Testimony of V.W. Kaczynski, Ph.D.
Before The California Fish and Game Commission:

February 3, 2005

San Diego, California

Were Coho Salmon South of San Francisco Ever Native, Indigenous?

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INTRODUCTION

In early 2004, I was retained by the California Forestry Association to critically review a paper by H.T. McCrary entitled, Memorandum Concerning RECOVERY STRATEGY FOR CALIFORNIA COHO SALMON (CDFG, 2003) WITH REGARD TO COASTAL STREAMS SOUTH OF SAN FRANCISCO dated December 18, 2003, submitted to the California Fish and Game Commission. My terms of reference were to review the references cited in the document, to determine in my professional judgment if the results stated in the paper were consistent with the information presented in the cited references, and to determine in my professional judgment if the conclusions, arguments and recommendations were supported by the results presented in the paper and/or the cited documents. The McCrary memorandum basically presented a scientific hypothesis that coho salmon (*Oncorhynchus kisutch*) south of San Francisco Bay are not native (indigenous). My review concentrated on determining the veracity of the biological and distribution information presented in the memorandum. In effect, my critical review was a quality assurance review. I did not comment on legal, social, or political issues. I also performed a quantitative straying rate impact analysis and a net replacement rate analysis to help evaluate why these southern populations of coho salmon have not persisted despite periodic heavy hatchery plantings.

Subsequently from time to time as a professional courtesy, I reviewed and commented on additional information brought forward by Mr. Alvarado including the Big Creek Lumber Company's NOAA ESU coho petition, the NOAA response, and the June 17th petition to the Commission to redefine the southern extent of the Central California coho salmon ESU by CCFA and Big Creek Lumber Company. Mr. Alvarado and I have drafted two papers for scientific publication on the status of coho salmon south of San Francisco so that this information could be brought forward to the fisheries profession for critical review.

Most recently I was retained by the Big Creek Lumber Company to review CDFG's Response to the June 17th petition to redefine the southern boundary of coho salmon and Big Creek's and the Central Coast Forest Association's Comments (dated January 26, 2005) to CDFG's response. My background and qualifications are briefly described in Appendix A.

SUMMARY OF FINDINGS, DECEMBER 2003 PETITION

Based on my review, I could not find any scientific basis to reject the 2003 McCrary findings and conclusion that coho salmon south of San Francisco Bay were not native fish. The best available scientific information (his references plus some additional ones) supported his findings.

The archeological references cited in McCrary for the absence of coho salmon bones in Native American refuse middens south of San Francisco presented prehistoric evidence that coho salmon were not indigenous to the south. In contrast, steelhead bones were found north and south of San Francisco and coho bones were found to the north in middens. This evidence supported a scientific hypothesis that coho salmon were prehistorically not present and therefore not indigenous to the south.

The earliest (late 1800s to turn-of-the-century) literature references to coho salmon presence and absence clearly list them as not occurring south of San Francisco. This information independently supported the hypothesis that coho salmon were not native south of San Francisco.

The best available scientific information reveals that coho salmon found south of San Francisco Bay apparently were the result of hatchery-stock plants beginning in 1906 (in cooperation with the United States Bureau of Fisheries) and continuing to recent times. The very early occurrence references and early stocking references were apparently missed by subsequent authors. This supported the absence hypothesis.

Historic newspaper and sporting journal articles support the hypothesis that coho salmon were not native to Santa Cruz County prior to the coho hatchery planting s begun in 1906. These articles stated that the planting s were a deliberate effort by the County in cooperation with the U.S. Fish Commission to establish coho as a new species in the area. This complimented the absence hypothesis.

Subsequent occurrence references in the literature for streams south of San Francisco were based on observations of adult coho salmon returning from these original stockings, mistakes (occurrences in other waters or of other species), false assumptions, and then daisy-chain references to these observations and later observations of occurrence. This was a sensitive finding as the traditional literature had been used to create the common false impression that coho salmon were native south of San Francisco. This finding supported the hypothesis that coho salmon were not native south of San Francisco.

McCrary's descriptions of harsh environmental conditions were substantiated in the references and suggested why coho salmon had not established permanent populations south of San Francisco, very harsh environmental resistance factors coupled to the life history of coho salmon. This independently supported the absence hypothesis.

A review of the available directly relevant genetic information also supported the absence hypothesis. There is a long history of non-native coho salmon hatchery plants into Santa Cruz County streams. Bryant (1994) concluded from genetic allozyme analysis, life history characteristics, and behavior that the Waddell and Scott Creek coho salmon populations were not distinct from coho salmon populations from the north. Anderson (1995) concluded that gene flow among California coho populations (including Waddell and Scott Creek) was high. It had to be considering the multiple stock plants that occurred over the decades. Brown et al. (1994) concluded that plants from Oregon and

Washington caused the swamping and homogenization of native California gene pools. They quoted "For example, Bartley et al. (1992) noted that, of the two southernmost runs of coho salmon, Waddell Creek fish had the highest level of heterozygosity for any California coho salmon population, presumably as the result of interbreeding with imported stocks." High heterozygosity within a population means that it has had much gene exchange with other populations, high genetic diversity, which is just opposite of what one would expect if the population was isolated.

The MBSTP/CDFG hatchery program has been ongoing and the effect of stray rates from the program on genetics needed to be considered. The following stray effect analysis used a stray rate of 20% (roughly half of the 15 and 27% stray rates found by Shapovalov and Taft 1954 and easy to calculate; probably low) and coho salmon outplants from the MBSTP/CDFG hatchery into the San Lorenzo River or Scott Creek (Streig 1993 as reported by Bryant 1994). A 3 percent marine survival estimate was used which was reasonable for the time period (Kaczynski 1998):

Year	Stock Used	Released Juveniles	Returning Adults	Adult Strays
1984	Russian River	17,160	515	103
1986	Unknown	15,860	476	95
1988	Noyo River	20,822	625	125
1988	Scott Creek	6,000	180	36
1988	Scott Creek	2,450 (a)	73	20 (b)
1989	Noyo River	25,362	761	152
1989	Scott Creek	2,756 (a)	83	22 (b)
1990	Prairie Creek	34,500	1,035	207
1990	Scott Creek	6,550 (a)	196	53 (b)
1991	San Lorenzo	19,800	594	119
1991	Scott Creek	5,040	151	30
1991	Scott Creek	5,460 (a)	164	44 (b)
1992	San Lorenzo	1,872	56	11
1993	San Lorenzo	11,800	354	71
1993	Scott Creek	1,860 (a)	56	15 (b)

(a) Released into Scott Creek.
(b) Strayed into Waddell Creek at a 27% stray rate per Shapovalov and Taft (1954).

The analysis showed that adult coho returns into Scott and Waddell Creeks have probably been significantly supplemented by strays from the MBSTP/CDFG program. The results indicated that the genetic straying effect was significant. Because the MBSTP/CDFG hatchery outplant program is ongoing, the significant genetic straying effect is ongoing. This supported the absence hypothesis.

Undoubtedly stray coho salmon from coastal streams north of San Francisco from time to time over the last few thousand years entered central California streams and possibly

spawned. Why didn't they persist? McCrary's memorandum addressed the harsh environmental freshwater conditions but the discussion could be expanded. Shapovalov and Taft (1954) described the distinct three year life cycle of coastal coho salmon in Waddell Creek and the resultant three distinct year classes. This situation can result in the loss of year classes when environmental conditions are severe and can eventually lead to the loss of local coho populations. Smith (1992 to 2002) described this situation for Scott and Waddell Creek coho salmon in the last several years. The implication is that such losses may well have occurred in the past. I applied a net replacement rate (Birch 1948) analysis to help evaluate how harsh conditions could affect local coho stray propagules.

Given the harsh freshwater conditions found in Waddell and Scott Creeks, 0.5 to 2% freshwater survival from egg to smolt are not unreasonable per the conditions described by Smith (1992 to 2002) and is at the lowest end of freshwater survivals reported in Sandercock (1991). Shapovalov and Taft (1954) gave a formula to calculate the expected coho eggs per females at various sizes. Using an observed average length of 63.8 centimeters in Waddell Creek, the average eggs per female would be 2,336 and this is consistent with the trend in egg numbers described by Sandercock (ibid). Using 1,168 female eggs per female 2 %, 1%, and 0.05% freshwater survival would require at least 4.3%, 8.6% and 17.1% marine survival respectively for year class persistence (a one-to-one net replacement rate). The median coho salmon marine survival estimate for the cool productive 1965 to 1975 time period in the California Current was 6.7%. The range was 3.7% to 9.1% (Kaczynski 1998). These data indicate that during a cool, productive California Current cycle, occasional, stray coho salmon propagules would have a net replacement rate of less than one (declining) in 3 of 11, 8 of the 11, and 11 of 11 years in this period at 2%, 1%, and 0.5% freshwater survival respectively. And these data also help explain the progressive depletion of coho year classes observed by Shapovalov and Taft (1954) during their study following heavy hatchery plants in the years immediately before their study. The low freshwater survival rates caused by harsh freshwater conditions could not be overcome by high enough marine survival rates. So the Waddell Creek coho salmon populations went steadily downwards and the same would happen to any stray local propagule year class. Local long term population persistence would be problematic to very unlikely during good, cool California Current conditions.

The combination of periodic, decade-scale linked warm and dry inland climate and droughts, warm unproductive California Current conditions, plus the hydrologic and climatic tendency to have seasonal floods, would give double to triple stress to any occasional coho stray year class (temporarily) occupying a local stream. Under such stressful conditions, persistence would be nearly impossible. Using 1,168 female eggs per female, a 1.2% marine survival rate (the average in the warm unproductive 1991 to 1997 California Current cycle) coupled to a 1% freshwater survival rate would result in a net replacement rate of 0.14 (declining by about 86% per year class cycle). A 1.2% marine survival rate coupled with a 0.5% freshwater survival rate would result in a net replacement rate of 0.029 (declining by about 93% per year class cycle). Natural extinction would occur in these situations fairly quickly as a replacement rate of 1 is necessary for persistence.

The best scientific information supported the conclusion that the climatic and geological conditions south of San Francisco did not favor the existence of a viable indigenous coho population. Natural environmental resistances were so harsh that occasional, small, localized, single year class propagules (strays) of coho salmon were lost. They could not naturally persist for long. Hatchery derived populations (from plants since 1906) have essentially suffered the same fate. These observations complimented the hypothesis that coho salmon were not native (indigenous) south of San Francisco.

SUBSEQUENT INFORMATION

After reviewing and commenting on the McCrary 2003 memorandum to the Commission, two items of evidence came forward that could be used to possibly reject the absence hypothesis: 1) preserved juvenile coho salmon specimens found in the California Academy of Science collection (the CAS specimens), and 2) the Wakeman Report (cited in Skinner 1962 and found in Redding, Throckmorton and Farwell 1872).

THE CAS SPECIMENS: In my professional opinion, the CAS specimens have a serious reliability problem as described in the Big Creek Lumber Co. and CCFA's January 26 2005 Comments (pages 17-19). If one gives these specimens the benefit of all doubts, they could represent a temporary propagule year class colony. Apparently there were very large commercial coho salmon landings in California in the early 1890 decade. 1892 apparently was a record harvest never seen before or since. A cool climate cycle began about 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 – 1899 drought reported by Water Resources (2003). The early scientific literature and soft literature speak to the absence (not found) 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 1900 decade before the introductory plants in 1906.

THE WAKEMAN REPORT: The January 26 2005 Comments by CCFA and Big Creek speak to possible credibility issues: expertise, contradiction 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 Gregoria and Pescadero streams at full sea (high tide) and that their fishing season was from October to March. They caught a wagonload of fish a day (quite a good fishery if true). He wrote of two species of fish being caught, "salmon" from 15 to 20 pounds, and "silver salmon" from 2 to 15 pounds. This appears reasonable.

The "salmon" reference was most likely fall chinook salmon. I doubt this was coho salmon because of the large weight reported which is consistent with chinook and not coho salmon. The fishing season beginning in October is more consistent with chinook; a coho run would be later (early to mid winter at least to the north).

The identification of the second fish reported caught ("silver salmon") is even more probable, steelhead. Why? He 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 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 because the adults have spent 18 months at sea, part of their fixed 3 year life cycle. And the protracted spawning season is more consistent with steelhead, especially extending into March. Coho salmon are an early to mid winter spawner.

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 literature. This is slightly circular but complimentary reasoning.

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 common names for steelhead at that time in California. If someone wants to hang their hat on this chancy bit of evidence (the use of the term "silver salmon") that coho salmon were historically native south of San Francisco, then he or she will have a hard time trying to explain the biological contradictions linked to the limited details of the Wakeman report.

THE CCFA and BIG CREEK LUMBER COMPANY JUNE 17TH PETITION

This document expanded on the December 2003 petition. In particular it provided more information on the reasons why coho salmon could not naturally persist south of San Francisco. The importance of climate, geology, stochastic events, and ocean conditions were more fully developed. I was particularly impressed with the discussions on the importance of droughts, both prehistoric and historic.

The main points made were:
1. There is a lack of archaeological evidence of prehistoric occurrence south of San Francisco.
2. Natural environmental conditions (geology, climate, stochastic events) created harsh environmental resistances that caused very low freshwater survivals. These low freshwater survivals could not be overcome by marine survivals. This explains why stray coho year classes could not persist and why populations established by hatchery stockings have not persisted. These natural conditions will eventually prevent any persistence of coho salmon in the future.

3. The early scientific and soft literature described coho salmon as not being found south of San Francisco and not in Santa Cruz County streams. Early historic literature appears to help confirm this.
4. Stocking of hatchery coho salmon began in 1906 (and perhaps earlier).
5. Hatchery stockings continued for a century and were heavy at times. These stockings were responsible for maintaining periodic coho salmon populations which apparently significantly declined without additional stockings.
6. Non-native coho stocks were used.
7. There is no distinctiveness, genetic, life history or otherwise, for the residual (hatchery derived) populations in Santa Cruz County streams.
8. The report documented that there have been two serious general false impressions: a) that coho salmon present south of San Francisco have been native fish, and b) that human degradation of Scott and Waddell Creeks was responsible for the virtual extirpation of coho salmon that has occurred.

In my professional judgment, this petition represents the best scientific information available regarding the status of coho salmon south of San Francisco and the natural southern edge of the range of coho salmon, 38 degrees north latitude - San Francisco. I agree with their conclusion that the only way coho salmon can persist in area streams is by significant hatchery supplementation (unless there is a century-scale cool climate shift). If supplementation is desired, at times this stocking will have to occur annually and will have to use out of area brood stock.

CDFG's 2004 RESPONSE and the CCFA and BIG CREEK LUMBER COMPANY'S 2005 RESPONSE

I was disappointed by CDFG's Response (December 2004) to the June 17th petition to redefine the southern boundary of the Central California Coho Salmon ESU. It essentially was a copy of the NOAA response and showed few original points. I have gone over all the points made in CCFA and Big Creek Lumber Company's January 26th comments and responses to CDFG's December 2004 report. In my professional opinion, the January 26 2005 comments and responses are scientifically valid. They represent the best available scientific information and help demonstrate the validity of the June 17th petition.

Respectfully Submitted,

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V.W. KACZYNSKI, Ph.D.
Senior Fisheries Scientist

EDUCATION

M.S. and Ph.D. from Cornell University (limnology)
B.S. from SUNY College at Buffalo (biology)

EXPERIENCE

In 1989, Dr. Kaczynski formed his own firm to evaluate and help solve fisheries and water quality problems. Prior to this, Dr. Kaczynski was firm-wide Director of Environmental Sciences for CH2M-Hill and President of Beak Consultants Inc. He has expertise in the interpretation of climate and ocean effects on salmon population dynamics, salmon habitat requirements, water quality, and the design of scientific studies in problem applications. He has 36 years of experience in the Pacific Northwest beginning with his research on the early marine life history of coho, pink and chum salmon while an Assistant Professor at the University of Washington.

His current work is with midcoast California coho salmon and why they have not persisted despite heavy stockings over the last century. Dr. Kaczynski was the project manager of instream and riparian habitat survey projects for the Oregon Forest Industries Council. Over 4,000 miles of habitats were quantitatively evaluated in cooperation with the Oregon Department of Fish and Wildlife. Hundreds of industry-sponsored watershed and stream enhancement projects have been completed or are underway as part of this program. He helped Simpson Timber Company in starting up a similar project for 400 stream miles in southwest Washington State. He consults with several timber companies on practices to protect and enhance salmon habitats in California, Oregon, Washington, Idaho and Alaska. Dr. Kaczynski assisted the Washington Forest Protection Association in reviewing the technical veracity of the stream protection rules in the recent (1999) “Forest and Fish” agreement, and similarly assisted OFIC in reviewing the Oregon Department of Forestry’s 1994 stream protection rules. He recently served on the Alaska Department of Natural Resources technical committee that evaluated the Alaska Forest Practices Act and Regulations in terms of adequacy to protect salmon habitat. He was an expert witness for the California Forestry Association in the lawsuit brought against the State of California charging that the state forest practice rules were inadequate to protect threatened and endangered salmon.

Dr. Kaczynski was the salmon impact task leader for Exxon Oil Company evaluating the impacts of the Valdez oil spill in Prince William Sound. He developed and supervised extensive field and laboratory studies. For Shell Oil Company he evaluated possible impacts of disposing of drilling fluids in Kachemak Bay, Alaska and potentially in the Gulf of

Alaska. For Phillips Petroleum Company, he evaluated disposal of produced water in the outer Santa Barbara Channel. He also evaluated the treatment and disposal of spent drilling fluids and additives in the Canadian Arctic and Beaufort Sea (for Pan Arctic Oil and Imperial Oil). Dr. Kaczynski was the project manager of a research study evaluating the use of spent geothermal fluids for creating waterfowl wetlands in western states (for the United States Fish and Wildlife Service) and for actually creating such a wetland in Nevada (Munson Geothermal).

He was the project manager and senior author of the Klamath Basin Fisheries Resource Plan for the US Department of Interior (BIA). This was a large project that evaluated causes for salmon declines in the California Trinity and Klamath Rivers, agency coordination, and development of a 20 year action plan which became Federal law with funding. He was the senior author of a similar study and report which evaluated salmon problems in Oregon and the junior author for similar study and report in Washington. Dr. Kaczynski has reviewed and formally commented on all endangered salmon species listing and critical habitat proposals by the NMFS (for the Northwest Forestry Association).

Dr. Kaczynski is presently a consultant to the Westland Irrigation District in eastern Oregon and was a senior consultant to several Yakima River valley irrigation districts. He conducted a historical review of salmon use in the Yakima Basin and land and water development. Water quality and flow constraints were identified and the abundance and distribution of spring chinook salmon were determined. For the Bureau of Reclamation (under U.S. District Court Order, after expert witness testimony offering an alternative for spilling stored irrigation water to protect chinook salmon spawning redds - nests), he conducted winter flow redd surveys and designed and implemented low angled berms to maintain water flow through the redds previously threatened by reduced river flows for irrigation storage. For the Sunnyside Irrigation District, he recommended fish ladder modification on the Yakima River at their diversion dam which subsequently aided fish passage and solved an agency problem. For the Glen Colusa Irrigation District, he studied Sacramento River flow, secondary channel flows, juvenile salmon downstream migration patterns, and fish screen and fish bypass problems at a very large irrigation diversion structure. He made recommendations for river elevation changes, side channel changes, and screen house and fish bypass exit locations to enhance juvenile salmon survival past the diversion intake. He was also a consultant to the Owyhee Cattlemen's Association.

Dr. Kaczynski has considerable fish bioengineering experience including the conceptual design and/or final engineering design review of the McCall, Sawtooth, and Cabinet Gorge salmon hatcheries and related capture and release facilities in Idaho; the Tulalip, Rocky Reach Annex, Turtle Rock Island, and Priest Rapid salmon hatcheries in Washington; and the Springfield and Coos Bay salmon hatcheries in Oregon. He was responsible for the conceptual design of the right bank fish ladder and fish counting station modifications and

the fish bypass system at the new hydroelectric unit in the right bank fish ladder attraction flow at The Dalles Dam, Columbia River. He evaluated fish screens and river currents at a pulp mill in Longview, Washington and was the senior fisheries scientist on the Electric Power Research Institute project which evaluated downstream juvenile migrant fish protection technologies for hydroelectric projects.

He was the project manager of environmental baseline studies for the Boardman coal-fired and Pebble Springs nuclear power plants along the Columbia River and for intake water siting locations. He supervised the Trojan nuclear power plant baseline preoperational environmental studies and developed the long term monitoring program. He was a senior fisheries scientist for fisheries tasks for siting a hog-fueled power plant in the upper Columbia River and for aluminum plants in western and central Oregon and in South Carolina.

He was the firmwide Director of Environmental Sciences for CH2M-Hill, President of Beak Consultants Inc. (U.S. operations), Vice President of Beak Consultants Ltd. (western Canada), and Environmental Technical Director for Texas Instruments.

PROFESSIONAL ORGANIZATIONS

American Fisheries Society, Certified Fisheries Scientist Emeritus
American Society of Limnology and Oceanography
New York Academy of Sciences
Sigma Xi

PROFESSIONAL AND COMMUNITY SERVICE

Past president of the Bioengineering Section and Portland Chapter of the American Fisheries Society; member environmental concerns, membership, and resolution committees. Financial chairman of the AFS Bioengineering symposium (Portland, Oregon 1988). Co-chair of the 10th International Stream Habitat Improvement Workshop (Corvallis, Oregon 1996). Past advisor to the College of Forestry and to the Department of Fish and Wildlife at Oregon State University. Advisor to the environmental technician program at Mount Hood Community College. Technical advisor to Oregon Department of Environmental Quality's Tualatin Basin 303-d water quality assessment. Past president and past trustee of the Portland Community College Foundation. Advisor to several local watershed councils.

PUBLICATIONS

He has published on the effects of climate and ocean conditions on salmon survival and population dynamics, early marine life history of pink and chum salmon, stream habitat

surveys and their use in designing stream enhancements, catastrophic wildfires in the Columbia Basin and their impacts on salmon, alternative strategies for mid-Columbia River salmon production, salmon hatchery design, parasite effects on bluefish, population ecology of freshwater shrimp, siting of large industrial plants, effects of secondary treated pulp mill effluent on Wisconsin River fish, utilization of spent geothermal fluids to create waterfowl wetlands, use of wetlands to polish treated industrial wastewater, environmental standards for the Mexican pulp and paper industry, and ethics in fisheries biology.

EXPERT WITNESS TESTIMONY

Dr. Kaczynski has been accepted as an expert witness and has testified in the following areas in over 30 cases: salmon stream and riparian habitat, salmon fisheries, salmon marine survival, sediment and water quality, toxicology, aquatic and marine ecology.