have been primarily limited by naturally occurring stochastic events, not habitat degradation. Recent hatchery output has been declining due to a series of stochastic events combined with periods of poor ocean conditions over the last thirty years.

> Figure 2 also shows that no coho salmon were planted from 1915/16 to 1927/28. If coho salmon populations were supported entirely by hatchery plants, then they would have likely been extirpated during this period.
>
> CDFG 2004, pg. 4

Table 2, not Figure 2, lists coho salmon plants from 1905-06 through 1930-31.

Nobody is suggesting that coho salmon would become extirpated the moment hatchery plants cease. Obviously, coho salmon were not planted from 1915-1928 because it was deemed unnecessary by hatchery staff. Interestingly the CDFG (2004a) Response to our petition does not comment on the 1928-34 California drought (the most severe in the state's recorded history) or on the nearly half a million coho planted in 1929 and 1930.

Incidentally, why do the 500,000 imported Washington State coho salmon planted from 1906 to 1910 not appear in any NOAA Fisheries or California Fish and Game status reviews or other documents prior to our petition (instead all these documents claim no data are available for these years)? These records are all publicly available, suggesting a serious lack of diligence.

CDFG (2004a) comments regarding the cause of recent reductions coho abundance south of San Francisco

> Recent status reviews all support the conclusion that coho salmon hatchery production in the region south of San Francisco has declined in recent years. The availability of local broodstock has been a major influence on hatchery output in the region. As fish have become scarcer, hatcheries in the region using local broodstock have had an increasingly difficult time obtaining enough fish to support their programs.
>
> CDFG 2004, pg. 5

First, an educated examination of the CDFG status review regarding coho south of San Francisco (Anderson 1995) reveals that these status reviews cannot be depended upon.

Second, why does the CDFG have such a difficult time understanding the actual factors limiting coho survival south of San Francisco (ie: a series of stochastic events combined with periods of poor ocean conditions over the last thirty years)?

Third, the availability of local broodstock has been a major influence on hatchery output only recently, as hatchery efforts historically imported coho as needed.

Fourth, since 1996 the primary restraint on hatchery output in the region has been lengthy, undue delays by the CDFG in issuing permits to the Monterey Bay Salmon and Trout Project to collect broodstock (D. Streig, personal communication to F. Alvarado, 2005).

> Counter to what would be expected if the petitioners' assertion were true, the earliest hatchery collection of coho salmon in 1909 was the largest of all the hatchery collections on record. As discussed above, the 518 females collected at that time could have resulted from the recorded 50,000 eggs planted three years earlier (Table 2) only if an unrealistically high survival was experienced by that group.
>
> CDFG 2004, pg. 5

On record? As discussed above, there are no records that 518 females were spawned in 1909 because it never occurred. Apparently the CDFG (2004a) felt this phony data was worth mentioning twice, but as in so many other instances, the CDFG (2004a) did not feel it was worth verifying.

> The petition dismisses the well-documented effect that habitat degradation has had on reducing coho salmon populations (e.g. increased sedimentation from land-use practices, elimination of habitat and decreased water quality due to urbanization, reduced stream flows due to water diversion) (Sullivan 1990; Brown and Moyle 1991; Marston 1992; Nelson 1994; Anderson 1995; Alley 1998a; 1998b; 1999; 2000).
>
> CDFG 2004, pg. 5

We have never dismissed the effects of habitat degradation. However, the habitat of Scotts and Waddell Creeks is <u>not</u> degraded. Simply because coho habitat has been degraded elsewhere does not mean it is here. To suggest that the water quality in these creeks has been compromised due to "urbanization" is ludicrous and shows the CDFG's utter lack of knowledge regarding these streams. Needless to say, these watersheds are in the most sparsely populated and rural part of Santa Cruz County. In addition we presented independent data in our petition to show that water quality for Waddell and Scotts Creeks surpasses water quality objectives and the mean for 155 monitoring stations within the Monterey Bay National Marine Sanctuary.

This is yet another example how the CDFG frequently holds local residents accountable for unavoidable, natural fluctuations in coho abundance by expressing a blanket list of threats (i.e., habitat loss and degradation due to agriculture, dams, roads, livestock, urbanization and logging).

This list has been repeated many times in the past without justification and once again we find the CDFG (Anderson 1995; CDFG 2004a) has not provided any stream specific examples of this alleged habitat degradation. For instance, the CDFG status review for coho salmon south of San Francisco (Anderson 1995) suggested that a relatively recent shift in the timing of the coho spawning migration in Scott and Waddell Creeks compared to the 1930s and 1940s is due to degraded conditions within the watersheds, creeks, and estuaries. Not only did Anderson fail to provide any evidence of degraded conditions, he also failed to notice a parallel shift in peak rainfall and flood probability over the same time period, causing a corresponding shift in creek discharge (Briggs 1996). The timing of coho salmon upstream migration is dependent on sufficient stream flows, particularly south of San Francisco, which is dependent on rainfall (Sandercock 1991; Shapovalov and Taft 1954).

Elsewhere, the CDFG status review for coho salmon south of San Francisco (Anderson 1995) began its discussion of the nature and degree of the threat to coho south of San Francisco by stating, "A major cause of decline for coho salmon has been the unnatural destruction and degradation of essential stream habitat." Yet later the CDFG (Anderson 1995) admit otherwise:

> "... overall the two streams [Scott and Waddell Creeks] are relatively stable, second-growth forested watersheds, providing high quality (but low volume) streamflows and ample amounts of coho salmon parr essential habitat, which is significantly underutilized" (Anderson, 1995).

This acknowledgment of the quality of our local environment is not enough to erase the clear impression that humans are to blame for local coho scarcity. It is this very impression upon which the California coho recovery strategy is focused (CDFG, 2003). Ironically, it is the landowners of these watersheds who have held back unrestrained development in the last fifty years through good stewardship of the land. It is they who have maintained what are arguably the most pristine watersheds in Santa Cruz County, and it is they who are to thank for the establishment of the new Big Creek Hatchery (Kingfisher Flat Hatchery). While local residents and land managers have a vested interest in maintaining their high quality environment, they cannot overcome the innate inability of coho salmon to thrive in naturally lethal habitat.

> Contrary to the argument made in the petition, clear-cutting and deforestation is not beneficial to salmonids even if it results in a temporary increase in stream flow.
>
> CDFG 2004, pg. 5

We did <u>not</u> state that clear-cutting and deforestation is beneficial to salmonids. This is the most atrocious distortion of our petition. The competition for limited dry season ground-stored water between forest use and stream flow is a fact. As a minor point we suggested that prior to clearcut logging and a major fire in the early 1900s prehistoric stream flows may have been lower given the water demands of a mature forest versus the younger second growth forests of today. Leave

it to the CDFG (2004a) to distort this trivial point while ignoring so many other major aspects of our petition.

> Although deforestation can lead to higher flows, these deforested areas tend to have higher peak flows with shorter duration (Bottorff and Knight 1996), which can leave fishes stranded off-channel or moved to undesirable habitats (Sandercock 1991, Spence et al. 1996, CDFG 2002). Higher peak flows can lead to decreased bank stabilization, modification of the stream through erosion and siltation, and decreased morphological complexity (Spence et al. 1996, CDFG 2001). Destabilized banks increase the potential for landslides and siltation which can bury or smother salmonid redds and alevins (Sandercock 1991). High silt loads have also been a deterrent to migrating smolts and adults (Smith et al. 1997) and can damage gill tissue of fry, smolt, and adults (CDFG 2002). Other impacts that can result from deforestation are reduction in cover and shade, reduction in nutrient input, and increased water temperature from solar radiation. All of these factors can have a detrimental effect on salmonid populations (Hicks et al. 1991).
>
> CDFG 2004, pg. 5

For the record, deforestation has <u>not</u> been an issue in these watersheds for the greater part of a century. Nor are high peak flows and landslides necessarily indicative of bad land use practices. Although A equals B, it does not necessarily follow that B equals A.

Also, the use of the Smith et al. (1997) citation by the CDFG (2004a) is interesting since Smith et al. attribute sediment load to naturally occurring factors . The CDFG (CDFG 2002) citation is also interesting as it is the status review for coho salmon <u>north</u> of San Francisco. All of the other citations here also concern other areas besides the coastal streams south of San Francisco or are not specific.

Incidentally, as far as the effects of deforestation on coho, Chapman and Knudson (1980) found that if the forest canopy is very dense, then coho biomass will be reduced. Similarly, Bilby and Bisson (1987) found that coho salmon production in summer ranged from 2.05 to 3.95 g/m^2 in an old-growth forested watershed and from 4.63 to 5.28 g/m^2 in a watershed that was mostly clear-cut. Bisson et al. (1988) monitored habitat use and summer production of stocked underyearling coho salmon from 1983 to 1986 in three streams affected by the 1980 eruption of Mount St. Helens. Midsummer water temperatures frequently exceeded presumed stressful thresholds and occasionally surpassed the incipient lethal limit (up to 29.5°C or 85°F, over three consecutive days at one stream). The extreme thermal conditions resulted from the lack of shading caused by widespread destruction of trees during the explosive phase of the eruption or by the removal of vegetation along streambanks during subsequent volcanic mudflows. In addition, there was relatively little submerged cover and limited pool habitat, relatively high populations densities of coho, and competition of coho with other fish species. Despite the severe conditions, coho

production rates were equal to or greater than those measured in other streams of comparable size in the region. Bisson et al. (1988) "saw no evidence of mortality when peak stream temperature climbed above 25.4°C, nor did [they] observe signs of lethargic or moribund behavior." The only observed behavioral response was an aggregation of coho salmon into a cool water plume created by inflowing groundwater. This aggregation took place when water temperature exceeded about 22°C (71.6°F), suggesting that even when stream temperatures appear high, cool water refuges such as groundwater seeps may be sought out by juvenile coho. But what of the higher coho production rates in such high water temperatures? Presumably, without an increase in food, most of the energy consumed at those temperatures would have been used to support metabolic functions with relatively little left for growth. To sustain the observed growth rates would have required an abundance of available food. Bisson et al. (1988) concluded that an abundance in food, at least in part, mediated the effects of summer temperature extremes. They noticed an increase in vigorously growing herbaceous vegetation along the streams over the course of the study.

> "The herb- and shrub-dominated riparian communities supported populations of terrestrial arthropods that were visually very abundant and active during summer" (Bisson et al. 1988)

In an unpublished study by Utah State University, densities of Chironomidae and *Baetis* spp. mayflies at another creek in the Mount St. Helens blast area reached very high levels. These two insect groups are prone to entering the drift and both are important components of the diet of juvenile coho (Mundie 1969). Similarly, Mispagel and Rose (1978) found terrestrial invertebrates to be more diverse among ground-level vegetation than among tree canopies.

> There is much more information and data supporting the argument that recent declines in coho salmon populations are attributable to well-documented habitat degradation caused by land-use practices, urbanization, and reduced stream flows.
>
> CDFG 2004, pg. 7

Where are these data? Habitat degradation may be a problem elsewhere for coho, but there is no habitat degradation in the Scotts and Waddell Creeks watersheds to speak of. The CDFG's logic that poor coho survival equates habitat degradation is invalid. Habitat degradation is certainly not the only possible reason why coho do not survive well on the margins of their range. As we have seen above, the CDFG (2004a) did not provide any examples of, or citations for habitat degradation on these creeks. Similarly, the CDFG status review (Anderson 1995) does not provide any either. Figures 6 and 7 shows the degree of "urbanization" on these watersheds. The California Fish and Commission are personally invited to visit these watersheds and witness this "habitat degradation" for themselves.

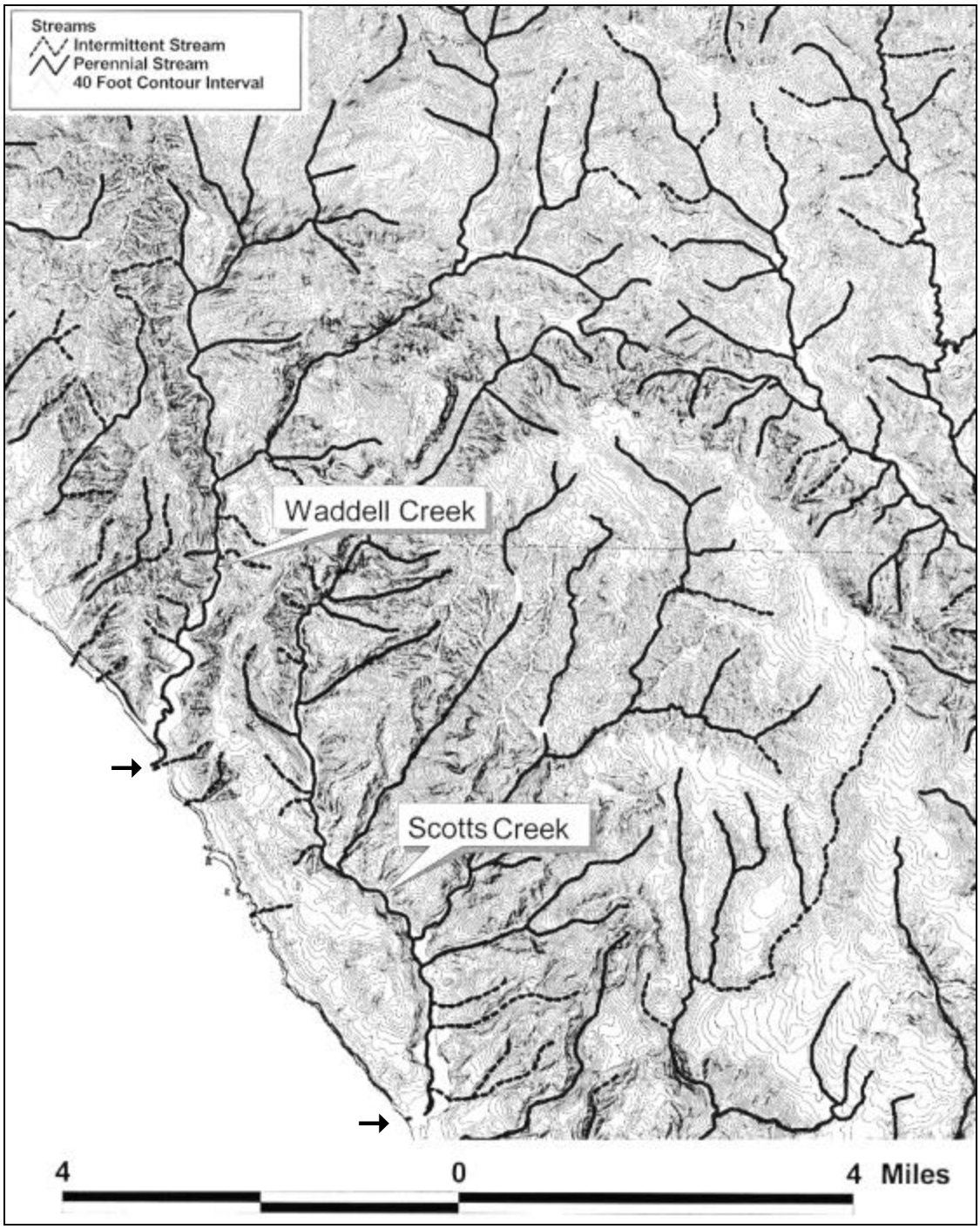

Figure 6: Topographical Map of Waddell and Scott Creeks Watersheds. The black arrows indicate the creek mouths. Source: (DeLorme 2001).

Figure 7: Aerial Photo of Waddell and Scott Creeks showing the largely undeveloped and emphatically forested condition of these watersheds. Arrows indicate creek mouths. Source: (TerraServer.com 2001).

CDFG (2004a) comments regarding genetic data

The petitioners did not adequately review the entire literature on coho salmon genetics and failed to accurately report the state of existing research, to present that research in proper context, and to appropriately weight the most recent, best available genetics research. In contrast to the assertions of the petitioners, all recent genetic

> analyses support the genetic distinctiveness of coho salmon from Scott, Waddell, and Gazos creeks, and their affinities to other nearby California coho salmon populations (see citations below). However, the available genetics data are of very limited usefulness for evaluating whether the existing coho salmon in Scott, Waddell, and Gazos creeks are native.
>
> CDFG 2004, pg. 5, 7

While we did provide a sound digest of coho salmon genetics, an exhaustive evaluation is not required nor is it needed. Coincidentally, an exhaustive evaluation of coho salmon genetics cannot be found in the petition to list coho south of San Francisco (Hope 1993), in the CDFG's status review for coho south of San Francisco (Anderson 1995), or any other CDFG document that we are aware of.

Suffice it to say, the available genetic data do not and cannot demonstrate that coho south of San Francisco are or are not native (Garza 2003a, b; 2004, C. Garza, personal communication to F. Alvarado, R. O. Briggs, and H. T. McCrary, 2004).

Why would the CDFG (2004a) demand a review of the entire literature on coho salmon genetics if they acknowledge that "available genetics data are of very limited usefulness for evaluating whether the existing coho salmon [south of San Francisco] are native?"

As far as the distinctiveness of coho south of San Francisco is concerned, there is no scientific yardstick which provides a threshold value for how genetically "unique" a population or set of populations must be for it to be considered eligible for ESA listing. To a certain extent every individual coho salmon is "genetically unique." Surely, we should expect the anthropogenic combination of multiple imported stocks over the last 100 years to produce a "genetically unique" fish.

To the extent that coho south of San Francisco are genetically similar to other nearby coho populations, it is also what we should expect given the relatively recent and heavy planting of nearby coho stocks such as Noyo River and Prairie Creek stocks.

> Over the past five years, scientists at NOAA Fisheries collected microsatellite genetic data from coho salmon in Scott, Waddell, and Gazos Creeks. Preliminary analyses reveal that coho salmon from those streams are closely related to one another, and are more distantly related to coho salmon in California streams north of them (J.C. Garza, NOAA Fisheries SWFSC, Santa Cruz, unpublished data).
>
> CDFG 2004, pg. 6

Of course coho salmon south of San Francisco are most closely related to each other. The creeks are planted by the same hatchery and, until very recently, were planted from the same stocks. Indeed, as recently as 1996 Waddell Creek "was augmented by hatchery-reared fry from the

Scott Creek[s] watershed" (Smith et al. 1997). Also, straying of fish between Waddell and Scotts Creeks is relatively common.

Interestingly, population structure estimations (Garza 2003a, 2004) suggest that coho south of San Francisco are more closely related to Noyo River coho (a distance of nearly 200 miles) than Russian River coho (approximately 100 miles away). Not surprisingly, Noyo River stock was planted more recently and in far greater numbers in Santa Cruz County than Russian River stock (Bryant 1994).

> The petitioners assert that there could not possibly be any native coho salmon left in streams south of San Francisco given the long history of out-of-basin hatchery planting that has occurred there.
>
> CDFG 2004, pg. 6

How could the CDFG (2004a) make such an error? We never stated "that there could not possibly be any native coho salmon left in streams south of San Francisco" or that the native coho were replaced by imported stocks. Instead, we very clearly asserted that there have never been any native coho in streams south of San Francisco.

CDFG (2004a) miscellaneous comments

> Recent Commission action to list coho salmon north of San Francisco under CESA includes hatchery as well as naturally spawning populations in this region.
>
> CDFG 2004, pg. 7

The question of whether these coho are "naturally spawning" or hatchery fish is irrelevant. Whether the fish spawn in the creek or are collected and artificially spawned in a hatchery has no bearing on whether or not the stock was native or exotic.

> NOAA Fisheries has recently completed a status review update of the CCC Coho ESU, which includes coho salmon south of San Francisco. They are proposing that the CCC Coho ESU be listed under the federal Endangered Species Act as endangered, rather than threatened as it is currently, and they are not proposing to exclude coho salmon south of San Francisco.
>
> CDFG 2004, pg. 7

First, we have submitted a separate petition to NOAA Fisheries presenting our research. NOAA Fisheries is still deliberating on a final determination regarding our petition.

Second, the proposal to upgrade the federal listing from threatened to endangered was based exclusively on "recent reduced hatchery output." As explained above, recent hatchery output has

been declining due to a series of stochastic events combined with periods of poor ocean conditions over the last thirty years, and CDFG delays in issuing permits to collect broodstock. Recent hatchery output has not been due to "habitat degradation." Regardless the CDFG recovery strategy (CDFG 2004b) is overwhelmingly focused on "habitat restoration."

Conclusions and Recommendations

The listing of coho in streams south of San Francisco is based on unsound science and the Response to our petition (CDFG 2004a) perpetuates this precedent. Due to the coho's rigid three year life cycle and the frequent, devastating stochastic weather events characteristic of the Central Coast, these streams never hosted and cannot support permanent coho colonies and no amount of wishful thinking, government declarations, multimillion dollar "restoration" projects or intrusion on property rights can change these facts. Ignoring the preponderance of evidence, the CDFG status review for coho south of San Francisco (Anderson, 1995) and the Response to our petition (CDFG 2004a) are peppered with errors and unsupportable affirmations and do not approach the standard of veracity and objectivity required for sound decisions under the CESA. Pursuant to FGC § 2074.6 the CDFG's recommendations to the Fish and Game Commission must be "based upon the best scientific information available." Competent, objective, and rational review of *all* the scientific information available will only lead to the conclusion we have outlined here and in our petition (Alvarado et al. 2004).

CDFG's unsubstantiated assumption that prior to anthropogenic influence permanent coho populations were naturally thriving south of San Francisco inappropriately shifts the burden of proof. The CDFG and the NMFS arrived at their listing decisions on the basis of an unchallenged, popular belief that the century old presence of hatchery maintained coho populations indicated a native and once naturally abundant population. That assumption, unchallenged for the better part of the last century, became an entrenched belief – a paradigm that eventually lead to the erroneous listing under the CESA. The CDFG is still, blindly defending that paradigm. As long as the paradigm stands unchallenged, erroneous decisions will follow. This paradigm (whose origin as popular belief is understandable) is not scientifically justified.

Since our petition unambiguously demonstrates that coho salmon are not native to streams south of San Francisco and are incapable of permanent colonization in these streams, listing them under the CESA places an impractical burden on the government and a heavy encumbrance on property owners and the public. The problem of "restoring" a population that never existed and could not survive under natural conditions is insurmountable since restoration of a nonexistent natural population is scientifically meaningless. It also carries the risk of significant, unintended environmental consequences that may prove detrimental to ecosystems and species that are in fact native.

Whether or not to artificially maintain exotic coho populations in hostile, nonnative habitats is a public policy decision. If it is the public will (as it has been in the past), it is possible to do so, but this should not be confused with restoration of an endangered or threatened native

population. It is inappropriate and counterproductive to apply the heavy regulatory governmental apparatus of the CESA to promote this arbitrary objective.

We thank you for this opportunity to comment and demonstrate how the record before the California Fish and Game Commission clearly shows by the great weight of the evidence that the southern extent of the Central California Coho ESU must be redefined to exclude streams south of San Francisco. The question that the California Fish and Game Commission should ask is, "does the evidence support the assumption that permanent coho salmon colonies ever existed south of San Francisco prior to human intervention?" The evidence presented herein shows that it does not, and we therefore respectfully request that the southern boundary of the Central Coast ESU be relocated to exclude streams south of San Francisco.

Appendix I

55. **Salmo purpuratus** Pallas.—*Oregon Brook Trout; Salmon Trout; Lake Trout.* (*Salmo clarki* Rich.)

Very abundant in all waters north of Mount Shasta and through the Great Basin and Rocky Mountain region; occasional southward to Santa Cruz. Found in abundance in salt water in Puget Sound and about the mouth of the Columbia. It is usually seen of but 2 to 8 or 10 pounds in weight, but occasional specimens weighing as much as 25 pounds are taken in the Columbia in summer (*C. J. Smith*). These latter are known usually as steel-heads, although the common steel-head is *S. gairdneri;* the young as brook-trout, and the partly grown as salmon-trout. This is the most widely distributed of our trout, and it is subject to many variations.

56. **Oncorhynchus kisutch** (Walb.) J. & G.—*Coho Salmon of Frazer's River; Silver Salmon; Kisutch; Bielaya Ryba.* Skewitz.

Sacramento River to Puget Sound and northward; very abundant in summer and fall. It is rarely taken in the Columbia in the spring, but great numbers run up the river in the fall. It is one of the smallest of the salmon, reaching a length of about 30 inches and a weight of 4 to 8 pounds. As a food-fish it ranks with the young of *O. chouicha*, which it much resembles. It may be readily distinguished by the few (40–50) pyloric cœca. In *O. chouicha* there are about 180 pyloric cœca. In fall the males become greatly distorted and hook-jawed, and specimens in every stage can be found in late summer.

57. **Oncorhynchus chouicha** (Walb.) J. & G.—*Quinnat Salmon; King Salmon; Chouicha; Chinnook Salmon; Spring Salmon; Columbia River Salmon; Sacramento Salmon; Winter Salmon; White Salmon.* Sawkwey.

From Ventura River northward to Behring's Straits, ascending Sacramento, Rogue's, Klamath, Columbia, and Frazer's Rivers in spring, as well as the streams of Alaska, Kamtschatka, Japan, and Northern China; in fall ascending these and probably *all* other rivers in greater or less abundance; the young taken in Monterey Bay, Puget Sound, etc., in summer in considerable numbers. This salmon, by far the most important fish in our Pacific waters, reaches a weight of about 70 pounds. The average in the Columbia River is about 22 pounds; in the Sacramento River about 18; in other rivers usually still smaller.

58. **Oncorhynchus nerka** (Walbaum) Gill & Jordan.—*Blue-back; Sukkeye; Red-fish; Rascal; Frazer's River Salmon; Krasnaya Ryba.*

From Columbia River to the Aleutian Islands; the principal salmon of Frazer's River; unknown in Eel River, Rogue River, and in the Sacramento. In the Columbia River it is much less abundant than the Quinnat salmon, and its flesh is less firm and paler. It reaches a weight of 5 to 8 pounds, four "blue-backs" being counted at the canneries equal to one Chinnook salmon. It runs chiefly in the spring, few of them being seen on Frazer's River or the Columbia in the fall. Like the Quinnat it ascends streams to great distances. It is known in the

(Jordan and Gilbert 1876-1919)

rich in spring, becoming paler in the fall as the spawning season approaches. Head 4; depth 4. B. 15–16 to 18–19, the number on the two sides always unlike. D. 11; A. 16. Gill-rakers usually 9+1 (*i. e.*, 9 above the angle and 14 below). Pyloric cæca 140–185. Scales usually 27–146–29, the number in a longitudinal series varying from 140–155, and in California specimens occasionally as low as 135. Vertebræ 66. L. 36 inches. Usual weight in the Columbia River 22 pounds; elsewhere 16–18 pounds, but individuals of 70–100 pounds have been taken. Ventura River to Alaska and Northern China, ascending all large streams; especially abundant in the Columbia and Sacramento Rivers, where it is the principal salmon. Upwards of 30,000,000 pounds are now taken yearly in the Columbia River. It ascends the large streams in spring and summer, moving up, without feeding, until the spawning season, by which time many of those which started first may have travelled more than a thousand miles. After spawning, most or all of those which have reached the upper waters perish from exhaustion. It is by far the most valuable of our salmon. It has lately been introduced into many eastern streams.

(*Salmo tshawytscha** Wallbaum, Artedi Pisc. 1792, 71: *Salmo orientalis* Pallas, Zoogr. Ross. Asiat. iii, 367, 1811–'31: *Salmo quinnat* Rich. Fauna Bor.-Amer. iii, 219, and of writers generally: *Oncorhynchus quinnat* Günther, vi, 152: *Oncorhynchus orientalis* Günther, vi, 159: *Oncorhynchus quinnat* Jordan, Proc. U. S. Nat. Mus. i, 69: *Parargyreus* Girard, Acad. Nat. Sci. Phila. 1856, 218: *Salmo quinnat, confluentus*, and *argyreus* Suckley, Monogr. Salmo, 105, 109, 110: *Salmo tschawytscha* Bloch & Schneider 1801, 407.)

a. Scales comparatively large, about 130 (125–135) in a longitudinal series; pyloric cæca 50–80.

502. O. kisutch (Walb.) Jor. & Gilb.—*Silver Salmon; Kisutch; Skowitz; Hoopid Salmon; Coho Salmon; Bielaya Ryba.*

Bluish green; sides silvery, with dark punctulations; no spots except a few rather obscure on top of head, back, dorsal fin, adipose fin, and the rudimentary upper rays of the caudal; rest of the caudal fin unspotted; pectorals dusky tinged; anal with dusky edging; sides of head without the dark coloration seen in the Quinnat; males mostly red in fall, and with the usual changes of form. Body rather elongate, compressed. Head short, exactly conical, terminating in a bluntly pointed snout, which is longer and broader than the lower jaw. Head shorter than in a young Quinnat of the same size. Interorbital space broad and strongly convex. Opercle and preopercle strongly convex behind; the preopercle very broad, with the lower limb little developed. Cheek

*A barbarous spelling of the word "chouicha" which we have thought proper to simplify.

broad. Eye quite small, much smaller than in young Quinnat of the same size. Suborbital very narrow, with a row of mucous pores along its surface. Maxillary slender and narrow, but extending somewhat beyond the eye. Teeth very few and small, only two or three on the vomer; those on tongue very feeble. Gill-rakers 10+13, rather long and slender, nearly as long as eye, toothed. Fins small. Pectorals and ventrals short, the ventral appendage three-fifths the length of the fin; caudal strongly forked, on a slender peduncle. Head 4; depth 4. B. 13–14. Pyloric cæca very few and large, 63 (45–80); scales 25–127–29. D. 10; A. 13–14 (developed rays). L. 15 inches. Weight 3–8 pounds. A small salmon, ascending streams in the fall to no great distance. Abundant from San Francisco northward.

(*Salmo kisutch* Walbaum, Artedi Pisc. 1792, 70: *Salmo kysutsch* Bloch & Schneider, 1801, 407: *Salmo sanguinolentus* Pallas, Zoogr. Ross. Asiat. iii, 379: *Oncorhynchus sanguinolentus* Günther, vi, 160: *Oncorhynchus lycaodon* Günther, vi, 155, in part: *Salmo scouleri* Suckley, Monogr. Salmo, 94: *Salmo canppitch* Richardson, Fauna Bor.-Amer. iii, 224, 1836: *Salmo tsuppitch* Günther, vi, 118 (not of Jordan, Proc. U. S. Nat. Mus. i, 72, 1878, = *Salmo purpuratus*); *Oncorhynchus tsuppitch*, Jordan, Forest and Stream, September 16, 1880, 130.)

**Gill-rakers comparatively long and numerous (30 to 40 in number); scales large, in about 130 series.

503. O. nerka (Walbaum) Gill & Jordan.—*Blue-back Salmon; Red-fish; Fraser's River Salmon; Sugk-eye Salmon; Krasnaya Ryba.*

Color clear bright blue above; sides silvery, this hue overlying the blue of the back; lower fins pale, upper dusky; no spots anywhere in adults in spring; the young with obscure black spots above; males deep crimson red in the fall; the fins blackish, the caudal then often speckled with black; young breeding males ("*Kennerlyi*") often sharply spotted. Body elliptical, rather slender. Head short, sharply conic, pointed, the lower jaw included. Maxillary rather thin and small, extending beyond eye. Teeth all quite small, most of them freely movable; vomer with about 6 weak teeth, which grow larger in fall males, instead of disappearing. Preopercle very wide and convex; opercle very short, not strongly convex. Preopercle more free behind than in *O. chouicha*. Ventral scale about half the length of the fin; caudal fin narrow, widely forked; anal fin long and low; dorsal low. Flesh deep red. Males becoming extravagantly hook-jawed in the fall, the snout being then prolonged and much raised above the level of rest of head, the lower jaw produced to meet it. Mandible $1\frac{1}{3}$ in head, in fall males, $1\frac{3}{4}$ in females; snout $2\frac{1}{4}$ in head, in fall males, $3\frac{1}{2}$ in females. Head 4; depth 4. Gill-rakers as long as eye, more numerous than in any other of our salmon, usually 16–23. B. 14+13. D. 11; A. 14; scales 20–133–20;

(Jordan et al. 1882)

The Silver Salmon (*Oncorhynchus kisutch*) reaches a weight of 3 to 8 pounds. It has 13 developed rays in the anal, 13 branchiostegals, 23 (10+13) gill-rakers, and 45 to 80 pyloric coeca. There are about 127 scales in the lateral line. In color it is silvery in spring, greenish above, and with a few faint black spots on the upper parts only. In the fall the males are mostly of a dirty red.

The Dog Salmon (*Oncorhynchus keta*) reaches an average weight of about 12 pounds. It has about 14 anal rays, 14 branchiostegals, 24 (9+15) gill-rakers, and 140 to 185 pyloric coeca. There are about 150 scales in the lateral line. In spring it is dirty silvery, immaculate, or sprinkled with small black specks, the fins dusky. In the fall the male is brick-red or blackish, and its jaws are greatly distorted.

The Humpback Salmon (*Oncorhynchus gorbuscha*) is the smallest of the species, weighing from 3 to 6 pounds. It has usually 15 anal rays, 12 branchiostegals, 28 (13+15) gill-rakers, and about 180 pyloric coeca. Its scales are much smaller than in any other salmon, there being 180 to 240 in the lateral line. In color it is bluish above, silvery below, the posterior and upper parts with many round black spots. The males in the fall are red, and are more extravagantly distorted than in any other in the *Salmonidæ*.

Of these species the Blue-back predominates in Fraser River, and in the Yukon River, the Silver Salmon in Puget Sound, the Quinnat in the Columbia and the Sacramento, and the Silver Salmon in most of the streams along the coast. All the species have been seen by us in the Columbia and in Fraser River; all but the Blue-back in the Sacramento

and in waters tributary to Puget Sound. Only the King Salmon has been noticed south of San Francisco. Its range has been traced as far as Ventura River. Of these species, the King Salmon and Blue-back Salmon habitually "run" in the spring, the others in the fall. The usual order of running in the rivers is as follows: *nerka*, *tschawytscha*, *kisutch*, *gorbuscha*, *keta*.

The economic value of the spring-running salmon is far greater than that of the other species, because they can be captured in numbers when at their best, while the others are usually taken only after deterioration. To this fact the worthlessness of *Oncorhynchus keta*, as compared with the other species, is probably wholly due.

The habits of the salmon in the ocean are not easily studied. King Salmon and Silver Salmon of all sizes are taken with the seine at almost any season in Puget Sound. This would indicate that these species do not go far from the shore. The King Salmon takes the hook freely in Monterey Bay, both near the shore and at a distance of six to eight miles out. We have reason to believe that these two species do not

(Jordan 1892a, 1894)

rarely seen south of the Columbia River, and probably never in California. In Alaska it far outnumbers all other kinds.

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The Humpback salmon (*Onchorhynchus gorbuscha*) is the smallest of the species, weighing from 3 to 6 pounds. It has usually 15 anal rays, 12 branchiostegals, 28 (13+15) gill-rakers, and about 180 pyloric cæca. Its scales are much smaller than in any other salmon, there being 180 to 240 in the lateral line. In color it is bluish above, silvery below, the posterior and upper parts with many round black spots. The males in the fall are red, and are more extravagantly distorted than in any other in the *Salmonidæ*.

Of these species the Blue-back predominates in Fraser River, and in the Yukon River, the Silver salmon in Puget Sound, the Quinnat in the Columbia and the Sacramento, and the Silver salmon in most of the streams along the coast. All the species have been seen by us in the Columbia and in Fraser River; all but the Blue-back in the Sacramento and in waters tributary to Puget Sound. Only the King salmon has been noticed south of San Francisco. Its range has been traced as far as Ventura River. Of these species, the King salmon and Blue-back salmon habitually "run" in the spring, the others in the fall. The usual order of running in the rivers is as follows: *nerka*, *tschawytscha*, *kisutch*, *gorbuscha*, *keta*.

The economic value of the spring-running salmon is far greater than that of the other species, because they can be captured in numbers when at their best, while the others are usually taken only after deterioration. To this fact the worthlessness of *Oncorhynchus keta*, as compared with the other species, is probably wholly due.

The habits of the salmon in the ocean are not easily studied. King salmon and Silver salmon of all sizes are taken with the seine at almost any season in Puget Sound. This would indicate that these species do not go far from the shore. The King salmon takes the hook freely in Monterey Bay, both near the shore and at a distance of six to eight miles out. We have reason to believe that these two species do not necessarily seek great depths, but probably remain not very far from the mouth of the rivers in which they were spawned. The Blue-back and the Dog salmon probably seek deeper water, as the former is seldom or never taken with the seine in the ocean, and the latter is known to enter the Strait of Fuca at the spawning season, therefore coming in from the open sea. The great majority of the King salmon, and nearly

(Jordan 1894)

summer, moving up, without feeding, until the spawning season, by which time many of those which started first may have traveled more than 1,000 miles. It ascends the Snake River to the neighborhood of Upper Salmon Falls, where it spawns in October and November. In the Salmon River of Idaho it ascends to the head waters, more than 1,000 miles from the sea, where it spawns in August and early September when the water has reached a temperature of about 54° F. After spawning, most or all of those which have reached the upper waters perish from exhaustion. It is by far the most valuable of our salmon. It has lately been introduced into eastern streams. (*Tschawytscha*, better spelled by earlier writers *Tchawicha*, the vernacular name in Alaska and Kamchatka.)

Salmo tschawytscha, Walbaum, Artedi Piscium, 71, 1792, rivers of Kamchatka; after the *Tchawytcha* of Krascheninnikov, Descr. Kamchatka, 178, 1755, and the *Tschawytscha* of Pennant, 1792; Bloch & Schneider, Syst. Ichth., 407, 1801.
Salmo orientalis, Pallas, Zoogr. Rosso-Asiat., III, 367, 1811, Kamchatka.
Salmo quinnat, Richardson, Fauna Bor.-Amer., III, 219, 1836, Columbia River; and of many writers.
Fario argyreus, Girard, Proc. Ac. Nat. Sci. Phila., 1856, 218, Cape Flattery; Fort Steilacoom.
Salmo confluentus, Suckley, Ann. Lyc. Nat. Hist. N. Y., December, 1858, and Pacific R. R. Surv., XII, Part 2, 324, 1860, Puyallup River, near Fort Steilacoom (Coll. Suckley); and Monogr. Salmo, 109, 1861 (1874).
Salmo argyreus, Suckley, Pacific R. R. Surv., XII, Part 2, 326, 1860, and Monogr. Salmo, 110, 1861 (1874).
Oncorhynchus quinnat, Günther, Cat., VI, 158, 1866; Jordan, Proc. U. S. Nat. Mus., 1878, 69.
Oncorhynchus orientalis, Günther, Cat., VI, 159, 1866.
Oncorhynchus chouicha,† Jordan & Gilbert, Synopsis, 306, 1883.

776. ONCORHYNCHUS KISUTCH (Walbaum).

(Silver Salmon; Kisutch; Skowitz; Hoopid Salmon; Coho Salmon; Bielaya Ryba; Quisutch.)

Head 4; depth 4. B. 13 or 14. Pyloric cœca very few and large, 63 (45 to 80); gill rakers 10 + 13, rather long and slender, nearly as long as eye, toothed; scales 25–127–29. D. 10; A. 13 or 14 (developed rays). Body rather elongate, compressed. Head short, exactly conical, terminating in a bluntly pointed snout, which is longer and broader than the lower jaw; head shorter than in a young Quinnat of the same size. Interorbital space broad and strongly convex. Opercle and preopercle strongly convex behind; the preopercle very broad, with the lower limb little developed; cheeks broad. Eye quite small, much smaller than in young Quinnat of the same size. Suborbital very narrow, with a row of mucous pores along its surface; maxillary slender and narrow, but extending somewhat beyond the eye. Teeth very few and small, only two or three on the vomer; those on tongue very feeble. Fins small. Pectorals and ventrals short, the ventral appendage three-fifths the length of the fin; caudal strongly forked, on a slender peduncle. Bluish green; sides silvery, with dark punctulations; no spots except a few rather obscure on top of head, back, dorsal fin, adipose fin, and the rudimentary upper rays of the caudal; rest of the caudal fin unspotted; pectorals dusky tinged; anal with dusky edging; sides of head without the dark coloration seen in the Quinnat; males mostly red in fall, and with the usual

† An unsuccessful attempt at respelling the barbarous looking word "tschawytscha."

changes of form. Length 15 inches. Weight 3 to 8 pounds. A small salmon, ascending streams in the fall to no great distance. Abundant from San Francisco northward, especially in Puget Sound and the Alaskan fjords; south on the Asiatic coasts to Japan. (*Kisutch*, the vernacular name in Alaska and Kamchatka; called by the Russians *Bielaya Ryba*, or whitefish.)

? *Salmo milktschitsch*, Walbaum, Artedi Piscium, 70, 1792, Bering Sea; after *Milktschitsch* or *Milkschitsch* of Pennant and Krascheninnikov; probably the young of *kisutch*.
Salmo kisutch,* Walbaum, Artedi Piscium, 70, 1792, Rivers and Lakes of Kamchatka; after the *Kisutch* of Pennant.
? *Salmo tsuppitch*, Bloch & Schneider, Syst. Ichth., 407, 1801, Kamchatka; after *Milktschitsch* of Krascheninnikov.
Salmo lycaodon, Bloch & Schneider, Syst. Ichth., 407, 1801, Kamchatka; after Pennant.
Salmo sanguinolentus, Pallas, Zoogr. Rosso-Asiat., III, 373, 1811, Bering Sea.
Salmo tsuppitch, Richardson, Fauna Bor.-Amer., III, 224, 1836, Columbia River; Günther, Cat., VI, 158, 1866.
? *Salmo* [illegible], Günther, Amer. Mag. Nat. Hist., 1877, 484, Yokohama, Japan.
Oncorhynchus lycaodon, Günther, Cat., VI, 155, 1866; in part.
Salmo scouleri, Suckley, Monogr. Salmo, 94, 1861 (1874).
Oncorhynchus sanguinolentus, Günther, Cat., VI, 160, 1866.
Oncorhynchus tsuppitch, Jordan, Forest and Stream, September 16, 1880, 130.
Oncorhynchus kisutch, Jordan & Gilbert, Synopsis, 307, 1883.

Subgenus HYPSIFARIO, Gill.

777. ONCORHYNCHUS NERKA (Walbaum).

(Blueback Salmon; Redfish; Fraser River Salmon; Saw-qui Salmon; Krasnaya Ryba.)

Head 4; depth 4. B. 13 to 15; D. 11; A. 14 to 16; scales 20–133–20; pyloric cœca 75 to 95; vertebræ 64. Gill rakers about 32 to 40, usually 14 or 15 + 22 or 23, as long as eye. Body elliptical, rather slender. Head short, sharply conic, pointed, the lower jaw included. Maxillary rather thin and small, extending beyond eye. Teeth all quite small, most of them freely movable; vomer with about 6 weak teeth, which grow larger in fall males, instead of disappearing. Preopercle very wide and convex; opercle very short, not strongly convex. Preopercle more free behind than in *O. tschawytscha*. Ventral scale about half the length of the fin. Caudal fin narrow, widely forked; anal fin long and low; dorsal low. Flesh deep red. Males becoming extravagantly hook-jawed in the fall, the snout being then prolonged and much raised above the level of rest of head, the lower jaw produced to meet it; mandible 1½ in head in fall males, 1⅔ in females; snout 2¼ in head in fall males, 3½ in females. Color clear bright blue above; sides silvery, this hue overlying the blue of the back; lower fins pale, upper dusky; no spots anywhere in adults in spring; the young with obscure black spots above.

Color of breeding male: back blood red, with dark edges to some of the scales; middle of side darker red, but unevenly so, usually darkest at middle of body; under parts dirty white, with numerous fine dark dustings; head above and on sides pale olivaceous, some darker mottling on

* Misprinted *kisatch* by Walbaum, the error corrected in the errata. The name *milktschitsch* has a few lines of priority over *kisutch*, but we are not absolutely sure that it belongs to the same species.

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(Jordan and Evermann 1896)

than the body, and with few spots; back, dorsal fin and tail usually profusely covered with round black spots, sometimes these are few, but never wholly absent; sides of head and caudal fin with a peculiar metallic tin-coloured lustre; flesh rich salmon-colour in spring, becoming paler as the spawning season approaches. In the late summer and autumn the jaws of the male become elongate and distorted, the anterior teeth become greatly enlarged, and the colour more or less tinged or blotched with dull red.

Silver Salmon

Oncorhynchus kisutch (Walbaum)

The silver salmon is blessed with a large number of vernacular names, among which may be mentioned hoopid salmon, coho; kisutch, skowitz; quisutsch, and bielaya ryba. Next to the chinook and the blueback it is the most important of the genus. It reaches a length of 15 inches, and a weight of 3 to 8 pounds, and is abundant from San Francisco northward along both the American and Asiatic coasts, entering the shorter coastal streams late in the fall. It occurs in Asiatic waters as far south as Japan. In our waters it is especially abundant in Puget Sound, the fjords of Alaska, and in the shorter rivers of Washington and Oregon.

As a food-fish, though inferior to the chinook and the blueback, it is of great importance. Large quantities are canned every year on the Oregon and Washington coasts; it is one of the best species to ship fresh.

Its spawning season is later than that of the chinook. They first appear in the southern end of Puget Sound about the first of September, and the run usually lasts until the first or middle of November. An examination of more than 2,000 examples at Celilo on the Columbia River in September and October indicated that their spawning time would not be later than October. This species is common in Japan.

Head 4; depth 4; D. 10; A. 13 or 14; Br. 13 or 14; pyloric cœca very large and few, 45 to 80; scales 25-127-29; gillrakers 10+13, rather long and slender, nearly as long as eye. Body slender and compressed; head short, shorter than in chinook of same size, very conical, the snout bluntly pointed; interorbital space broad and strongly convex; opercle and preopercle strongly

convex behind, the preopercle very broad, with the lower limb little developed; eye much smaller than in chinook of same size; maxillary slender and narrow, but extending somewhat beyond the eye; teeth very few and small, only 2 or 3 on the vomer, those on tongue very feeble; fins small. Colour, bluish green on back, the sides silvery, with dark punctulations; no spots except a few rather obscure ones on top of head, back, dorsal fin, adipose fin, and the rudimentary upper rays of the caudal; pectorals dusky, and with dusky edge; sides of head without dark colouration as seen in the chinook; males mostly red in fall, and with the usual changes of form.

The silver salmon is easily distinguished from the chinook, which it most resembles, by its fewer scales, fewer pyloric cœca, and fewer branchiostegals.

Blueback Salmon; Sockeye Salmon

Oncorhynchus nerka (Walbaum)

The blueback salmon is found from the coast of southern Oregon, north to northern Alaska and Kamchatka, and Japan. It has been occasionally reported from the Sacramento and Klamath rivers, but is not at all common south of the Columbia. The principal rivers in the United States which it frequents are the Columbia, Quinialt and Skagit, in each of which very great runs occur. It enters the Fraser in enormous numbers, and is the most abundant and valuable salmon in Alaska.

The runs in the different rivers begin at different times, depending partly upon the distance of the spawning beds from the sea, and the temperature of the water.

The run in the Columbia begins in March or April, and the fish ascend to the headwaters of the Salmon River in Idaho, which they reach in July and August, a journey of some 1,000 miles from the sea. In the Skagit the run begins somewhat later, the fish reaching their spawning grounds in and above Baker Lake in August and September.

The run in the Fraser River is synchronous with that in the Skagit, or possibly a little later. In Alaska most of the streams which it enters are relatively short, and the runs do not begin until a short time before the spawning period. So far as known the blueback enters only such rivers as have lakes in their head-

(Jordan 1904b; Jordan and Evermann 1905)

but the blue-back is not found in the Sacramento. Only the quinnat and the dog-salmon have been noticed south of San Francisco. In Japan *keta* is by far the most abundant species of salmon. It is known as saké, and largely salted and sold in the markets. *Nerka* is known in Japan only as landlocked in Lake Akan in northern Hokkaido. *Milktschitsch* is generally common, and with *masou* is known as masu, or small salmon, as distinguished from the large salmon, or saké. *Tschawytscha* and *gorbuscha* are unknown in Japan. *Masou* has not been found elsewhere.

The quinnat and blue-back salmon, the "noble salmon," habitually "run" in the spring, the others in the fall. The usual order of running in the rivers is as follows: *tschawytscha, nerka, milktschitsch, gorbuscha, keta.* Those which run first go farthest. In the Yukon the quinnat runs as far as Caribou Crossing and Lake Bennett, 2250 miles. The red salmon runs to "Forty-Mile," which is nearly 1800 miles. Both ascend to the head of the Columbia, Fraser, Nass, Skeena, Stikeen, and Taku rivers. The quinnat runs practically only in the streams of large size, fed with melting snows; the red salmon only in streams which pass through lakes. It spawns only in small streams at the head of a lake. The other species spawn in almost any fresh water and only close to the sea.

The economic value of the spring-running salmon is far greater than that of the other species, because they can be captured in numbers when at their best, while the others are usually taken only after deterioration.

The habits of the salmon in the ocean are not easily studied. Quinnat and silver salmon of all sizes are taken with the seine at almost any season in Puget Sound and among the islands of Alaska. This would indicate that these species do not go far from the shore. The silver salmon certainly does not. The quinnat pursues the schools of herring. It takes the hook freely in Monterey Bay, both near the shore and at a distance of six to eight miles out. We have reason to believe that these two species do not necessarily seek great depths, but probably remain not very far from the mouth of the rivers in which they were spawned. The blue-back or red salmon certainly seeks deeper water, as it is seldom or never taken with the seine along shore, and it is known to enter the Strait of Fuca in

(Jordan 1904a, 1907)[3]

[3] David Starr Jordan wrote that only king salmon (*Oncorhynchus tschawytscha*) had been noticed south of San Francisco until the 1890s, after which Stanford ichthyologists discovered that dog (chum) salmon occasionally stray into the coastal streams of the Monterey Bay. Clearly, David Starr Jordan's work reflected the most up-to-date information.

Appendix II

Mark Twain, who sailed with Captain Wakeman on December 15, 1866, wrote of the captain:

> "I will do him the credit to say that he knows how to tell his stirring forecastle yarns ... with his strong, cheery voice, animated countenance, quaint phraseology, defiance of grammar, and extraordinary vim in the matter of emphasis and gesture ... He is a burly, hairy, sunburned, stormy-voiced old salt... and is tattooed from head to foot like a Feejee islander..." (Levy, 2003).

Two years later, in Panama, Mark Twain described an encounter he had with Wakeman:

> "While I was standing in the bar of the Grand Hotel..., I heard a familiar voice holding forth in this wise:
> 'Monkeys! don't tell me nothing about monkeys, sir! I know all about 'em! Didn't I take the Mary Ann through the Monkey Islands? – snakes as big as a ship's mainmast, sir! – and monkeys! – God bless my soul, sir, just at daylight she fetched up at a dead stand-still, sir! – what do you suppose it was, sir? It was monkeys! Millions of 'em, sir! – banked up as high as the cat-heads, sir! – trying to swim across the channel, sir, and crammed it full! I took my glass to see thirteen mile of monkeys, two mile wide and sixty fathom deep, sir! – counted, ninety-seven million of 'em, and the mate set 'em down, sir – kept tally till his pencils was all used up and his arm was paralyzed, sir! Don't tell me nothing about monkeys, sir – because I've been there – I know all about 'em, sir!'
> It is hardly possible, but still there may be people who are so ignorant as not to know that this voice belonged to Captain Ned Wakeman, of the steamship America" (Schmidt, 1997).

Appendix III

MONTH	Probability of more than 1 inch of precipitation in a single day		Probability of more than 4 inches of precipitation in a single day	
	Santa Cruz County	Marin County	Santa Cruz County	Marin County
December	9.31%	9.32%	**1.29%**	**0.93%**
January	11.28%	12.91%	**1.42%**	**0.69%**
February	11.43%	10.87%	**1.02%**	**0.83%**
March	7.70%	6.93%	**0.34%**	**0.07%**
April	3.31%	2.73%	**0.15%**	**0.11%**
May	**0.76%**	**1.11%**	**0.05%**	**0.04%**
June	**0.15%**	**0.31%**	0.00%	0.00%
July	**0.00%**	**0.04%**	0.00%	0.00%
August	**0.00%**	**0.08%**	0.00%	0.00%
September	**0.25%**	**0.37%**	**0.05%**	**0.00%**
October	2.68%	2.72%	0.05%	0.14%
November	7.07%	7.96%	**0.45%**	**0.33%**

Table 1: Precipitation probability in a single day for Santa Cruz and Marin counties. Precipitation probablility was calculated using precipitation records for the Ben Lomond No. 4 station in Santa Cruz County (1937-2004) and the Kentfield station in Marin County (1931-2004). Both these stations represent the highest precipitation records for their respective counties. Source: (NOAA 2004).

Appendix IV

"Distinctive differences in habitat characteristics [south of San Francisco] included spawning in extreme hydrological cycles. Distinctive life history characteristics included the reduced number of eggs produced by female coho salmon that spawn in Scott and Waddell Creeks" (Bryant 1994, pg. 69).

"A dominant factor in the decline of coho in Waddell and Scott creeks … appears to be stochastic events (floods and droughts) which weaken or eliminate individual year classes. Since coho females are almost always 3 year olds, weakened year classes have a poor chance of recovery and extirpation is likely, even if spawning and rearing habitat are sufficient to support a viable coho population" (Smith 1994, pg. 1).

"Since 1988, one year class (1991, 1994, …) on Scott Creek has been severely reduced, and the same year class on Waddell Creek has apparently been lost, due to drought impacts … The 1992 year classes on Scott and Waddell creeks were also apparently seriously reduced by a February flood" (Smith 1994, pg. 1).

"These southernmost populations experience and respond to the unfavorable, adverse environmental conditions associated with the fringe of any distribution. In such areas, environmental conditions can become marginal, harsh or extreme for coho survival and, presumably, these southernmost populations have adapted to the less-than-optimal environments" (Anderson 1995, pg. 4).

"Scott and Waddell Creek coho spawn in a wide variety of substrate conditions. Much spawning habitat is limited to less than optimal small gravels with high sand and silt content and moderate to high embeddedness. These streams are characterized by large quantities of highly mobile sediment bedload. Fingerlings must seek and survive in pools that exhibit elevated summer and fall water temperatures at the margin of acceptability" (Anderson 1995, pg. 9).

"The inflexible 3-year maternal brood year lineage and early winter spawning traits of coho salmon south of San Francisco Bay place these stocks in high jeopardy from drought or flood events. Such events have cumulative and catastrophic consequences for the long-term viability of southern coho salmon, and can result in the extirpation of year classes and broodstock lineages, as has occurred with the 1991-1994 lineage on Waddell and Scott Creeks and the near elimination of the companion 1992-1995 lineage on both streams (Smith 1994b, 1994c, Brown et al. 1994, Bryant 1994, J. Nelson, CDFG, Pers. Comm., MBSTP Annual Reports). As discussed by Smith (1994b), the functionally extinct 199-1994 brood year lineage was severely impacted by drought (D) or flood (F) events in 1976 (D), 1977 (D on smolt), 1982 (F), and 1991 (D), 1983 (F), 1986 (F), and 1992 (F). The 1993-1996 lineage, the only sustained lineage remaining, has not experienced such extreme natural stochastic events for over two decades (Smith 1994b)." (Anderson 1995, pg. 28)

"Floods, which destroy nests, and droughts, which may block adult or smolt migrations, have been more important than rearing habitat in controlling recent coho abundance" (Smith et al. 1997, pg. 14).

"Judsen and Ritter (1964), the California Department of Water Resources (CDWR, 1982), and the California State Lands Commission (CSLC, 1993) have stated that northwestern and central coastal California have some of the most erodible terrain in the world" (Schmitten 1997, pg. 24599).

"The role of hatchery rearing again appears crucial to rebuilding 3 viable year classes. Alternatively, if the single strong year class is crippled or eliminated by drought or flood in 2002, coho will be essentially extirpated south of San Francisco Bay" (Smith 2001, pg. 6).

"Spawning coho were abundant on at least Waddell and Scott creeks, but the severe winter storms apparently destroyed most redds" (Smith 1998, pg. 1).

"The inflexible 3-year maternal brood year lineage and early winter spawning traits of coho salmon south of San Francisco Bay place these stocks in high jeopardy from drought and flood events. Such events have cumulative and catastrophic consequences for the long-term viability of southern coho, and can result in the extirpation of brood years and broodstock lineages" (Baker et al. 1998, pg. 39).

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California Department of Fish and Game Response to the Fish and Game Commission on a Petition to Delist Coho Salmon South of San Francisco

December 2004

Introduction

A petition to redefine the southern boundary of the Central California Coast coho salmon (*Oncorhynchus kisutch*) Evolutionary Significant Unit (CCC ESU) under the California Endangered Species Act (CESA) (Alvarado et al. 2004) was received by the California Fish and Game Commission (Commission) on July 2, 2004. The petition was submitted by the Central Coast Forest Association (CCFA) and Big Creek Lumber Company. The petition contends that coho salmon are not native south of San Francisco, but are the result of hatchery introductions of exotic stocks of coho salmon through early hatchery operations. The petition supports this argument by citing habitat incompatibility of the species and lack of coho salmon evidence in the historical and archeological record. For these reasons and others the petitioners are asking the Commission to redefine the boundary of listed coho salmon so it excludes coastal streams south of San Francisco Bay, and to delist coho salmon inhabiting these streams from the CESA list of endangered species.

Pursuant to § 2073.5 of the California Fish and Game Code (FGC), the petition was referred to the California Department of Fish and Game (Department) for evaluation. The Department evaluated the petition to determine if it contained sufficient scientific information to indicate that the petitioned action may be warranted. The information in the petition was reviewed thoroughly and the major references cited in the petition were obtained and analyzed. The most current relevant available information not referenced in the petition was also obtained and analyzed.

Coho salmon in streams south of San Francisco were listed by the Commission as endangered under CESA on December 31, 1995. The scientific evidence at the time indicated a listing of endangered was warranted. To date, the Department has been updating and reviewing the available scientific information regarding coho salmon both north and south of San Francisco. This information was used in the Department's analysis of the petition and formulation of the recommendation to the Commission.

The petition to delist coho salmon south of San Francisco is predicated on five main points:

1. Archeological evidence supports the concept that coho salmon populations were not present prehistorically in the coastal streams south of San Francisco.
2. Harsh environmental conditions prevented the establishment of permanent coho salmon populations south of San Francisco.
3. The scientific and historical record substantiates the absence of coho salmon populations south of San Francisco.
4. Coho salmon south of San Francisco have been introduced through frequent replanting of hatchery produced coho salmon of various origins.

5. Recent reductions in hatchery support have allowed the naturally hostile-to-coho salmon environment to nearly extirpate the introduced coho salmon populations south of San Francisco.

Each of these points is evaluated below.

Archeological evidence supports the concept that coho salmon populations were not present prehistorically in the coastal streams south of San Francisco.

The petitioner's conclusion that coho salmon are not native to the streams south of San Francisco is based primarily on archeological evidence that shows the absence of identified coho salmon remains in prehistoric Native American middens, and their assertion that there were no credible surveys reporting coho salmon in those streams prior to 1906.

In a study commissioned by the CCFA, Gobalet (2003) reported finding no identifiable coho salmon remains in Native American middens south of San Francisco. Gobalet (2003) and Gobalet et al. (2004) report many reasons why they found little evidence of coho salmon remains, including the difficulty of identifying salmonid bones to species and the fact that salmonid bones do not preserve well, as evidenced by the low percentage observed from the middens studied (Gobalet 2003). Also, the fish may have been prepared where they were caught.

Finding salmonid bones in archeological middens is problematic, even where salmonids are plentiful. In the Central Valley, where large runs of Chinook salmon were documented (Yoshiyama et al. 1996, 1998) and where the ethnographic record indicates that the salmon fishery was of considerable importance to the native populations of the region (Yoshiyama et al. 2001), native communities may have consumed, per capita, as high as 365 pounds of Chinook salmon per year (Yoshiyama 1999, as cited in Gobalet et al. 2004). However, the archeological record does not reflect this: in the Sacramento River drainage, only 9.2% of the recovered archeological elements were from salmonids, and in the San Joaquin drainage, only two salmonid bones were found among 9,169 elements. This translates to a total salmonid contribution of 6.3% of the 29,265 bones from the entire Central Valley (Gobalet et al. 2004).

Gobalet et al. (2004) postulate that the frequency of coho salmon elements found in the archeological record of the San Francisco Bay area (14 out of 105,000 elements) should match those on the coastal side in San Mateo and Santa Cruz counties, therefore, one would need to find 7,506 elements before a single coho salmon bone could be expected. The collections from eight archeological sites (Gobalet et al. 2004) and two others (Gobalet and Jones 1995) from San Mateo and Santa Cruz counties yielded only 1,156 diagnostic elements. Of those elements only five (0.4%) were salmonid and those were all steelhead. This is not surprising due to the higher abundance of steelhead, and the ratio of elements needed to uncover one coho salmon. Interestingly, even though coho salmon remains were not specifically identified in the midden sites south of San Francisco, Gobalet at al. (2004) mentions the possibility that the salmon bones identified from a Monterey County site at Big Creek (south of Big Sur) are those of coho salmon which would place them further south than their current range.

Regarding the amount of coho salmon evidence found, Gobalet et al.(2004) state, "Because of this paucity of materials, far more sampling is required to use the archeological record as definitive evidence for the absence of coho salmon from this section of coast." Also,

Gobalet (2003) in his concluding statement in the report commissioned by petitioners states, "We must, however, be cautious because the absence of evidence is not evidence of absence."

Harsh environmental conditions prevented the establishment of permanent coho salmon populations south of San Francisco

The petition states that because of the climatic and physical instability of the habitat south of San Francisco, coho salmon could not survive other than ephemerally[1]. However, these conditions are not significantly different from north of San Francisco where there are known populations of native coho salmon. The Department found no evidence that the streams south of San Francisco Bay were more "flashy," as claimed, than streams north of the bay. Using stream gauge data (USGS 2004) the Department compared two similar streams, Lagunitas Creek and the San Lorenzo River. Lagunitas Creek is a known coho salmon bearing stream north of San Francisco Bay in Marin County, whereas the San Lorenzo River is south of San Francisco Bay in Santa Cruz County. As stated in the petition, the San Lorenzo River fluctuates from drought to flood conditions preventing perennial habitation of coho salmon. However, a comparison of the two streams shows very little variance in the amplitude of flow over a 20 year period (Figure 1). This time period was chosen to include both drought and flood years and the availability of comparable data (USGS 2004).

Further, the Department was unable to discern a dramatic difference in climate north and south of San Francisco Bay. The Department looked at a variety of information, such as yearly rainfall and 24 hour precipitation events (USGS 2004, CDEC 2004, NOAA 2004), yet found no clear evidence to substantiate the petitioner's claim that the climate and conditions differed substantially between north and south of San Francisco Bay.

The scientific and historical record substantiates the absence of coho salmon populations south of San Francisco

The petition states there are no credible surveys reporting coho salmon in the streams south of San Francisco prior to the 1906 acceptance of 50,000 coho salmon eggs at Brookdale Hatchery on the San Lorenzo River in Santa Cruz County (Bowers 1906). However, specimens of coho salmon from Scott and Waddell creeks have been identified in the California Academy of Sciences (CAS) ichthyology collection from the year 1895 (CAS 2004). The CAS museum documents eleven coho salmon from Waddell Creek and four from Scott Creek collected on June 5, 1895 by the party of Rutter, Scofield, and Seale (CAS 2004). Also, two coho salmon were collected from San Vincente Creek and one from Gazos Creek by the same party, and although they were not dated, can reasonably be assumed to have been collected during the same period[2].

[1] Even if these populations are ephemeral, their presence establishes the historical range of the species and they play an important role in long-term persistence of the species. They have the same protections under CESA that the more robust populations have.

[2] The petition acknowledges these 1895 collections of juvenile coho salmon, however, dismisses them as non-credible collections because the records are "chaotic and contradictory". The petitioners do not provide any discussion or evidence as to why they believe the records are "chaotic and contradictory". We find no reason to dismiss these collections, and find them to be credible evidence that coho salmon were present in Santa Cruz County streams prior to the first known hatchery introduction of coho salmon to this region in 1906.

Further, as late as 1870, commercial harvest of coho salmon occurred on Pescadero and San Gregorio creeks in San Mateo County (Skinner 1962).

Streig (1991) reported that coho salmon eggs were harvested from an estimated 518 females at the Scott Creek egg taking station in 1909. It is highly unlikely that these fish could have been produced from the 50,000 eggs delivered and raised at Brookdale Hatchery on the San Lorenzo River in 1906, even if all of the fry were planted in Scott Creek. Applying an egg-to-fry survival rate of 75% (average egg-to-fry survival rate of coho salmon raised at Iron Gate Hatchery); a fry-to-smolt survival rate of 9.7% (highest reported value by Sandercock 1991); and a smolt-to-adult survival rate of 7.7% (highest reported value by Shapovalov and Taft 1954) yields an estimate of about 280 adults to Scott Creek, far less than the estimated 1,036 fish [3] that returned in 1909.

Finally, Shapovalov and Taft (1954) state that the only introduced fish found in Waddell Creek was striped bass, implying that coho salmon were native to the drainage.

Coho salmon south of San Francisco have been introduced through frequent replanting of hatchery produced coho salmon of various origins.

Numerous coho salmon artificial production facilities have operated in the area south of San Francisco since the early 1900s. Between 1905 and 1953 the Brookdale Hatchery raised coho salmon on the San Lorenzo River. Big Creek Hatchery was operated on Big Creek, a tributary to Scott Creek, between 1927 and 1952, until destroyed by flood. The current Monterey Bay Salmon and Trout Program began operating the Kingfisher Flat Hatchery on Scott Creek near the site of the original Big Creek Hatchery in 1972. Big Creek and Brookdale hatcheries took eggs both from nearby Scott Creek and from other out-of-basin sources. Silver King, a commercial salmon rearing company, operated a facility in Santa Cruz County in the 1980s using broodstock from Oregon, Washington, and British Columbia. We know of no data that support the assertion that coho salmon have been maintained in streams south of San Francisco by hatchery input. Mainly this is because there is little data available to evaluate the hatchery contribution to natural abundance. The petitioners do not provide any evidence that supports their assertion. Hatchery reports (see Tables 1 and 2 and Figure 2) show that since the early 1900s hatchery production in the region has been sporadic and relatively small even when out-of-basin broodstock or eggs were used. Only about 1.6 million very early life stage plantings are recorded over a 26 year period. Mortality in these early life stage plants would likely have been very high because of the small size of the fish. From the available data, we are not able to tell whether this level of sporadic production maintained the existing natural populations or not. However, Figure 2 shows that recent hatchery output has been extremely variable and declining. Figure 2 also shows that no coho salmon were planted from 1915/16 to 1927/28. If coho salmon populations were supported entirely by hatchery plants, then they would have likely been extirpated during this period.

It should be noted that CESA does not discriminate between hatchery and naturally spawning populations. Recent Commission action to list coho salmon north of San Francisco under CESA includes hatchery as well as naturally spawning populations in this region.

[3] Assuming a 1 to 1 sex ratio, the 518 females that returned to Scott Creek in 1909 would have yielded a total run into Scott Creek of 1,036 adults.

Recent reductions in hatchery support have allowed the naturally hostile-to-coho salmon environment to nearly extirpate the introduced coho populations south of San Francisco.

Recent status reviews all support the conclusion that coho salmon hatchery production in the region south of San Francisco has declined in recent years. The availability of local broodstock has been a major influence on hatchery output in the region. As fish have become scarcer, hatcheries in the region using local broodstock have had an increasingly difficult time obtaining enough fish to support their programs. Counter to what would be expected if the petitioners' assertion were true, the earliest hatchery collection of coho salmon in 1909 was the largest of all the hatchery collections on record. As discussed above, the 518 females collected at that time could have resulted from the recorded 50,000 eggs planted three years earlier (Table 2) only if an unrealistically high survival was experienced by that group.

The petition dismisses the well-documented effect that habitat degradation has had on reducing coho salmon populations (e.g. increased sedimentation from land-use practices, elimination of habitat and decreased water quality due to urbanization, reduced stream flows due to water diversion) (Sullivan 1990; Brown and Moyle 1991; Marston 1992; Nelson 1994; Anderson 1995; Alley 1998a; 1998b; 1999; 2000). Contrary to the argument made in the petition, clear-cutting and deforestation is not beneficial to salmonids even if it results in a temporary increase in stream flow. This idea is a gross oversimplification of the complex processes of geomorphology and ecology. Although deforestation can lead to higher flows, these deforested areas tend to have higher peak flows with shorter duration (Bottorff and Knight 1996), which can leave fishes stranded off-channel or moved to undesirable habitats (Sandercock 1991, Spence et al. 1996, CDFG 2002). Higher peak flows can lead to decreased bank stabilization, modification of the stream through erosion and siltation, and decreased morphological complexity (Spence et al. 1996, CDFG 2001). Destabilized banks increase the potential for landslides and siltation which can bury or smother salmonid redds and alevins (Sandercock 1991). High silt loads have also been a deterrent to migrating smolts and adults (Smith et al. 1997) and can damage gill tissue of fry, smolt, and adults (CDFG 2002). Other impacts that can result from deforestation are reduction in cover and shade, reduction in nutrient input, and increased water temperature from solar radiation. All of these factors can have a detrimental effect on salmonid populations (Hicks et al. 1991).

Additional Genetic Considerations

The petition is not an objective evaluation of the best available coho salmon genetics information. The petitioners did not adequately review the entire literature on coho salmon genetics and failed to accurately report the state of existing research, to present that research in proper context, and to appropriately weight the most recent, best available genetics research. In contrast to the assertions of the petitioners, all recent genetic analyses support the genetic distinctiveness of coho salmon from Scott, Waddell, and Gazos creeks, and their affinities to other nearby California coho salmon populations (see citations below). However, the available genetics data are of very limited usefulness for evaluating whether the existing coho salmon in Scott, Waddell, and Gazos creeks are native.

California coho salmon population genetics has been studied since the early 1980s using a variety of molecular genetic techniques and materials. CDFG (2002) and Weitkamp et al. (1995) present reviews of these population genetic analyses, which include assessments of coho

salmon populations south of San Francisco. Recent work (Weitkamp et al. 1995; Banks et al. 1999; Hedgecock et al. 2001; Hedgecock et al. 2002; Garza and Gilbert-Hovath 2003; J.C. Garza, NOAA Fisheries SWFSC, Santa Cruz, unpublished data) has added considerably to our understanding of coho salmon population genetics in California. These recent analyses support California ESU delineations drawn by Weitkamp et al. (1995) and adopted by the Department (CDFG 2002). The best available scientific data indicate that two to three somewhat reproductively isolated ESU-level groups exist across the range of coho salmon in California. These correspond to the SONCC Coho ESU and the CCC Coho ESU, with some data suggesting a third ESU-level group consisting of populations of coho salmon south of San Francisco.

Over the past five years, scientists at NOAA Fisheries collected microsatellite genetic data from coho salmon in Scott, Waddell, and Gazos Creeks. Preliminary analyses reveal that coho salmon from those streams are closely related to one another, and are more distantly related to coho salmon in California streams north of them (J.C. Garza, NOAA Fisheries SWFSC, Santa Cruz, unpublished data).

The petitioners assert that there could not possibly be any native coho salmon left in streams south of San Francisco given the long history of out-of-basin hatchery planting that has occurred there. However, the effects of hatchery influence on naturally spawning population genetics are not always as severe or benign as expected since they depend largely on the differences between specific hatchery and naturally spawning stocks, and interbreeding or other interactions occurring between them. Hindar et al. (1991) and Skaala et al. (1990) in reviews of the genetic effects of hatchery stocks on naturally spawning salmonids cited examples of effects that ran the gamut from native stocks that had been largely or entirely displaced by hatchery stocks, to hybridization between native and hatchery fish, to examples in which repeated hatchery releases had no deleterious effect at all on the native population. Stocking records alone cannot be used to conclusively document replacement of one stock by another.

Conclusions and Recommendation

After careful review of the petition and the available scientific information, the Department concludes that there is not sufficient information contained in the petition to indicate that the petitioned action may be warranted. We base these findings primarily on:

1. The petitioner's assertion that the archeological evidence indicates that coho salmon populations were not present prehistorically in the coastal streams south of San Francisco is not supported by the available information and not supported by the archaeologist that performed the investigations. There were not enough salmonid bones recovered at the sites to make the conclusion that coho salmon were absent from this region, and more samples are needed before a definitive conclusion can be made (Gobalet et al.2004).

2. The climatic and hydrologic evidence does not support the petitioner's conclusion that harsh environmental conditions prevented the establishment of permanent coho salmon populations south of San Francisco Bay . Climatic and hydrologic data show that the environmental conditions in San Mateo and Santa Cruz counties are not significantly different from coastal areas north of San Francisco.

3. Historical museum records from 1895 indicate that coho salmon were present in several streams south of San Francisco and there is documentation that commercial harvest of coho salmon was on-going as late as 1870 on two San Mateo County streams. These and other evidence demonstrate that coho salmon were present prior to 1906, which is the date of the first known planting of hatchery coho salmon south of San Francisco.

4. The petitioners do not provide any evidence that supports their assertion that coho salmon have been maintained in streams south of San Francisco by hatchery input. We know of no data that supports or refutes this assertion, primarily because there is little data available to evaluate the hatchery contribution to natural abundance. However, hatchery reports show that since the early 1900s hatchery production in the region has been sporadic and relatively small even when out-of-basin broodstock or eggs were used. Recent hatchery output has been extremely variable and declining.

5. There are no data to support the petitioners' assertion that recent reductions in hatchery support have caused the severe reduction in coho salmon populations south of San Francisco. Recent status reviews support the conclusion that coho hatchery production in the region south of San Francisco has declined in recent years. The availability of local broodstock has been a major influence on hatchery output in the region. As fish have become scarcer, hatcheries in the region using local broodstock have had an increasingly difficult time obtaining enough fish to support their programs. There is much more information and data supporting the argument that recent declines in coho salmon populations are attributable to well-documented habitat degradation caused by land-use practices, urbanization, and reduced stream flows.

6. In contrast to the assertions of the petitioners, all recent genetic analyses support the genetic distinctiveness of coho salmon from Scott, Waddell, and Gazos creeks, and their affinities to other nearby California coho salmon populations. These recent genetic analyses support the California ESU delineations drawn by NOAA Fisheries and adopted by the Department. The available genetics information does not support the petitioners' assertions that coho salmon found today in streams south of San Francisco are not native. Also, because of the wide range of responses of naturally spawning populations to hatchery stocking, stocking records alone cannot be used to conclusively document replacement of the naturally spawning stock by the hatchery stock.

7. CESA covers certain native species that the Commission has designated as candidate, threatened, or endangered. A native species is one that is indigenous to California. CESA's protection extends to covered species wherever they occur in California. In addition, CESA does not discriminate between hatchery and naturally spawning populations. Recent Commission action to list coho salmon north of San Francisco under CESA includes hatchery as well as naturally spawning populations in this region.

8. NOAA Fisheries scientists have also reviewed the information contained in the petition (Pete Adams, NOAA Fisheries, pers. comm.). NOAA Fisheries has recently completed a status review update of the CCC Coho ESU, which includes coho salmon south of San Francisco. They are proposing that the CCC Coho ESU be listed under the federal Endangered Species Act as endangered, rather than threatened as it is currently, and they are not proposing to exclude coho salmon south of San Francisco.

For the reasons cited above, the Department recommends that the Commission reject the petition.

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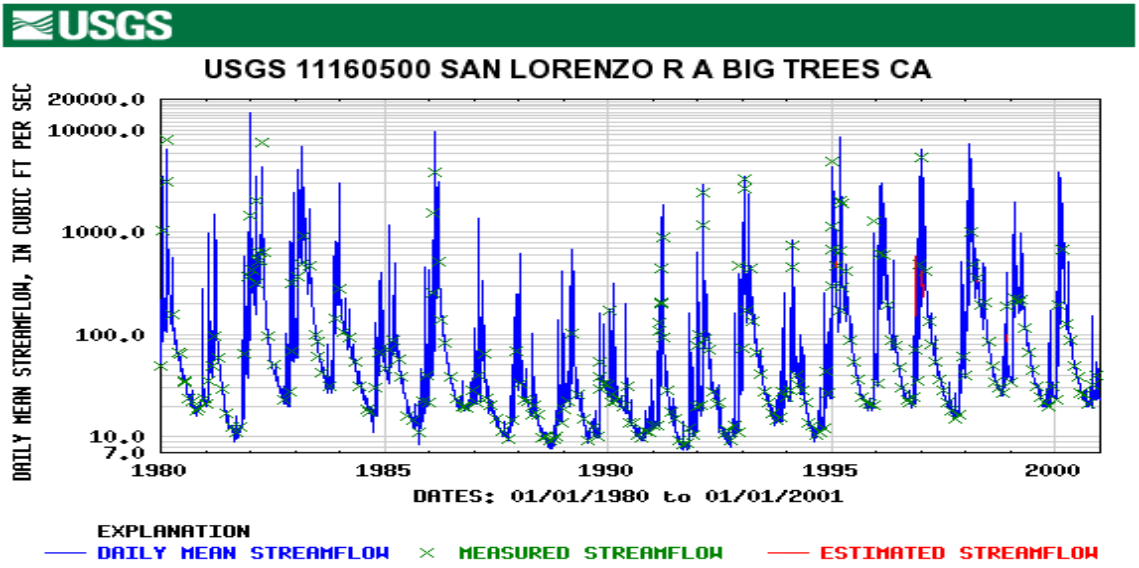
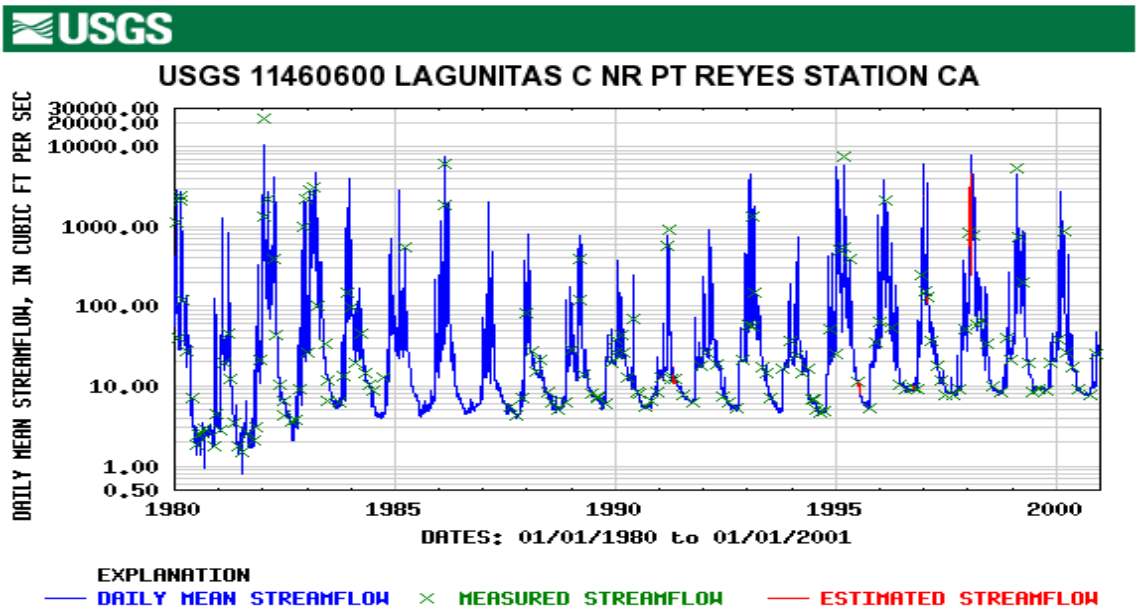
Figure 1. Comparison of hydrographs of the San Lorenzo River (top) and Lagunitas Creek (bottom), 1980 to 2001.



LATITUDE 37°02'40", LONGITUDE 122°04'17" NAD27. DRAINAGE AREA 106 SQUARE MILES (USGS).



LATITUDE 38°04'49", LONGITUDE 122°47'00" NAD27. DRAINAGE AREA 81.7 SQUARE MILES.

Table 1. Summary of number of coho salmon egg take from Scott Creek, CA. Data from Streig 1991. *nd*, no data; *ns*, no coho salmon spawned.

Year	Number of females	Number of green eggs taken
1908	*nd*	
1909	518	1,400,000
1910-1921	*ns*	
1922-1923	*nd*	
1924-1926	*ns*	
1927-1928	*nd*	
1929	111	29,800
1930	50	134,750
1931	*nd*	
1932-1933	*ns*	
1934	46	12,400
1935	*ns*	
1936	24	64,000
1937	55	14,800
1938	36	97,500
1939	77	207,500
1940	*ns*	

Table 2. Total coho salmon artificial production releases in streams South of San Francisco, 1905-06 through 1930-31.

Year	Hatchery	Broodstock Source	Life Stage	Total planted South of SF
1905-06	Brookdale	Baker Lake, WA	Eggs	50,000
1906-07	Brookdale	Baker Lake, WA	Eggs	100,000
1907-08	Brookdale	Baker Lake, WA	Eggs	100,000
1908-09	Brookdale	Baker Lake, WA	Eggs	50,000
		Scott Creek, CA	Fry	600,000
1909-10	Brookdale	Baker Lake, WA	Eggs	200,000
1910-11				0
1911-12				0
1912-13	Brookdale	Scott Creek, CA	Fry	25,000
1913-14				0
1914-15	Brookdale	Scott Creek, CA	Fry	71,000
1915-16				0
1916-17				0
1917-18				0
1918-19				0
1919-20				0
1920-21				0
1921-22				0
1922-23				0
1923-24				0
1924-25				0
1925-26				0
1926-27				0
1927-28				0
1928-29	Brookdale	Scott Creek, CA	Fry	281,200
1929-30	Brookdale/ Big Creek	Scott Creek, CA	Fry	178,075
1930-31				0
Total planted				**1,605,275**

Figure 2. Total number of coho salmon (smolts and fry) produced at Monterey Bay Salmon and Trout Project and released in streams South of San Francisco, 1988-2000. (David Streig, unpublished hatchery records). Trend-line drawn using linear regression.