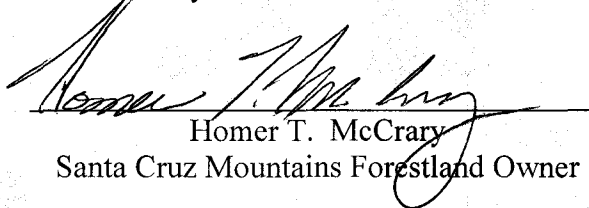


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Response to the NOAA Fisheries, Santa Cruz Laboratory's **Second Review
of the November 6, 2003 Petition from Homer T. McCrary
Concerning Coho Salmon South of San Francisco**

Submitted By


Homer T. McCrary
Santa Cruz Mountains Forestland Owner

May 10, 2005

Introduction

On November 6, 2003 we submitted a petition requesting that NOAA Fisheries redefine the Central California Coho ESU to exclude streams south of San Francisco on the basis that coho in this area are not a native species. The NOAA Fisheries Southwest Regional Office forwarded our petition to the NOAA Fisheries Southwest Fisheries Science Center Santa Cruz Laboratory (SCL) for scientific review. On September 17, 2004 we received a copy of the SCL's review of our petition. We found the review was gravely flawed and as a result we submitted a detailed response to the SCL's flawed review. Subsequently the NOAA Fisheries Southwest Regional Office forwarded our response to the SCL. Six months later the SCL responded with a second review (presumably authored by Peter Adams) that fails to correct their initial scientifically flawed critique and appears to be a reiteration of the same misinformation. Once again we are asking the NOAA Fisheries to please either show us valid and rational justification for the listing of coho salmon south of San Francisco, or immediately redefine the Central California Coho ESU to exclude streams south of San Francisco.

Below is our response to the latest analysis from the SCL. The following discussion rebuts the arguments employed, for the second time, by the SCL.

Review of Individual Arguments

1. What David Starr Jordan and his colleagues may have meant when they repeatedly stated that coho were not *present* south of San Francisco, is wishful speculation. In order to dispel any confusion about Jordan's occasional use of the word "abundant" in a few of these publications, we provided copies of several different excerpts (McCrary 2004, Appendix I), but apparently the SCL missed these. Furthermore, Jordan did more than just give a "general ichthyofaunal reference," as claimed by the SCL. He was personally familiar with and gave detailed accounts of all fishing interests in Santa Cruz and San Mateo counties (Jordan 1887). Jordan's comment that coho salmon are "not common south of the Columbia" (Jordan 1894) was not an error as the SCL suggests, but is obviously accurate relative to the distribution of coho in the Columbia and further north, where coho were and still are significantly more common. It is probably best to take David Starr Jordan's words at face value instead of relying on tortured interpretations. Moreover, the David Starr Jordan archive at Stanford University contains correspondence that corroborates Jordan's published statements. If the SCL is resolved to disregard all the pre-1906 scientific literature, they need only to acknowledge the multiple magazine and newspaper articles presented in our petition that all attest to the absence of coho in Santa Cruz County streams prior to their introduction. Indeed, there is an overwhelming dearth of historical (pre-1906) data in all NOAA Fisheries documents related to this issue.
2. It is true that B. W. Evermann "later" listed Monterey Bay as the southern extent of coho salmon distribution, however this was in 1931, twenty-five years after coho had been introduced to Santa Cruz County. His discussion of the distribution of coho is limited to one sentence and only reflects coho presence at the time. His discussion of introduced species is limited to fish introduced into *California* (Evermann and Clark 1931). As coho are native elsewhere in California, it is unreasonable for the SCL to expect that Evermann would discuss the origin of coho south of San Francisco.

3. Shapovalov and Taft's brief discussion of introduced and native fish is a discussion of fish "besides the steelhead and silver salmon" (Shapovalov and Taft 1954, pg. 26). The origin of the coho and steelhead was obviously unimportant to them as they fail to mention the fact that large numbers of exotic coho were imported from Prairie Creek into Waddell and Scotts Creek immediately before and throughout the course of their study. Shapovalov and Taft's statement, "other native species," is totally ambiguous in spite of whatever the reader's bias might be. Whether they meant "other species that *are* native" or "other species that are *also* native" is a moot point. In other words consider the following statements:
"Mr. Bush was in attendance. Other *foreign* politicians present were Mr. X and Mr. Y." Certainly one should not extrapolate from this that Mr. Bush is a foreign politician.
4. Regarding the documented introduction of coho salmon, the SCL claims that, "One-hundred thousand of these eggs were shipped in 1910, and thus could not have contributed to the populations observed by Gilbert." Since Gilbert did not find coho south of San Francisco until the winter of 1910-11, and the Brookdale Hatchery began importing coho in the winter of 1905-06, this statement by the SCL is misleading. Furthermore, our petition included documented observations confirming the successful introduction, survival, and return of these fish by 1909.
5. We are glad the SCL finally acknowledged the relevance of metapopulation dynamics. It is true that extinction and recolonization of ephemeral populations occurs beyond the southern and northern extremes of the coho range. However the following statement by the SCL suggests a deliberately selective misunderstanding of these metapopulation dynamics: "So, it would be natural that populations at the southern extreme of their range were at some time in the past founded and continually reinforced by straying migrants." We have always maintained it is likely that ephemeral populations were at some time in the past founded south of San Francisco by strays, yet to suggest they were "continually reinforced by straying migrants" is indefensible, particularly as straying was far less frequent than naturally occurring stochastic events which periodically destroyed these fragile, temporary colonies. Further, to suggest (albeit incorrectly) that these ephemeral colonies were continually reinforced by strays is to admit this area is geographically extreme, is not suitable long-term habitat, and can harbor only fragile, temporary colonies dependent on supplementation.¹

¹ "Most biogeographic research is the study of the structure and dynamics of geographic ranges: their sizes, shapes, boundaries, overlaps, and locations ... The entire subject of metapopulation dynamics focuses on the processes and consequences of small-scale colonization and extinction, and these processes undoubtedly occur around the boundaries of many geographic ranges" (Brown et al. 1996). Thus, metapopulations are not static. Barring the presence of a relatively permanent geographic feature, metapopulation range boundaries are constantly shifting due to the natural extinction and colonization of marginal populations. Furthermore, the edges of geographic ranges are set by ecological limiting factors that determine local distribution and abundance. The most relevant and commonsensical feature of geographic ranges is that abundance of individuals tends to be low near the boundaries of the range (Brown et al. 1996). Essentially, populations on the fringes of a range are generally smaller, more susceptible to demographic and environmental stochasticity, and thus more likely to become locally extirpated. According to Godfrey et al. (1965), "on the North American continent, the region of the coho's greatest abundance extends from central Alaska to the State of Washington." Sandercock (1991) noted that coho are found in considerably smaller numbers towards the northern and southern limits of their distribution. "Populations in reaches with poor habitat became extinct during periods of low marine survival. With favorable marine survival, high productivity reaches served as sources for recolonization of lower quality reaches through straying of spawners. Consequently, both population size and distribution expanded and contracted through time" (Nickelson and Lawson 1998).

6. The SCL's new discussion of the climate and geomorphology of the Santa Cruz Mountains illustrates the quality of the entire critique. Apparently the author did not read our previous discussion of this topic (McCrary 2004, pg. 13-17) and does not understand basic hydrologic science. The SCL now avers that higher average rainfall north of San Francisco indicates streams there are more flashy than those south of San Francisco. Higher average rainfall throughout the year generally results in streams that are better-supplied and less susceptible to droughts. All other conditions being similar, the flashiness of a stream is predicated by precipitation extremes, not average precipitation. NOAA's own data show a greater range of precipitation extremes in Santa Cruz County (McCrary 2004, pg. 13-17). By way of illustration, the flashiest streams on record are those of desert climates that experience extreme storm events with very low average precipitation. Nevertheless, the fact that coho naturally do not survive well here is not in doubt nor can the complex subject of stream character be simply reduced to patterns of precipitation. Further, any geographic divisions, such as the EPA Ecoregions, which do not concern coho habitat requirements, are irrelevant.
7. We have already addressed the many credibility issues associated with the 1870 Wakeman report: lack of expertise, contradictions and exaggeration. Ignoring these issues, we can address what was reported from a fisheries perspective. Wakeman obviously reported what local fishermen were telling him. They fished at the mouths of San Gregorio and Pescadero streams at full sea (high tide) and their fishing season was from October to March. They caught a wagonload of fish a day (quite a good fishery if true). Wakeman wrote of two species of fish being caught, "salmon" from 15 to 20 pounds, and "silver salmon" from 2 to 15 pounds. The "salmon" reference was most likely fall Chinook salmon because of the large weight reported which is consistent with Chinook and not coho salmon. Adult coho salmon south of San Francisco generally average about 8 pounds. The fishing season beginning in October is more consistent with Chinook; a coho run would be later. The identification of the second fish reported caught ("silver salmon") is undoubtedly steelhead. Why? Wakeman reported that this fish returned to sea after spawning. Commercial fishermen would recognize a spawned out fish because the fish would be noticeably thinner, probably darker in color, and the flesh would be inferior to a bright incoming fish. And if they used gill nets, the sea-bound adult steelhead would be caught in the upstream side of the net. Steelhead return to the sea after spawning; coho salmon do not. This second fish ranged in size from 2 to 15 pounds. This weight range is consistent with steelhead runs having fishes of varying sizes depending on their time spent maturing in the ocean, here probably up to 3 years. Adult coho salmon can vary in size from year to year but within a year they are fairly consistent in size. Also, the protracted spawning season is more consistent with steelhead. This identification of the 2 species of fish reported by Wakeman is consistent with the distributions of Chinook salmon and steelhead reported in the early scientific literature, south of San Francisco. Coho were not found south of San Francisco according to the early scientific literature. The only possible confusing point is that Wakeman called the second fish "silver salmon." In today's vernacular, this would mean coho salmon. But "silver salmon" was one of the lay common names for steelhead at that time in California.
8. Without careful investigation, the California Academy of Sciences specimens purportedly collected by Stanford ichthyologists in 1895 appear to contradict the archaeological, historical, and scientific record. First, a single sighting of a species does not establish its

natural habitat range, especially since an occasional ephemeral population is to be expected beyond the range boundary. Second, the original identification of these fish as dog salmon appears reasonable since dog salmon occasionally stray in these streams. Third, the obvious reliability problems related to the broken chain of custody and conflicting documentation disqualify these specimens for scientific or legal use. As we have already shown, this deficiency is emphasized by Stanford ichthyologist, J. Bohlke (1953) who concluded that fish specimens collected prior to 1906 were scrambled by the San Francisco earthquake and are not reliable. If one gives these specimens the benefit of all doubts, they could represent a temporary propagule year class colony since the early 1890s were very prolific for salmon, which would have encouraged straying. There were very large commercial salmon landings in California in the early 1890s and apparently 1892 was a record harvest never seen before or since (Redding et al. 1892). A cool climate cycle began around 1890, which would be beneficial to salmon; and a cool productive California Current cycle should also have occurred as its cycles are correlated with inland climate cycles. If the CAS specimens do represent a stray year class colony, they didn't persist. A possible explanation is the 1898-99 drought reported by the California Department of Water Resources (Snow 2004). The early scientific literature and soft literature speak to the absence of coho salmon south of San Francisco at the beginning of the 20th century and coho salmon did not apparently reside in Scott and Waddell Creeks in the early 1900s before the introductory plants in 1906. Coincidentally, these dubious specimens, the Wakeman report, and a personal communication from P. Moyle comprise the entire impetus for Gobalet et al. to doubt their results regarding the archaeological record.

9. The SCL again dismissed all archaeological results that corroborate our conclusions. We have not claimed that the archaeological evidence alone provides definitive proof of anything. However, all studies of the archaeological record south of San Francisco are consistent with the more explicit historical and scientific literature. Given the weight of all other lines of evidence, the archaeological record is not crucial to our petition. Nevertheless, it is a valuable contribution and a much stronger piece of evidence than either the Wakeman report or the 1895 specimens. The archaeological record should not be summarily dismissed.
10. We have not seen the latest genetics data collected by the SCL, but we are aware of these, as-yet-unpublished, studies. The germane point here is that these genetic analysis techniques cannot ascertain whether coho salmon are native south of San Francisco or not. Nevertheless, several misleading statements by the SCL should be noted:
 - First, Adams claims that all Central California Coast ESU populations are “more closely related to each other than to any other coho salmon populations.” To begin with, the majority of coho importations south of San Francisco have been stocks from within California, so one should expect a strong genetic relationship between amongst these fish. Furthermore, to our knowledge, the SCL has not included any coho outside California in their genetic comparisons, so it is still unknown how related our coho are “to any other coho salmon population.”
 - Second, Adams claims “all populations south of the Golden Gate are more closely related to each other than to any others.” Well, there are only two populations south

of San Francisco (about 50 miles south of the Golden Gate), and these are about 5 miles apart. More importantly, these two populations are functionally one single population as one creek has been repeatedly planted with fish from the other creek. Obviously they are most closely related to each other.

- Third, Adams claims “populations from Marin County are their closest relatives.” Well, more precisely, 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. Furthermore, the SCL has not included coho outside of California in these comparisons, in spite of the fact that the first coho introductions south of San Francisco were from Washington. Nor, to our knowledge, has the SCL attempted a genetic analysis of the aforementioned 1895 coho specimens in spite of the fact that we provided the SCL’s lead geneticist with tissue samples of these specimens one year ago.
- Fourth, the effects of “adaptation/drift and distance-dependent migration” over the last 100 years (since the establishment and maintenance of an introduced populations) are not precluded just beyond the edge of their historical range boundary (San Francisco). However, it is absurd to suggest that relatively infrequent, sparsely documented migration from the north has had a greater impact than the 2,020,114+ northern coho that have been brought here artificially. Furthermore, while there is no evidence that naturally-occurring migrants have buffered southern coho against environmental variability, it is a documented fact that artificial hatchery support has been critical in maintaining and augmenting these same coho during times of naturally-occurring, devastating-to-coho floods and droughts.
- Fifth, the following statement by Adams is so astounding we felt the need to quote it:
“While salmon from other populations in the Central California Coast ESU, primarily the Noyo River, have been transplanted into coho populations south of San Francisco Bay, they can not have had a large effect, because there are alleles present at 11 of the 18 microsatellite genes that are not found in the Noyo River. In some cases, alleles in these southern populations do not appear to be present in any other population in the Central California ESU. This result effectively eliminates the possibility that the San Mateo and Santa Cruz county populations were founded by fish planted from the Noyo River or any other California population.”

How incredible for Adams to suggest that because coho south of San Francisco are not genetically identical to Noyo River coho, 370,640 Noyo River transplants to San Mateo and Santa Cruz counties have not had an effect on southern coho genetics. Indeed, it was not us but the SCL that established a genetic affinity between Santa Cruz coho and Noyo River coho. Obviously any alleles in these southern populations that do not appear anywhere else in the Central California ESU are undoubtedly a result of the 1,400,000+ coho from outside Central California to be transplanted here. Above all, nobody has ever stated that “San Mateo and Santa

Cruz county populations were founded by fish planted from the Noyo River or any other California population.” Since the beginning of this pointless banter with the SCL we have made it absolutely clear that coho from Baker Lake, Washington were initially introduced south of San Francisco followed by an array of transplants from a plethora of different places over the last 100 years.

- Sixth, although in some cases out-of-basin transplants do not successfully reproduce, Hindar et al. (1991) demonstrated instances where transplantation efforts permanently altered the genetic structure of fish populations and even some instances where the resident population was entirely displaced. Other studies have found that transplants of different stocks from California, Oregon, and Washington have obscured genetic differentiation amongst California stocks (Bartley et al. 1992; Brown et al. 1994). How exactly the variety of introduced stocks have mingled south of San Francisco is still unknown. Though if we are ever to answer that question we suggest the SCL begin by recognizing these introductions, rather than blindly protecting an untenable paradigm.
- Lastly, it should be obvious to the reader that the SCL’s molecular genetic results do not rule out the reality that coho salmon populations south of San Francisco were founded by and supplemented by an array of introduced stocks from northern California, Oregon, and Washington.

11. It is not surprising that the SCL has suggested a second opinion from Peter Moyle and his colleagues at UC Davis. Our work has already received a peer review by the eminently qualified fisheries biologist, Dr. Victor Kaczynski. While an additional, objective review of our research would be valuable, Peter Moyle cannot provide such objectivity. Although Moyle is a highly respected member of the fisheries community, some of his previous work suggests an obdurate inclination to extend the historical range of coho in California and/or an unfamiliarity with important facts. For instance, the article “Historical Decline and Current Status of Coho Salmon in California,” co-authored by Moyle, is partially based on the assumption that coho salmon south of San Francisco are native and “probably occurred in smaller streams flowing into Monterey Bay and perhaps as far south as the Big Sur River” (Brown et al. 1994). Although Brown, Moyle, and Yoshiyama do not offer any direct references to support this assumption, they cite Snyder (1908) in reference to the claim that “[t]he southernmost recorded spawning stream is the San Lorenzo River, Santa Cruz County” (ibid.). Actually, Snyder (1908) does not concern anything south of the Sacramento River and makes no mention of any fish in the San Lorenzo River or anywhere else south of San Francisco. This error gives the false impression that adult coho were present prior to the return of introduced stocks in 1909. Similarly, in another article, Brown and Moyle (1991) also make the assumption that coho are native south of San Francisco yet do not cite any pertinent information predating the 1930s, long after their artificial introduction. Both Brown et al. (1994) and Brown and Moyle (1991) are frequently cited (especially by the CDFG and NOAA Fisheries) as surrogate evidence that coho are native to streams south of San Francisco. Elsewhere we have seen Moyle use the discredited Wakeman report and 1895 specimens as “proof” that coho are native south of San Francisco (Gobalet et al. 2004). Furthermore, another report by Moyle (2002) erroneously stating that coho salmon once ascended the Klamath River and its tributaries at least as far upstream as

Klamath Falls, Oregon, is yet another indication of Moyle's predisposition, this time resulting from Moyle's imprecise use of zoogeographic boundaries (Hamilton et al. 2005). Clearly, Moyle seeks to extend the historical range of coho salmon regardless of the facts. Indeed, Moyle has contributed to and popularized the mistaken paradigm that coho salmon are native south of San Francisco. There is no doubt his influence has already played a significant role in the SCL's staunch adherence to this indefensible position (McCrary 2004, Appendix V).

Conclusion

It has now been 18 months since we submitted our petition. At every step of the way the SCL has shown a total disregard for their scientific responsibilities, and a disregard for the credibility of NOAA Fisheries and its decision makers. It is especially puzzling that Pete Adams failed to so much as acknowledge our personal letter offering to provide him and his staff with any and all of our reference materials. Let the record show that if NOAA Fisheries adopts the SCL's recommendation to reject our petition, it will be scientifically unjustified. If our conclusions are wrong let an intelligent, informed, and scientifically competent review show it. The redundant, vacuous arguments presented by the SCL do not constitute such a review and continually sidestep the most compelling data in our petition.

We thank you for this opportunity to comment and demonstrate how the record before NOAA Fisheries 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.

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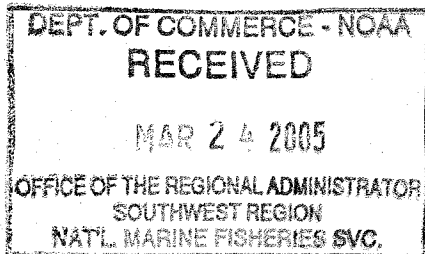


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<input type="checkbox"/> NOTE AND RETURN TO ME	<input type="checkbox"/> PER YOUR REQUEST	
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COMMENTS:

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RJA
SJ
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March 17, 2005

TO: Rodney McInnis, Regional Administrator

FROM: Churchill B. Grimes, Santa Cruz Laboratory Director *CB Grimes*

THROUGH: William Fox, Science Director William Fox, Science Director *W Fox*

SUBJECT: Coho Salmon South of San Francisco

The purpose of this memorandum is to respond to the document entitled "Response to NOAA Fisheries, Santa Cruz Laboratory, review of November 6, 2003 petition concerning coho salmon south of San Francisco" by Fabian Alvarado. This document reiterates the major points made in the original petition to delist coho salmon south of San Francisco. The four major points argued by the petitioners contending that coho salmon are not native south of San Francisco are: 1) that David Starr Jordan wrote that coho salmon were abundant from San Francisco north, 2) that out-of-area coho salmon hatchery plantings were made to San Mateo and Santa Cruz counties, and that these plantings founded the populations found in the area, 3) that archeological studies report finding no coho salmon remains [found] in the area, indicating that coho salmon are not native, and 4) that the "flashy" nature of the local environment, i.e., steep gradients and characteristic brief periods of intense rainfall associated with winter storms, makes the region unsuitable for coho salmon. This response discusses each point below and adds new information on the genetic structure of coho salmon in California that has been recently developed at the NMFS Santa Cruz Laboratory.

The petitioners claim that certain writings of renowned ichthyologist David Starr Jordan "unequivocally attest to the absence of coho salmon south of San Francisco." Jordan wrote in a number of reports (Jordan and Gilbert, 1876-1919; Jordan et al. 1882, Jordan 1892a,b, 1894; Jordan and Evermann 1896, 1902; Jordan 1904a, b; Jordan and Evermann 1905; Jordan 1907, see original petition) that "[coho salmon are] abundant from San Francisco northward, especially in Puget Sound and the Alaskan Fjords" and the petitioners supply the additional Jordan quote "Only the King [chinook] salmon has been noticed south of San Francisco." We disagree with the petitioners claim. Jordan was describing the North American distribution of coho salmon in a general ichthyofaunal reference, and his use of commonly used phraseology in such works that a species is abundant to or from some geographical landmark means just what it says, and does not mean that species are not present in reference to that landmark. B. W. Evermann, one of Jordan's coauthors on these reports, later listed Monterey Bay as the southern extent of coho salmon distribution without suggesting that their presence was the result of hatchery introductions. Jordan also wrote "This species [coho] is not common south of the Columbia, but is sometimes taken in California." (Jordan 1894). Coho salmon were clearly more abundant in Oregon and California than indicated by this statement, further



highlighting the difficulty in relying on these general faunal references for precise species distribution information.

There are other records of coho salmon occurring south of San Francisco prior to any accounts of hatchery plantings; the petitioners claim these records are invalid and should be disregarded. Perhaps the most important are collections made by Cloudsley Rutter in 1895 from San Mateo and Santa Cruz counties that are now held in the California Academy of Science (CAS) Ichthyologic Collection. According to Dave Catania, Senior Collections Manager for the CAS Ichthyological Collection, it is true that when the collections in question were originally entered into the Stanford University ledger, the specimens were identified as chum and chinook salmon instead of coho. However, the specimens were re-identified as coho salmon while in the possession of Stanford University, before the collection was transferred to CAS. When CAS entered the Stanford University Collection in an electronic database in the 1990s, they initially used the original Stanford University ledgers as the source for species identifications, and incorrectly entered the species identifications. The database entries were corrected in 1999 when the original collection jars were examined and the re-identifications were once again discovered. We find no reason to doubt that, in fact, these fish are coho salmon collected from San Mateo and Santa Cruz counties in 1895. Further, we do not agree with the petitioner's claim that "even if they [the collections] were fully verified, the specimens are not evidence of a native population of coho. Ephemeral (temporary) salmon colonies established by strays are not uncommon." Metapopulation dynamics characterized by local extinction and recolonization and reinforcement by straying are typical for coho salmon in California. So, it would be natural that populations at the southern extreme of their range were at some time in the past founded and continually reinforced by straying migrants. These populations are part of the ESU, and would be included in an ESA listing.

Another report rejected by the petitioners is Wakeman's description of two species of salmonids in San Gregorio and Pescadero creeks in 1870. Wakeman identified one of the species as silver salmon, and described differences in run timing that support his conclusion that there were two different salmonid species. He further stated that both species go out to sea after spawning, which for coho salmon would be incorrect, perhaps bringing his report into question.

Perhaps the most important piece of historical literature is Shapovalov and Taft's landmark "Study of the steelhead and the silver salmon in their natural habitat" conducted in Waddell and Scott creeks beginning in 1931. Much admired for its accuracy and thoroughness, and utilized by salmon scientists to this day, this report refers to a list of fish occurring in Waddell and Scott creeks that includes silver salmon. The next sentence begins "Other native species". Furthermore, Shapovalov and Taft report includes a section on exotic species, and they do not mention coho salmon among the exotic species.

The petitioners claim that coho salmon in San Mateo and Santa Cruz counties were introduced through out-of-area hatchery plantings. The only records of out-of-area plantings prior to 1911 were 400,000 eggs transferred from Baker Lake to Brookdale Hatchery and planted in unspecified Santa Cruz County locations between 1905 and 1910. By 1910, coho salmon clearly occurred in San Mateo and Santa Cruz counties (Gilbert U.S. Fish. Bull. 32:1-32, Snyder U.S. Fish. Bull. 32:47-72). One-hundred thousand of these eggs were shipped in 1910, and thus could not have contributed to the populations observed by Gilbert. These (Baker Lake) eggs were almost certainly planted as fry, which was the practice with the planting of Scott Creek coho salmon from 1913 to 1930. This practice is no longer used by hatcheries because of extremely poor survival of plantings at these life stages. Thus, it is likely that few if any of these planted fish

survived, and recent genetic evidence that will be presented later in this memorandum support this point.

The petitioners claim that the absence of coho salmon bones at native American archeological sites in San Mateo and Santa Cruz counties also indicates that coho were not native to the area. The principal researcher in this field (identified by petitioners as the "leading expert" and whose publications they use to justify their position) does not consider the lack of coho salmon bones in the archaeological record in San Mateo and Santa Cruz counties to be evidence of coho absence in the area (Gobalet et al. TAFS 133: 801-833). Gobalet et al. write, "The [salmonid] samples from the eight archaeological sites in San Mateo and Santa Cruz counties (Table 1) and the two sites previously reported by Gobalet and Jones (1995; SMA-139, SCR-123) were limited, did not include sites on Pescadero or San Gregorio creeks, and yielded 1,156 diagnostic elements, of which only five (0.4%) were salmonids (all steelhead). This low occurrence is remarkably consistent with results at 69 coastal sites from Monterey County to Santa Barbara County, in which only 212 steelhead bones (0.2%) were found among the approximately 100,000 elements evaluated (Gobalet and Jones 1995; Gobalet 2000). Because of this paucity of materials, far more sampling is required to use the archaeological record as definitive evidence for the absence of coho salmon from this section of coast. This is particularly important to acknowledge, because there is no question that coho salmon were native to San Mateo and Santa Cruz counties (Behnke 2002; P. B. Moyle, personal communication). Specimens dating from 1895 that were collected by Cloudsley Rutter in streams south of San Francisco are in the collection of the California Academy of Sciences (D. Catania, California Academy of Sciences, personal communication). If coho salmon exist in the archaeological record of the San Mateo County and Santa Cruz County coasts at the same frequency as in the San Francisco Bay area (14 of 105,000 elements), then at least 7,506 elements would have to be recovered before a single coho salmon could be expected. A comparable circumstance was that over 29,000 specimens from Central Valley archaeological sites were identified before a single vertebra of the threatened delta smelt was found."

The claim of the petitioners that the "flashy" nature of the environment, i.e., steep stream gradients and brief periods of intense rainfall associated with winter storms, south of San Francisco makes the area unsuitable for coho salmon. The evidence available does not support this argument. The seasonal distribution of rainfall north and south of San Francisco Bay are very similar, as are average coastal stream gradients (National Climatic Data Center precipitation data). In fact, contrary to the petitioners argument, average rainfall north of San Francisco Bay is somewhat higher than south, giving northern streams a more "flashy" nature than San Mateo and Santa Cruz county streams. Further, the geographic configuration of EPA Ecoregions (<http://www.epa.gov/bioindicators/html/usecoregions.html>), based on climate as well as other factors, group San Mateo and Santa Cruz counties with areas to the north and begin a new Ecoregion immediately to the south.

Perhaps the strongest scientific evidence refuting the petitioners claim is new molecular genetic data assembled by the NMFS SWFSC Santa Cruz Laboratory indicating that coho salmon south of the Golden Gate are not the result of anthropogenic introduction, and are a historic part of the species southernmost ESU. These data are from two studies of genetic variation for 18 microsatellite genes in coho salmon populations from the entire range of the species in California. These two studies include genotypes from >5500 fish, an examination of the genetics of fish from various life stages and brood years, and systematic sampling to remove temporal and age-class variation. The 18 microsatellite genes are highly variable, with a total of almost 500 alleles, and have sufficient information content to detect isolation between populations, and to provide insight into biogeographic patterns at multiple scales.

These genetic studies provide several lines of evidence indicating that coho salmon from south of San Francisco Bay, i.e., fish in Scott, Waddell and Gazos creeks, are not the result of recent introduction or stocking and are native to the area. First, all analyses performed, including matrices of genetic distance, phylogeographic trees, assignment tests and isolation by distances tests, indicate that the Central California Coast Coho Salmon ESU is one genetic lineage with all ESU populations more closely related to each other than to any other coho salmon populations. Moreover, within the ESU all populations south of the Golden Gate are more closely related to each other than to any others, and populations from Marin County are their closest relatives.

More generally, structure within the ESU is one of isolation by distance, with genetic distance highly correlated with geographic distance. This is an equilibrium pattern that exists when populations are structured by adaptation/drift and distance-dependent migration acting together. It is not consistent with the hypotheses that anthropogenic outplanting replaced lineages in the southern part of the range, or that these populations are non-native introductions. It also suggests that populations further to the north are connected by relatively frequent migrants that enhance demographic viability of southern populations, and likely buffer them against environmental variability.

While salmon from other populations in the Central California Coast ESU, primarily the Noyo River, have been transplanted into coho populations south of San Francisco Bay, they can not have had a large effect, because there are alleles present at 11 of the 18 microsatellite genes that are not found in the Noyo River. In some cases, alleles in these southern populations do not appear to be present in any other population in the Central California ESU. This result effectively eliminates the possibility that the San Mateo and Santa Cruz county populations were founded by fish planted from the Noyo River or any other California population. These results are consistent with evidence from another study of coho salmon genetics, by Hedgecock et al. at the University of California's Bodega Marine Laboratory, that out-of-basin transplants do not always successfully reproduce. They found no similarity between coho salmon from the Noyo River transplanted into the Russian River and those breeding there 5 years later.

While these molecular genetic results do not rule out the possibility that coho salmon populations in San Mateo and Santa Cruz counties may have received some small genetic signal from the introduction of foreign stocks, they clearly demonstrate that these populations meet all of the predictions of a native species at the southern edge of their range and should be considered as such.

In summary, the petitioners' claim that coho salmon are not native south of San Francisco and were introduced by hatchery plantings is simply not supported by historical nor recent scientific results. If you believe there is a need for further evaluation and comment on this question, I suggest that you solicit a review by a recognized authority outside of NMFS SWFSC. An obvious choice would be Dr. Peter Moyle at the University of California, Davis, who is the leading expert on native California fishes.