Historic and Recent Occurrence of Coho Salmon (*Oncorhynchus kisutch*) in California Streams within the Southern Oregon/ Northern California Evolutionarily Significant Unit

Justin Garwood[1]
California Department of Fish and Game

Fisheries Branch Administrative Report, 2012-03

August 2012

1 Northern Region Anadromous Fisheries Resource and Monitoring Program, 5341 Ericson Way, Arcata, Ca 95518

NOTE TO READERS

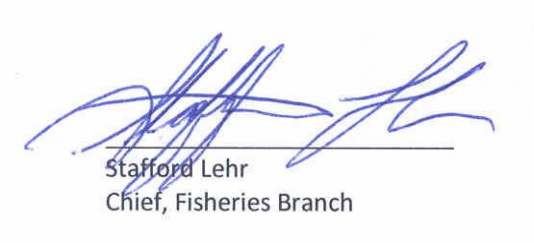
Historic and Recent Occurrence of Coho Salmon (Oncorhynchus kisutch) in California Streams within the Southern Oregon/ Northern California Evolutionarily Significant Unit is seminal review of distribution of juvenile coho salmon within the range of the Southern Oregon/ Northern California Coastal (SONCC) Evolutionarily Significant Unit (ESU) and summarizes comprehensive field surveys conducted from 2001-2003. Bill Jong (retired), Larry Preston (retired), and Michelle Gilroy of the California Department of Fish and Game (DFG) are responsible for the framework, design, data collection and data validation for this study. DFG's Fisheries Restoration Grants Program provided considerable financial support for the project from 2002-2005. This document contains a summary of previous coho salmon distribution, an updated coho salmon stream list, contemporary coho salmon survey results, and maps and descriptions of coho salmon streams by population or basin.

Coho salmon populations occurring within SONCC ESU have declined substantially leading to protections under federal and state endangered species acts (ESA). Both listings have initiated the development of state and federal recovery plans and a monitoring framework to measure population trends and recovery progress. The State Strategy for recovery of coho salmon was finalized by DFG and approved by the Fish and Game Commission in 2004. Empirical data describing historic coho salmon stream occupancy remains vital for ESA protections, designing monitoring programs, and recovery efforts across the SONCC ESU. This study provides an independent synthesis of available fisheries data through 2004, resulting in a list of 542 historic coho salmon streams in the California portion of the SONCC ESU. The list of streams includes 325 verified coho salmon streams from a previously published distribution list (Brown and Moyle 1991) and 217 additional streams identified through this study.

Based on the verification methods used, results from this study represent a 40% increase in the number of documented historic coho salmon streams. In addition to the data and literature review, a standardized field observation study was conducted from 2001 to 2003 across the California portion of the SONCC ESU to establish a contemporary distribution for a subset of historic coho salmon streams. A total of 628 surveys were completed in 301 historic coho salmon streams resulting in a minimum observed occupancy rate of 62% for the three years combined. Annual minimum occupancy rates ranged from 31 to 62%. These results have implications for the interpretation of previously published distribution lists and where future monitoring and recovery goals are implemented. For example, the design of effective spatial structure and diversity monitoring programs for coho salmon requires a broad understanding of historic spatial structure at both local scale and across the SONCC ESU.

As with all of its products, DFG and Fisheries Branch are very interested in ascertaining the utility of this document, particularly in regard to its application to monitoring and assessing coho salmon presence and informing restoration and recovery actions.

Therefore, we encourage you to provide us with your comments. Comments should be directed to Justin Garwood, Northern Region, Anadromous Fisheries Resource and Monitoring Program, 5341 Ericson Way, Arcata, Ca 95518, (707) 825-4723, jgarwood@dfg.ca.gov.



Stafford Lehr
Chief, Fisheries Branch

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INTRODUCTION

SONCC ESU Coho Salmon Status and Viability Assessment

California represents the southern extent of coho salmon (*Oncorhynchus kisutch*) distribution in North America. Two coho salmon Evolutionarily Significant Units (ESU's) defined by the National Oceanic and Atmospheric Administration (NOAA) occur in the northwest portion of California. Coho salmon populations occurring within The Southern Oregon/ Northern California Coastal (SONCC) ESU (Figure 1) have declined substantially leading to protections under the federal (ESA) and California (CESA) Endangered Species Acts (Federal Register 1997, CDFG 2002). Both listings have initiated the development of recovery plans defining delisting goals (CDFG 2004, NOAA *in progress*), determination of the population structure within the ESU (Williams et al. 2006), and defining a population monitoring framework to measure population trends and recovery progress (Williams et al. 2008, Adams et al. 2011).

NOAA established four viable salmon population (VSP) parameters to determine a population's risk of extinction. These parameters include: abundance, productivity (population growth rate), spatial structure, and diversity in life history (McElhany et al. 2000). Trend monitoring for these VSP parameters is the tool used to minimize uncertainties around extinction risk and recovery status of the SONCC ESU as a whole. Two additional spatially explicit criteria needed to assess ESU viability include: 1) population representation, and 2) redundancy and connectivity of populations (Williams et al. 2008). These criteria help define the spatial arrangement and total number of populations needed for ESU-level monitoring. Therefore, to determine recovery for the SONCC ESU, numerous long-term population monitoring programs addressing coho salmon productivity and life history attributes need to be established across the ESU. Intensive coho salmon population abundance and productivity monitoring will be collected in a select number of sustaining independent populations throughout the ESU (Adams et al. 2011). However, extensive monitoring for both spatial structure and diversity traits of coho salmon will be assessed more broadly at both the population and ESU levels (Adams et al. 2011).

Spatial Structure and Diversity in Life Histories

In order to assess spatial structure and diversity traits, monitoring programs must conduct widespread spatially explicit sampling across the known historic distribution of coho salmon in the SONCC ESU (Adams et al. 2011). In the absence of robust empirical data on historic coho salmon distribution, predictive models have been developed to quantify potential coho salmon habitat (i.e. intrinsic habitat potential) based on physical landscape attributes (Burnett et al. 2003, Agrawal et al. 2005). These models are useful tools for defining historic population sizes, recovery thresholds, and potential habitat quality. However, available empirical presence data complements these modeling procedures by defining known historic coho salmon stream use. Furthermore, available data describing coho salmon distribution provides the means to interpret, evaluate, and refine predictive

Figure 1. Map of the National Marine Fisheries Service Southern Oregon/Northern California Coast coho salmon Evolutionarily Significant Unit.

model results at local scales. For example, Spence et al. (2005) used historic coho salmon distribution data in the Central California Coast coho salmon ESU to evaluate individual intrinsic potential model parameters.

This study attempts to provide a synthesis of all known empirical data on historic coho salmon distribution necessary to design effective spatial structure and diversity monitoring programs. Furthermore, information on historic coho salmon distribution will allow managers and recovery efforts access to baseline coho salmon distribution information from the entire historic record.

Previous SONCC ESU Coho Salmon Distribution Literature

Previous lists defining coho salmon presence and distribution in individual streams within the SONCC ESU have been developed for various management and ESA listing purposes (Table 1). Early DFG lists generated by Boberg and Kenyon (1979a, b, c, d), Cherr and Griffin (1979), and Mills (1983) were used to define salmonid species assemblages in individual streams for resource managers. Some results were based on empirical data from DFG stream files. However, many results were based on professional judgment from biologists estimating the occurrence and potential distribution of several salmonid species in individual streams. Thus, first-hand evidence supporting historical coho salmon distribution in individual streams from these species assemblage lists cannot be substantiated without actually reviewing original evidence.

The first effort to catalog coho salmon distribution in all California streams was by Hassler et al. (1988) and further refined by Hassler et al. (1991). The authors acknowledged the observed decline of coho salmon in California and their two reports were developed so managers could focus stream restoration efforts in known coho salmon streams (Hassler et al. 1991). Supporting evidence for over 70% of the SONCC ESU coho salmon streams listed in the Hassler et al. (1988, 1991) came exclusively from the authors citing earlier lists generated by Boberg and Kenyon (1979) and Cherr and Griffin (1979). During the same period, researchers at University of California Davis generated a list of 396 historic coho salmon streams throughout the California portion of the SONCC ESU to quantify observed declines in coho salmon distribution in California (Brown and Moyle 1991). The historic coho salmon stream list in Brown and Moyle (1991) was based on literature review, personal communications, and available data, specifically on wild produced coho salmon. Brown and Moyle (1991) cited Hassler et al. (1988) and Mills (1983) as supporting documentation for 227 (57%) and 47 (12%) coho salmon streams, respectively (see Table 1 in Brown and Moyle 1991).

Subsequent coho salmon stream lists generated by Brownell et al. (1999) and NMFS (2001) added new streams to the original 396 identified in Brown and Moyle. Additions were based largely on recent data (e.g. Ellis 1997) and directed field efforts by Brownell et al. (1999). The most recent list of historic coho salmon streams for the SONCC ESU was produced by NMFS (2001) and includes 599 individual streams. This list was part of a status review update and used all previous sources outlined in this section and in Table 1.

Table 1. Summary of coho salmon stream distribution lists within the SONCC ESU developed by various sources.

Source	Institution	Study Description	California SONCC ESU Coverage	# Coho Streams Listed
Boberg and Kenyon (1979a, b, c, d) Cherr and Griffin 1979	California Department of Fish and Game	County-level stream inventory reports produced by DFG (California Department of Fish and Game) biologists in 1979. Fish distributions are based on DFG stream files, and the best judgment of habitat suitability for each salmonid species. Since these criteria cannot be separated, results are largely subject to lacking conclusive evidence.	Complete	306
Mills 1983	California Department of Fish and Game	Review of utilization of Eel River tributary streams by anadromous salmonids. Prepared for status report of California wild and scenic rivers salmon and steelhead fisheries. Reports on stream miles available to each salmonid by individual stream. Information is derived from regional DFG office stream files and best judgment. No data review methods are provided and the data are subject to the author's interpretation.	Incomplete	69
Hassler et al. 1988, Hassler et al. 1991	Humboldt State University, prepared for California Department of Fish and Game	State-wide lists of streams having evidence supporting coho salmon presence. Uses personal communications, raw data, reports, publications, and field surveys. Largely cites DFG stream inventory reports produced by Boberg and Kenyon (1979) and Cherr and Griffin (1979) to produce coho salmon stream lists.	Complete	366
Brown and Moyle 1991	University of California Davis, prepared for NOAA	Updated state-wide list of streams having evidence supporting coho salmon presence. Used raw data, stream survey reports, personal communications and literature. Largely cites Mills (1983) and Hassler et al. (1988) to produce coho stream list.	Complete	396
Ellis 1997	California Forestry Association and California Forest Resources Council, submitted to NOAA	Provides a partial list of streams containing coho salmon derived from field data collected from 1988 to 1997. Information was used as supporting evidence to comments provided to NOAA regarding the ESA listing proposal on behalf of the California timber industry.	Incomplete	159
Brownell et al. 1999	Kier and Associates, prepared for NOAA	Updated Coho salmon stream list for the California portion of the SONCC ESU. Used raw data, stream survey reports, and literature. Largely cites Boberg and Kenyon (1979), Brown and Moyle (1991), Ellis (1997), Mills (1983), and Hassler et al. (1988) to produce coho stream list. In addition, used recent literature, raw data, and conducted snorkel surveys in a subset of streams to define coho presence. Added 123 new streams to the Brown and Moyle (1991) list.	Complete	511
NMFS 2001	NOAA, Southwest Fisheries Science Center	Updated coho salmon stream list for the California portion of the SONCC ESU. Compilation of all preceding literature review and coho salmon distribution studies. Largely cites previous stream inventory reports, produced by Boberg and Kenyon (1979), Cherr and Griffin (1979), Hassler et al. (1991), Ellis (1997), Mills (1980) and Brownell et al. (1999).	Complete	599
This Study (Garwood 2012)	California Department of Fish and Game	Review of original documentation supporting coho salmon distribution using a protocol with defined evidence standards coupled with an intensive field study in streams within the California portion of the SONCC ESU. Study does not cite previously published coho salmon distribution lists. However, original data available in previously published coho salmon distribution lists (e. g. stream snorkel surveys conducted by Brownell et al. [1999]) were incorporated.	Complete	542

The Need for a New SONCC ESU Coho Salmon Distribution List

Most recent coho salmon distribution lists in California are collections of previously published independent investigations (Table 1) having varying data inclusion criteria and review methods. This report provides a comprehensive independent coho salmon stream list for the SONCC ESU where all documentation can be traced to original first-hand evidence. The advantage of this type of investigation is the interpretation of supporting evidence is controlled by a specific standardized protocol. For example, coho salmon distribution data resulting from biologists using "best judgment" can be disqualified based on the lack of available empirical data. Therefore, the resulting product is supported by an evidentiary standard which can be easily interpreted and reproducible (Frey 2005, McKelvey et al. 2008). Spence et al. (2005) used standardized ranking criteria to catalog historic coho salmon streams in the Central California Coast ESU so data of varying quality was ranked based on its reliability. This DFG study offers a similar robust analysis supporting historic coho salmon streams in the SONCC ESU for population recovery efforts.

Objectives

The objectives of this study are to: (1) Generate an independent historical coho salmon stream list for the California portion of the SONCC ESU using a specific evidence standard; (2) Compare this list to previously published coho salmon stream lists to address differences; (3) Construct a brood year matrix for all data supporting coho salmon streams from the years of 1979 to 2004; (4) Report contemporary coho salmon presence data for a subset of historic coho salmon streams using a standardized stream sampling protocol.

Results from this study can be used to compare empirical historic coho salmon distribution to current monitoring data supporting various VSP parameters and viability attributes. The resulting historic stream list can also be used to design various coho salmon sampling frames and evaluate predictive habitat models, especially those used in federal and state recovery plans. Additionally, the stream list can support research into changes in habitat quantity and quality, abundance, and relationships with other species at large spatial scales. Last, the historic stream list from this study provides resource managers the most current evidence on known coho salmon presence throughout the California portion of the SONCC ESU so species-specific protections can be established and enforced at local scales.

METHODS

Study Area

This report presents the results of a six year project that examined fisheries sampling in California coastal watersheds from north of Punta Gorda to the California-Oregon border, which corresponds to the California extent of the SONCC ESU (Figures 1 and 2). The

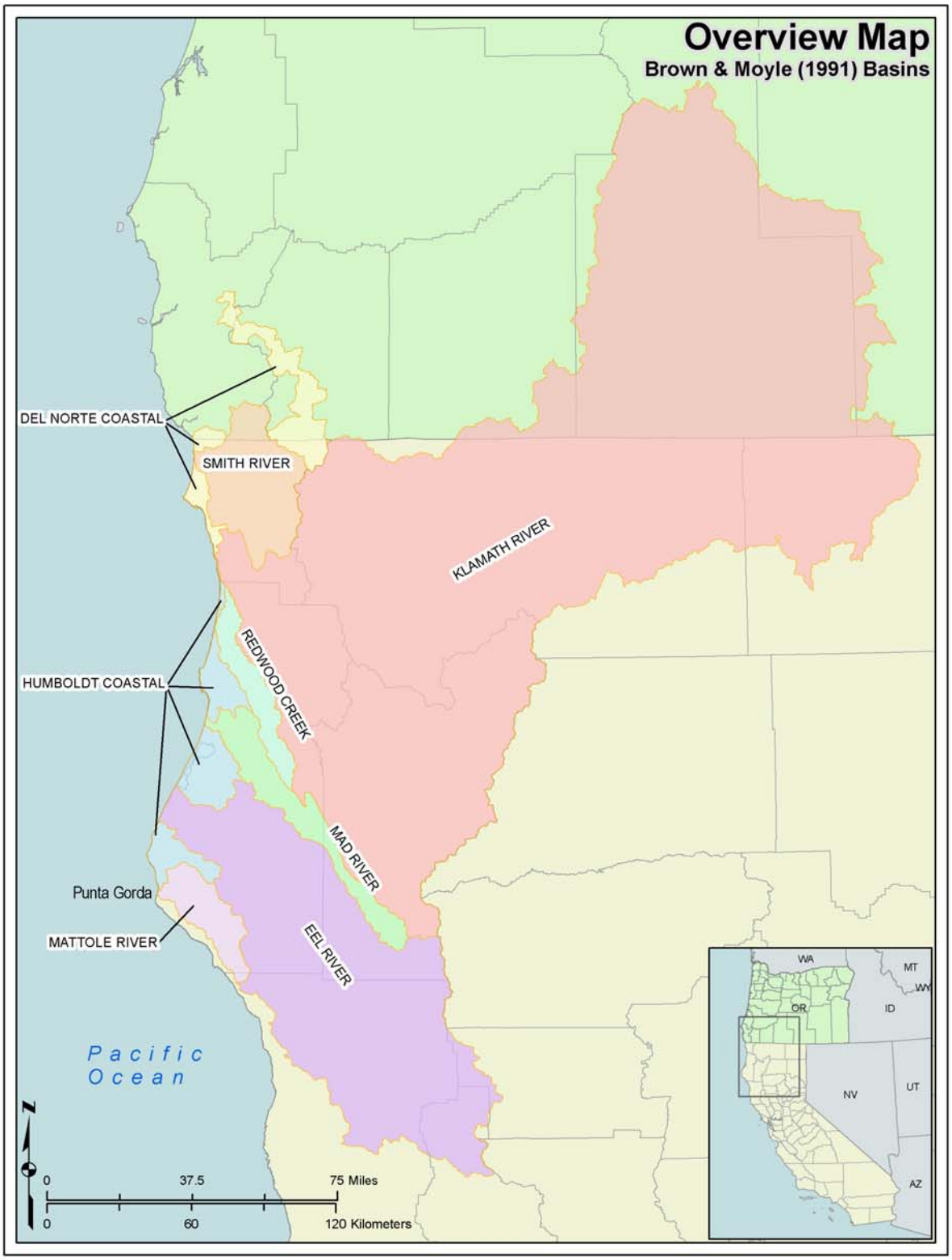

Figure 2. Map of project area extent and locations of Brown and Moyle basins in Southern Oregon/Northern California Coast Coho Salmon Evolutionarily Significant Unit.

project area is spread across five counties including Del Norte, Humboldt, Mendocino, Siskiyou, and Trinity. All data used to construct the coho salmon stream list were from stream sections available to anadromous salmonids occurring below natural barriers. However, all available historic information collected in streams now occurring upstream of dams (e. g. Klamath River dams) was also examined.

Brown and Moyle (1991) list 396 historic coho salmon waters in California north of Punta Gorda. These waters were grouped into eight basins from north to south: Del Norte Coastal, Smith River, Klamath River, Humboldt Coastal, Redwood Creek, Mad River, Eel River, and Mattole River (Figure 2). In most cases these basins represent functionally independent coho salmon populations as defined by NOAA (Williams et al. 2006), with the exception of Del Norte Coastal and Humboldt Coastal. In order to adopt NOAA fisheries independent population construct, Humboldt Bay Tributaries (all streams flowing into Humboldt Bay) were grouped separately from the Humboldt Coastal group defined by Brown and Moyle (1991). Smaller dependent coho salmon populations identified by Williams et al. (2006) were placed in artificial groups as Humboldt Coastal and Del Norte Coastal for simplicity[2].

Document Procurement

Project-personnel obtained raw data, written reports and other materials that describe fisheries resource sampling conducted throughout the project area. Literature was acquired either through fulfilled data requests or by visiting and photocopying data collections (i.e., Department of Fish and Game field offices, Dr. Peter Moyle and Dr. Larry Brown, Humboldt State University, US Forest Service, US Fish and Wildlife Service, Bureau of Land Management, State Parks, Cal Trout, Yurok Tribe, Karuk Tribe, Salmon River Restoration Council, PALCO, Green Diamond Resource Company, Campbell Timber Company, Mendocino Redwood Company, Sierra Pacific Industries, Barnum Timber Company, Mattole Salmon Group, Oregon Department of Fish and Wildlife, NOAA Fisheries and other scientific collectors). Personal communications from biologists with direct field observations were considered literature, with written correspondence as documentation.

Previously published distribution lists and status reviews (Table 1) were not used to develop this coho salmon stream list. These status reviews represent an author's interpretation of documents using literature review protocols that may not be consistent with those used in this investigation. However, a directed effort to obtain all citations and other supporting evidence in previous status reviews was made. Additionally, some coho salmon stream distribution lists summarized in Table 1 provided original data (e. g. stream snorkel surveys conducted by Brownell et al. 1999). These data were reviewed and incorporated into the analysis.

[2] Coho salmon streams occurring in California, but drain into the Illinois River (Oregon), were grouped into the Del Norte Coastal basin for this California specific study. These streams are actually part of the functionally independent Illinois River population defined by Williams et al. (2006).

Records were acquired from 1896 through 2004; however evidence from two documents from 2010 and 2011 confirming a new coho salmon stream were subsequently added to this analysis. Documents were assigned a document number and then catalogued using EndNote v6-X4 Bibliographic software (Thomson ISI ResearchSoft, Berkeley, CA)[3].

Contemporary Coho Salmon Stream Surveys

Sampling was conducted to establish contemporary coho salmon occurrence (years: 2001-2003) in streams throughout the California portion of the SONCC ESU. Sampling efforts were focused on historic coho salmon streams previously identified by Brown and Moyle (1991). However, additional surveys were completed in a subset of suspected coho salmon streams not identified in previous status reviews. Surveys were conducted by survey crews headquartered in Arcata, CA under the direction of the California Department of Fish and Game. The Department primarily used a standard Coho Salmon Presence Modified Ten Pool Survey Protocol (commonly referred to as the modified Ten Pool Protocol (Jong et al. 2002). Generally, direct observation snorkel surveys were used to document coho salmon occurrence. The Ten Pool Protocol was designed to ensure all project-personnel were able to identify salmonids, spread survey effort evenly through known or supposed coho salmon range of anadromy, and collect and record data in a methodical and standardized way. It addition to direct observation snorkel surveys, some streams were sampled alternatively by electrofishing or with minnow traps. A limited number of stream surveys were completed by other DFG salmonid monitoring projects and salmonid monitoring groups (i.e. US Forest Service, Karuk Tribe, Yurok Tribe, Green Diamond Resource Company, Humboldt State University, and others) to reduce duplication of effort. Landowners were contacted to request permission for access and surveys were conducted only where access agreements were secured.

Data Analysis

Document Review Process and Evidentiary Standards

Only documents reporting original data were used to define coho salmon presence in SONCC ESU streams. Each document was reviewed at least twice independently by project-personnel to extract sampling method, location coordinates, all aquatic species found and other necessary information to build a stream sampling history database. Errors in species identification are possible with these data, but cannot be assessed from historical information. When possible, original observers were contacted to confirm rare observations of coho salmon. Reports describing habitat suitability for coho salmon (e. g. Boberg and Kenyon [1979], Cherr and Griffin [1979]) were not considered as proof of presence. In addition, statements from documents indicating a species existed in a particular stream, but lacked specific observations, were also not used. Finally, information regarding hatchery produced coho salmon (e.g. stream planting receipts) was recorded and eliminated from analysis since these fish were not naturally produced in the receiving waters.

[3] Reference to trade names does not imply endorsement by the California Department of Fish and Game.

Spence et al. (2005) used standardized ranking criteria to catalog historic coho salmon streams in the Central California Coast ESU based on the reliability of supporting evidence (*see* methods *in* Spence et al. [2005]). Generally, more historic fisheries data are available in the SONCC ESU. Therefore, this study relied specifically on direct observations from original field data. Additionally, Spence et al. (2005) ranked a stream lower if the only available coho salmon observations were located near the stream's mouth. The spatio-temporal distribution and stage specific habitat needs of coho salmon are complex and cannot be assessed with limited available historic data. Thus, all first-hand coho salmon observations, and their respective spatial locations, were treated equally regardless if some streams only had observations occurring near a stream's mouth.

Prior to this study, the Brown and Moyle (1991) stream list was the primary reference regarding the general historic distribution of coho salmon in the SONCC ESU (Table 1). Therefore, the Brown and Moyle (1991) coho salmon stream list was used as a starting point for this research. Project-personnel examined the chain of citations used to assemble the Brown and Moyle (1991) coho salmon stream list to determine which citations should be used to compile the revised stream list. If evidence could not be found through exhaustive searching, or provided evidence could not be substantiated for any coho salmon stream identified by Brown and Moyle (1991), the stream was eliminated from the revised list.

Spatial Representation of Streams

To identify the spatial location of all streams researched in this study and to map the known historic distribution of coho salmon, two geographic information system (GIS) products were developed. First, many streams in the SONCC ESU have duplicate names, with some being in close proximity. Additionally, some named streams are not labeled or are not identified on available US geological survey maps. For these reasons, unique identification numbers were used to identify individual streams and maps were created highlighting the entire hydrography for each researched stream (Figures 3 through 10; GIS shape files available upon request). The second map product was developed to define all known coho salmon observation locations from the literature and this study resulting in known upstream extents of historic coho salmon distribution. Notwithstanding, this study was not designed to define the actual upper-most stream distributions of coho salmon and it likely under-represents their potential distribution in many streams. The results of this observed coho salmon distribution is summarized as a GIS shape file in the CDFG Biogeographic Information and Observation System (bios.dfg.ca.gov).

Coho Salmon Brood Year Calculation

When coho salmon occurrence was documented ("Presence confirmed"), their brood year was calculated based on life stage. Brood year was assigned based on spawning year the observed lifestage represented. For example: adult coho salmon observed spawning in October 2004 would be designated as Brood Year (BY) 2004; likewise, the confirmed presence of young-of-the-year (yoy) coho salmon in May 2005 would be designated as BY

2004. When a survey did not establish their presence, then "Presence not confirmed" was assigned; brood year assignment was based upon sampling methods and which coho salmon age class would have been present during a given sampling date. For example: a 1998-99 spawner survey only found Chinook salmon then "Presence not confirmed" was assigned to BY 1998.

Contemporary Stream Surveys and Notes on Species Detection

The majority of field surveys from this project were single-stage design and occurred in one to three discrete sampling units per stream (Jong et al. 2002). The Ten Pool Protocol was developed to be simple, rapid, and affordable so a large portion of SONCC ESU coho salmon streams could be visited during this investigation. Single-visit observational studies such as this are inherently subject to imperfect detection, especially when the habitat and target species densities vary widely between sampling units (MacKenzie et al. 2002, Thompson 2004). A study by Webster et al. (2005) compared the Ten Pool Protocol used in this study to four other two-stage sampling designs using simulations and found it to be inadequate for detecting juvenile coho salmon at low densities. Since the field project design did not account for statistical detection rates, some streams may have indeed had coho salmon, but were unable to be observed using the Ten Pool Protocol. For these reasons, results from the field study are intended to represent a minimum presence of coho salmon in identified historic SONCC ESU coho salmon streams. Likewise, all results from the literature review are also interpreted as a minimum representation of coho salmon streams. However, overall results from the collective data presented in this study likely represent a robust historic coho salmon stream list.

Supporting Evidence and Documentation

To distill the large volume of information resulting from this review, all original documentation supporting coho salmon distribution and brood years for the SONCC ESU was summarized in a companion document (Garwood 2012). Garwood (2012) includes a coho salmon brood year table, a referenced bibliography for all documents reviewed for salmonid data, a summary table of coho salmon and other aquatic species observed during contemporary surveys, and the sampling protocol used in the respective surveys.

RESULTS

Updated SONCC ESU Historical Coho Salmon Stream List

Approximately 9,000 documents relating to 1,288 waters[4] within the California portion of the SONCC ESU were processed. A document review database comprised of 28,710 records from 3,433 documents supports a comprehensive and revised list of 542 coho salmon streams in the California portion of the SONCC ESU (Tables 2 and 3) and a presence by brood year table (Garwood 2012). A comprehensive bibliography supporting

[4] This list includes four lagoons: Lake Earl [103]; Freshwater Lagoon [734], Stone Lagoon [735], and Big Lagoon [738].

Table 2. List of 542 California coastal streams in the Southern Oregon Northern California Coho Salmon ESU examined during this investigation for brood-year presence of coho salmon. Capitalized stream names identify the original 392 Brown and Moyle (1991) historic coho salmon streams. Italicized stream names (n= 67) indicate coho salmon presence was identified in Brown and Moyle (1991) but could not be substantiated based on this review. Streams listed in lowercase were identified through this study. Streams are grouped using their watershed/basin designations and are listed sequentially as they occur along the California coast, north to south. Refer to Garwood (2012) for individual source documentation.

Del Norte Coastal

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
1	COHO	East Fork Illinois River	1	1998
2	COHO	DUNN CREEK	6	1992 – 2002
4	COHO	North Fork Dunn Creek	6	1981 – 2001
5	COHO	West Fork Illinois River	1	1998
6	COHO	ELK CREEK	11	1979 – 2003
8	COHO	BROKEN KETTLE CREEK	3	1996 – 2002
9	COHO	Unnamed trib (aka South Fork Broken Kettle Creek)	4	1997 – 2000
10	COHO	Brushy Creek	1	1997
11	COHO	Unnamed trib B; Elk Creek	1	1981
13	COHO	Winchuck River	1	2000
14	COHO	SOUTH FORK WINCHUCK RIVER	14	1938 – 2003
103	COHO	Lake Earl	3	1985 – 1987
105	COHO	UNNAMED TRIB (aka YONKERS CREEK); Lake Earl	1	1951
107	COHO	JORDAN CREEK	3	1950 – 1983
109	COHO	ELK CREEK	5	1998 – 2002
111	COHO	Unnamed trib B; Elk Creek	1	1986
115	COHO	WILSON CREEK	20	1937 – 2003

Smith River

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
18	COHO	SMITH RIVER	6	1982 – 2000
19	COHO	Jordan Creek	1	2011
20	COHO	ROWDY CREEK	28	1938 – 2004
21	COHO	DOMINIE CREEK	3	2000 – 2002
23	COHO	South Fork Rowdy Creek	6	1994 – 2003
24	COHO	SAVOY CREEK	2	2000 – 2001
28	COHO	COPPER CREEK	5	1994 – 2002
29	COHO	MORRISON CREEK	4	1951 – 2001
31	COHO	LITTLE MILL CREEK (aka Jaqua Creek)	4	1950 – 2001
32	COHO	Sultan Creek (aka Sutton Creek)	4	1993 – 2001
34	COHO	Peacock Creek	2	1994 – 2001
35	COHO	Clarks Creek	3	1994 – 1997
37	COHO	MILL CREEK	6	1949 – 2000
38	COHO	EAST FORK MILL CREEK	13	1982 – 2003
39	COHO	First Gulch	2	2011 – 2012
40	COHO	Unnamed trib A (aka Kelly Creek); East Fork Mill Creek	6	1982 – 2002
41	COHO	BUMMER LAKE CREEK	7	1982 – 2002
42	COHO	Unnamed trib B (aka Low Divide Creek); East Fork Mill Creek	3	1995 – 2002
43	COHO	WEST BRANCH MILL CREEK	24	1980 – 2003
47	COHO	SOUTH FORK SMITH RIVER	5	1935 – 2000
48	COHO	CRAIGS CREEK	3	1994 – 2002
49	COHO	COON CREEK	1	1994
51	COHO	Rock Creek	1	1994

Smith River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
55	COHO	HURDYGURDY CREEK	7	1979 – 2001
62	COHO	JONES CREEK	4	1993 – 2002
63		*MUZZLELOADER CREEK*		
64		*BUCK CREEK*		
65	COHO	QUARTZ CREEK	1	2001
66	COHO	EIGHTMILE CREEK	1	2000
67		*WILLIAMS CREEK*		
68		*PRESCOTT FORK*		
69	COHO	MYRTLE CREEK	1	2002
70		*HARDSCRABBLE CREEK*		
71	COHO	NORTH FORK SMITH RIVER	2	1976 – 1994
73		*UNNAMED TRIB (aka PERIDOTITE CREEK); North Fork Smith River*		
74		*STILL CREEK*		
75		*DIAMOND CREEK*		
82	COHOi	MIDDLE FORK SMITH RIVER	–	1962 – 2002
83		*EIGHTEENMILE CREEK*		
86	COHO	PATRICK CREEK	7	1983 – 2002
87		*TWELVEMILE CREEK*		
88		*ELEVENMILE CREEK*		
89	COHO	SHELLY CREEK	2	1994 – 2001
90		*TENMILE CREEK*		
92		*WEST FORK PATRICK CREEK*		
95	COHO	MONKEY CREEK	3	1962 – 2002
96	COHO	SISKIYOU FORK	1	1991
98		*PACKSADDLE CREEK*		
99	COHO	GRIFFIN CREEK	1	2001
102	COHO	KNOPTI CREEK	1	2000

Klamath River

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
117	COHO	KLAMATH RIVER	27	1940 – 2004
118	COHO	SALT CREEK	2	2000 – 2001
119	COHO	HIGH PRAIRIE CREEK	5	1949 – 2001
120	COHO	HUNTER CREEK (aka East Fork Hunter Creek; aka Panther Creek)	24	1937 – 2003
122	COHO	MYNOT CREEK	5	1939 – 2001
123	COHO	West Fork Hunter Creek	5	1995 – 2002
126	COHO	Unnamed trib; Hunter Creek	1	1998
127	COHO	RICHARDSON CREEK (aka Marshall Pond)	3	1987 – 2002
128	COHO	HOPPAW CREEK	11	1937 – 2001
129	COHO	Unnamed trib (aka North Fork Hoppaw Creek); Hoppaw Creek	8	1994 – 2002
130	COHO	SAUGEP CREEK	4	1995 – 2002
131	COHO	WAUKELL CREEK	3	1961 – 2002
133	COHO	TURWAR CREEK	19	1938 – 2002
136	COHO	McGARVEY CREEK	17	1949 – 2002
137	COHO	Unnamed trib (aka Den Creek); McGarvey Creek	1	2000
138	COHO	Unnamed trib (aka West Fork McGarvey Creek); McGarvey Creek	7	1994 – 2000
139	COHO	TARUP CREEK	10	1985 – 2002
140	COHO	OMAGAAR CREEK	2	1995 – 1996
141	COHO	BLUE CREEK	19	1984 – 2002
142	COHO	Pularvasar Creek	2	1995 – 1997
143	COHO	Unnamed trib (aka One Mile Creek); Blue Creek	1	1995
144	COHO	WEST FORK BLUE CREEK	4	1987 – 2002
145		*POTATO PATCH CREEK*		

Klamath River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
147	COHO	NICKOWITZ CREEK	1	1996
148	COHO	CRESCENT CITY FORK BLUE CREEK	10	1990 – 2001
149	COHOi	Unnamed trib A; Crescent City Fork Blue Creek	–	2001
150	COHO	Unnamed trib (aka Doctor Rock Creek); Unnamed trib A; Crescent City Fork Blue Creek	1	2001
152	COHO	AH PAH CREEK	15	1978 – 2003
153	COHO	North Fork Ah Pah Creek	3	1982 – 2001
155	COHO	Unnamed trib (aka Moon Creek); Ah Pah Creek	4	1999 – 2002
156	COHO	SOUTH FORK AH PAH CREEK	14	1978 – 2002
157	COHO	BEAR CREEK	6	1988 – 2002
160	COHO	Surpur Creek	1	2002
161	COHO	Unnamed trib (aka Little Surpur Creek); Klamath River	1	1996
162	COHO	TECTAH CREEK	6	1988 – 2002
165	COHO	Johnson Creek	3	1995 – 1998
166	COHO	PECWAN CREEK	3	1995 – 2000
167	COHO	East Fork Pecwan Creek	1	1999
171	COHO	METTAH CREEK	4	1990 – 1999
173	COHO	ROACH CREEK	7	1988 – 2001
179		*MINERS CREEK*		
180	COHO	Tully Creek	3	1989 – 1999
182	COHO	PINE CREEK	3	1984 – 2000
183		*LITTLE PINE CREEK*		
184	COHO	TRINITY RIVER	25	1948 – 2002
185	COHO	SOCTISH CREEK	2	1981 – 2000
186	COHO	MILL CREEK	4	1981 – 2000
189	COHO	HOSTLER CREEK	2	1984 – 2000
190	COHO	SUPPLY CREEK	3	1981 – 2000
192	COHO	CAMPBELL CREEK	2	1984 – 2000
193	COHO	TISH TANG A TANG CREEK	2	1984 – 2000
194	COHO	HORSE LINTO CREEK	17	1984 – 2004
195	COHO	Cedar Creek	4	1990 – 2003
197	COHO	WILLOW CREEK	12	1984 – 2002
199	COHO	SOUTH FORK TRINITY RIVER	16	1974 – 1998
200	COHO	Madden Creek (aka Old Campbell Creek)	10	1983 – 2002
214	COHO	ELTAPOM CREEK	2	1950 – 2001
220	COHO	PELLETREAU CREEK	1	1951
221	COHOi	HAYFORK CREEK[e]	–	2001 – 2002
222	COHO	OLSEN CREEK	2	2001 – 2002
226	COHO	Corral Creek (aka Corral Bottoms Creek)	1	2001
246	COHOi	Salt Creek[e]	–	2001 – 2002
247	COHO	Philpot Creek[e]	2	2001 – 2002
273	COHO	BUTTER CREEK	1	2001
288		*RATTLESNAKE CREEK*		
305	COHO	Sharber Creek (aka Sharber-Peckham Creek)	10	1984 – 2000
306	COHO	NEW RIVER	5	1992 – 2001
308	COHO	Bell Creek	1	1983
318	COHO	East Fork New River	3	1995 – 2001
332	COHO	Big French Creek	3	1988 – 2001
334	COHO	Price Creek	1	1993
335	COHO	MANZANITA CREEK	2	2001 – 2002
338	COHO	NORTH FORK TRINITY RIVER	8	1982 – 2002
340	COHO	EAST FORK NORTH FORK TRINITY RIVER	9	1986 – 2002
351	COHO	CANYON CREEK	14	1981 – 2002
354	COHO	Soldier Creek	1	2001
355	COHO	Dutch Creek	2	1988 – 1998

Klamath River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
358	COHO	BROWNS CREEK	5	1989 – 2004
361	COHO	Reading Creek	2	1988 – 1989
362	COHO	Weaver Creek	6	1985 – 1999
364	COHO	Little Browns Creek	2	1999 – 2000
365	COHO	East Weaver Creek	3	1988 – 2001
366	COHO	Five Cent Gulch	1	1999
368	COHO	Sidney Gulch	1	1999
369	COHO	West Weaver Creek	3	1998 – 2001
370	COHO	INDIAN CREEK	5	1989 – 2002
373	COHO	Grass Valley Creek	4	1985 – 1999
375	COHO	RUSH CREEK	10	1982 – 2002
376	COHO	DEADWOOD CREEK	6	1983 – 2002
380	COHO	Aikens Creek	3	1992 – 2002
381	COHO	BLUFF CREEK	3	1988 – 2001
386	COHO	SLATE CREEK	4	1988 – 2002
387	COHO	RED CAP CREEK	7	1986 – 2002
389	COHO	BOISE CREEK	3	1991 – 2002
391	COHO	CAMP CREEK	9	1987 – 2002
394	COHO	Whitmore Creek	1	2002
399	COHO	SALMON RIVER	16	1985 – 2003
403	COHO	WOOLEY CREEK	3	1987 – 1991
409	COHO	Butler Creek	1	2003
410	COHO	Portuguese Creek	1	1999
412	COHO	NORDHEIMER CREEK	1	2001
413	COHO	NORTH FORK SALMON RIVER	4	1988 – 2004
420		*NORTH RUSSIAN CREEK*		
421		*SOUTH RUSSIAN CREEK*		
422	COHO	SOUTH FORK SALMON RIVER	5	1988 – 2002
423	COHO	KNOWNOTHING CREEK	5	1987 – 2001
424	COHO	East Fork Knownothing Creek	1	1987
426	COHO	Negro Creek	2	1987 – 2001
427	COHO	METHODIST CREEK	4	1987 – 2001
436	COHO	EAST FORK SOUTH FORK SALMON RIVER; (aka East Fork Salmon River)	2	1991 – 2004
437		*TAYLOR CREEK*		
444	COHO	IRVING CREEK	3	1987 – 2002
445	COHO	Stanshaw Creek	3	1999 – 2002
446	COHO	Sandy Bar Creek	3	1999 – 2002
447	COHO	Rock Creek	2	2001 – 2002
449	COHO	DILLON CREEK	7	1995 – 2002
454	COHO	Swillup Creek	6	1993 – 2002
456		*UKONOM CREEK*		
457	COHO	King Creek	3	1995 – 2002
458	COHO	INDEPENDENCE CREEK	5	1993 – 2002
459	COHO	Titus Creek	2	2001 – 2002
460	COHO	CLEAR CREEK	7	1991 – 2002
461	COHO	South Fork Clear Creek	3	2000 – 2002
470	COHO	ELK CREEK	14	1987 – 2003
471	COHO	EAST FORK ELK CREEK	4	1988 – 2002
473	COHO	Twin Creeks	3	1995 – 2001
474	COHO	Cougar Creek	2	1988 – 2001
479	COHO	Little Grider Creek	3	1991 – 2002
480	COHO	INDIAN CREEK	13	1986 – 2002
481	COHO	Doolittle Creek	4	1989 – 2001
483	COHO	EAST FORK INDIAN CREEK	4	1987 – 2000
484	COHO	SOUTH FORK INDIAN CREEK	3	1999 – 2001

Klamath River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
488	COHO	MILL CREEK	5	1987 – 2002
491	COHO	Cade Creek	2	2001 – 2002
493	COHO	Horse Creek (aka Little Horse Creek)	2	2001 – 2002
494	COHO	CHINA CREEK	7	1986 – 2002
498	COHO	THOMPSON CREEK	6	1984 – 2001
499	COHO	Fort Goff Creek	6	1991 – 2002
500	COHO	Portuguese Creek	5	1997 – 2002
502	COHO	WEST GRIDER CREEK	1	2002
503	COHO	SEIAD CREEK	7	1990 – 2002
506	COHO	GRIDER CREEK	12	1980 – 2002
510	COHO	Walker Creek	2	1998 – 2002
511	COHO	O'Neil Creek	2	2001 – 2002
512	COHO	Scott River	24	1979 – 2004
513	COHO	Mill Creek (Scott Bar)	4	1993 – 2004
514	COHO	Wooliver Creek	1	1997
515	COHO	TOMPKINS CREEK	3	1984 – 2004
518	COHO	KELSEY CREEK	3	1987 – 2004
519	COHO	CANYON CREEK	6	1987 – 2004
522	COHO	SHACKLEFORD CREEK	9	1992 – 2004
523	COHO	MILL CREEK (aka Shackleford/Mill)	6	1988 – 2004
528	COHOi	Moffett Creek		2004
529	COHO	McAdam Creek	1	2004
532	COHO	KIDDER CREEK	6	1992 – 2004
533	COHO	PATTERSON CREEK	4	1981 – 2004
536	COHO	ETNA CREEK	3	1998 – 2004
540	COHO	FRENCH CREEK	11	1992 – 2004
541	COHO	MINERS CREEK	6	1992 – 2004
542	COHO	North Fork French Creek	2	1992 – 2000
546	COHO	SUGAR CREEK	4	1995 – 2004
547	COHO	Wildcat Creek	1	2001
548	COHO	SOUTH FORK SCOTT RIVER	3	1995 – 2004
549	COHO	Boulder Creek	2	1994 – 1995
552	COHO	EAST FORK SCOTT RIVER	2	2001 – 2004
554	COHO	BIG MILL CREEK	2	1993 – 2001
559	COHO	Kangaroo Creek	1	2004
561	COHO	Rail Creek	1	2004
562	COHO	HORSE CREEK	9	1979 – 2004
563	COHO	BUCKHORN CREEK	2	2001 – 2002
564	COHO	MIDDLE CREEK	1	2002
565	COHO	SALT GULCH	4	1988 – 2002
571		*BARKHOUSE CREEK*		
572	COHO	Little Humbug Creek	1	1997
573	COHO	BEAVER CREEK	12	1983 – 2004
574	COHO	West Fork Beaver Creek	2	1988 – 2001
583	COHO	Cow Creek	1	1986
584	COHO	Empire Creek	1	1994
587	COHO	HUMBUG CREEK	5	1988 – 2002
591	COHO	SHASTA RIVER	25	1979 – 2004
592	COHO	Yreka Creek	1	2001
599	COHO	BIG SPRINGS CREEK	1	2004
600	COHO	Parks Creek	1	2004
601	COHO	Williams Creek	3	1992 – 1998
602	COHO	Blue Gulch	1	1997
603	COHO	COTTONWOOD CREEK	4	1979 – 2004
610	COHO	WILLOW CREEK	1	2003

Klamath River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
611	COHO	Little Bogus Creek	8	1994 – 2003
612	COHO	Dry Creek	7	1994 – 2003
613	COHO	BOGUS CREEK	24	1979 – 2004
614	COHO	Brush Creek	1	2001
615	COHO	Jenny Creek		
616	COHO	FALL CREEK		

Humboldt Coastal (North of Punta Gorda)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
621	COHO	Squashan Creek (aka Squawshan Creek)	1	1983
735	COHOi	Stone Lagoon	–	1951 – 1992
736	COHO	UNNAMED TRIB (aka FRESH CREEK; aka McBrindle Creek)	1	1971
737	COHO	McDONALD CREEK	3	1951 – 1992
738	COHO	BIG LAGOON	4	1956 – 1958
739	COHO	Tom Creek	4	1957 – 1996
740	COHO	Maple Creek	5	1956 – 2002
742	COHO	Pitcher Creek	1	1997
743	COHO	North Fork Maple Creek	1	2002
767	COHO	LITTLE RIVER	18	1950 – 2002
768	COHO	SOUTH FORK LITTLE RIVER (aka Carson Creek)	7	1982 – 2003
769	COHO	Unnamed trib; South Fork Little River	1	2002
772	COHO	Railroad Creek	7	1987 – 2002
775	COHO	LOWER SOUTH FORK LITTLE RIVER	15	1986 – 2003
776	COHO	Unnamed trib E (aka Danielle Creek); Little River	7	1985 – 2002
777	COHO	Unnamed trib D (aka Heightman Creek); Little River	1	1987
778	COHO	UPPER SOUTH FORK LITTLE RIVER	11	1981 – 2003
783	COHO	STRAWBERRY CREEK	1	1967
784	COHO	Norton Creek (aka North Fork Widow White Creek)	1	2001
785	COHO	Widow White Creek	1	2000
1383	COHO	GUTHRIE CREEK		
1388		*BEAR RIVER*		
1389		*BONANZA GULCH*		
1390		*SOUTH FORK BEAR RIVER*		
1392		*HOLLISTER CREEK*		
1418		*McNUTT GULCH*		

Redwood Creek

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
626	COHO	REDWOOD CREEK	23	1896 – 2000
628	COHO	PRAIRIE CREEK	24	1949 – 2001
629	COHO	Skunk Cabbage Creek	1	1992
630	COHO	Unnamed trib (aka Davidson Creek; aka Davison Creek); Prairie Creek	3	1999 – 2002
632	COHO	LITTLE LOST MAN CREEK	16	1950 – 2002
633	COHO	LOST MAN CREEK	20	1979 – 2002
635	COHO	Unnamed trib (aka Larry Damm Creek; aka Harry Damm Creek); Lost Man Creek	3	1987 – 2001
636	COHO	Unnamed trib (aka North Fork Lost Man Creek; aka Wigeon Creek); Lost Man Creek	1	2001
637	COHO	UNNAMED TRIB (aka STREELOW CREEK; aka Wolf Creek, aka North Fork Streelow Creek); Prairie Creek	8	1980 – 2002

Redwood Creek (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
639	COHO	Unnamed trib B (aka South Fork Streelow Creek); Unnamed trib A; Unnamed trib (aka STREELOW CREEK; aka Wolf Creek; aka North Fork Streelow Creek)	1	1999
640	COHO	MAY CREEK	10	1950 – 2001
641	COHO	GODWOOD CREEK	8	1979 – 2002
642	COHO	BOYES CREEK	11	1950 – 2002
646	COHO	BROWN CREEK	10	1983 – 2002
647	COHO	Unnamed trib (aka South Fork Brown Creek); Brown Creek	2	1995 – 1996
648	COHO	Unnamed trib (aka North Fork Brown Creek); Brown Creek	2	1995 – 1996
655	COHO	Unnamed trib; Redwood Creek	1	1979
656	COHO	Unnamed trib (aka Hayes Creek); Redwood Creek	2	1979 – 1999
658	COHO	McArthur Creek	2	1994 – 2000
659	COHO	Elam Creek	2	1998 – 2000
667	COHO	Unnamed trib (aka Cole Creek); Redwood Creek	1	1999
668	COHO	TOM McDONALD CREEK	7	1979 – 2002
669	COHO	Harry Weir Creek (aka Emerald Creek)	2	1992 – 1993
670	COHO	BRIDGE CREEK	5	1991 – 2001
681	COHO	COYOTE CREEK	1	1979
684	COHO	PANTHER CREEK	1	1974
687	COHO	LACKS CREEK	1	1952
689	COHO	Unnamed trib (aka Karen Creek; aka Dolly Varden Creek); Redwood Creek	1	1979
696	COHO	Unnamed trib (aka Pilchuck Creek); Redwood Creek	1	1979
702	COHO	Minor Creek	1	1994

Mad River

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
786	COHO	MAD RIVER	24	1948 – 2002
788	COHO	WARREN CREEK	1	2000
791	COHO	LINDSAY CREEK	19	1948 – 2002
792	COHO	GRASSY CREEK	10	1948 – 2001
793	COHO	SQUAW CREEK	12	1948 – 2002
796	COHO	Unnamed trib (aka Anker Creek; aka South Branch East Fork Lindsay Creek; aka North Fork Anker Creek); Lindsay Creek	3	1999 – 2002
797	COHO	Unnamed trib (aka South Fork Anker Creek); Unnamed trib; Lindsay Creek	2	2000 – 2001
798	COHO	MATHER CREEK	4	2000 – 2004
800	COHO	HALL CREEK	5	1967 – 2002
801	COHO	NOISY CREEK	5	1948 – 2002
802		*MILL CREEK*		
803	COHO	LEGGIT CREEK	2	2002 – 2003
805	COHO	KELLY CREEK	1	1960
806	COHO	POWERS CREEK (aka Dave Powers Creek)	1	1983
807		*PALMER CREEK*		
808	COHO	NORTH FORK MAD RIVER	12	1937 – 2002
809	COHO	SULLIVAN GULCH	9	1993 – 2003
810	COHO	CAMP BAUER CREEK (aka HATCHERY CREEK)	4	1950 – 2002
811		*LONG PRAIRIE CREEK*		
816		*QUARRY CREEK*		
818	COHO	DRY CREEK	1	2000
819	COHO	CANON CREEK	23	1963 – 2003
822	COHO	MAPLE CREEK	4	1987 – 2001
823	COHO	BLACK CREEK (aka Black Dog Creek)	1	1963
824	COHO	BOULDER CREEK	3	1980 – 1999

Humboldt Bay Tributaries

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
825	COHO	Blue Slide Creek	1	2003
830	COHO	JANES CREEK	1	1984
832	COHO	JOLLY GIANT CREEK	7	1984 – 2002
833	COHO	Unnamed trib (aka Campbell Creek); Gannon Slough	1	1992
834	COHO	Unnamed trib (aka Beith Creek); Gannon Slough	3	1991 – 1993
837	COHO	JACOBY CREEK	13	1949 – 2002
838	COHO	Unnamed trib (aka Golf Course Creek); Jacoby Creek	1	1995
839	COHO	Unnamed trib B (aka Cascade Creek); Jacoby Creek	1	1995
840	COHO	Morrison Gulch	5	1999 – 2003
841	COHO	Unnamed trib; Jacoby Creek	3	1995 – 2002
842	COHO	Unnamed trib C (aka North Fork Jacoby Creek); Jacoby Creek	2	1995 – 2000
843	COHO	ROCKY GULCH	3	1957 – 2004
844	COHO	Washington Gulch	1	1983
845	COHO	UNNAMED TRIB (aka COCHRAN CREEK); Fay Slough	1	2002
846	COHO	Unnamed trib; Cochran Creek	1	2001
847	COHO	FRESHWATER CREEK	25	1949 – 2003
850	COHO	McCREADY GULCH	10	1983 – 2003
851	COHO	LITTLE FRESHWATER CREEK	12	1987 – 2003
852	COHO	CLONEY GULCH	18	1985 – 2003
853	COHO	FALLS GULCH	8	1987 – 2003
854	COHO	GRAHAM GULCH	13	1985 – 2003
855	COHO	South Fork Freshwater Creek	15	1986 – 2003
857	COHO	RYAN CREEK	7	1985 – 2003
861	COHO	Unnamed trib B; Ryan Creek	3	1993 – 2001
862	COHO	Unnamed trib A; Ryan Creek	1	1994
864	COHO	ELK RIVER	2	1950 – 1983
865	COHO	MARTIN SLOUGH	5	1999 – 2004
866	COHO	Unnamed trib A; Martin Slough	1	2004
868	COHO	NORTH FORK ELK RIVER	17	1986 – 2002
870	COHO	Browns Gulch	2	1992 – 1993
871	COHO	Lake Creek	2	1989 – 1993
872	COHO	Bridge Creek	3	1988 – 1993
873	COHO	McWhinney Creek	2	1989 – 1993
874	COHO	South Branch North Fork Elk River	6	1989 – 2001
875	COHO	North Branch North Fork Elk River	8	1989 – 2002
876	COHO	Doe Creek	1	2001
878	COHO	SOUTH FORK ELK RIVER	14	1985 – 2002
880	COHO	Tom Gulch	3	1993 – 2002
882	COHO	LITTLE SOUTH FORK ELK RIVER	5	1993 – 2002
883	COHO	Unnamed trib (aka Line Creek); South Fork Elk River	2	1989 – 1993
884		*UNNAMED TRIB (aka COLLEGE OF THE REDWOODS CREEK); Humboldt Bay*		
885	COHO	SALMON CREEK	9	1989 – 2002

Eel River

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
886	COHO	EEL RIVER	9	1982 – 2001
887	COHO	SALT RIVER	5	1937 – 1993
890		*RUSS CREEK*		
891		*REAS CREEK*		
892	COHO	Francis Creek	1	2003
894		*PALMER CREEK*		
895	COHO	Strongs Creek	1	1993
896		*ROHNER CREEK*		

Eel River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
899	COHO	VAN DUZEN RIVER (aka East Fork Van Duzen River)	5	1939 – 1995
900	COHOi	Barber Creek	–	1977
901	COHO	WOLVERTON GULCH	1	1977
902	COHOi	YAGER CREEK	–	1950 – 2010
903	COHO	WILSON CREEK	1	1962
904	COHO	COOPER MILL CREEK	2	1950 – 2001
906	COHO	LAWRENCE CREEK	9	1987 – 2001
909	COHO	SHAW CREEK	10	1987 – 2002
910	COHO	Fish Creek	2	2009 – 2010
918	COHO	CUDDEBACK CREEK	1	1939
919	COHO	CUMMINGS CREEK	7	1948 – 1992
920	COHO	FIEDLER CREEK	1	1950
921	COHO	HELY CREEK	2	1950 – 2001
922	COHO	ROOT CREEK	1	1977
923	COHO	GRIZZLY CREEK	7	1950 – 2001
926	COHO	STEVENS CREEK	1	1990
928		*HOAGLAND CREEK*		
930		*LITTLE LARABEE CREEK*		
932	COHOi	Little Van Duzen River (aka South Fork Van Duzen River)[e]	–	1983
933	COHO	Butte Creek[e]	1	1983
945	COHO	PRICE CREEK	1	1939
949	COHO	Oil Creek	2	1989 – 2001
950	COHO	HOWE CREEK	3	1964 – 1988
951	COHO	ATWELL CREEK	2	2001 – 2002
954	COHO	Monument Creek	1	1989
955	COHO	Kiler Creek	1	1991
956	COHO	DINNER CREEK	1	1938
959	COHO	JORDAN CREEK	6	1938 – 2002
963	COHO	SHIVELY CREEK	2	1979 – 2001
965	COHO	BEAR CREEK	7	1948 – 2002
967	COHO	CHADD CREEK	8	1950 v 2002
970	COHO	LARABEE CREEK	2	1938 – 1962
973	COHO	CARSON CREEK	11	1980 – 1996
988	COHO	SOUTH FORK EEL RIVER	6	1938 – 1988
989	COHO	BULL CREEK	5	1938 – 2001
993	COHO	Calf Creek	1	1987
995	COHO	SQUAW CREEK	6	1987 – 2002
996		*ALBEE CREEK*		
997		*MILL CREEK*		
1007	COHO	Decker Creek	1	2000
1010	COHO	CANOE CREEK		
1011		*BRIDGE CREEK*		
1012	COHO	ELK CREEK	5	1938 – 2002
1013	COHO	SALMON CREEK	5	1938 – 2002
1014	COHO	Mill Creek	3	1989 – 2002
1016	COHO	BUTTE CREEK	3	1938 – 2002
1017	COHO	FISH CREEK	2	1992 – 2002
1021	COHO	DEAN CREEK	2	1988 – 1989
1023	COHO	Unnamed trib (aka Wood Creek); South Fork Eel River	3	1939 – 2004
1024	COHO	Leggett Creek	3	1991 – 1999
1025	COHO	REDWOOD CREEK (aka Pollock Creek)	19	1981 – 2002
1026	COHO	SEELY CREEK	4	1988 – 2002
1028	COHO	MILLER CREEK	3	1982 – 2002
1030	COHO	CHINA CREEK	7	1992 – 2002
1032	COHO	DINNER CREEK	6	1992 – 2002

Eel River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
1033	COHO	Bear Canyon (aka Bear Gulch)	2	1991 – 1991
1035	COHO	Connick Creek (aka Hacker Creek)	2	1938 – 1992
1036	COHO	SPROUL CREEK (aka Sprowl Creek; aka South Fork Sproul Creek)	21	1980 – 2004
1037	COHO	LITTLE SPROUL CREEK	9	1988 – 2002
1038	COHO	WARDEN CREEK	1	1992
1039	COHO	WEST FORK SPROUL CREEK	22	1982 – 2004
1041	COHO	Unnamed trib (aka East Branch West Fork Sproul Creek); West Fork Sproul Creek	2	1991 – 1992
1042	COHO	Unnamed trib; Sproul Creek	1	1992
1043	COHO	Cox Creek	2	1991 – 1992
1044	COHO	Sawmill Creek	1	1982
1045	COHO	EAST BRANCH SOUTH FORK EEL RIVER	1	1987
1046	COHO	SQUAW CREEK	1	1937
1048	COHO	Fish Creek	1	1993
1049	COHO	DURPHY CREEK	4	1939 – 2001
1052	COHO	MILK RANCH CREEK	1	2001
1053	COHO	Low Gap Creek	1	1992
1054	COHO	INDIAN CREEK	13	1987 – 2002
1055	COHO	Jones Creek	1	1992
1057	COHO	Moody Creek	2	1992 – 2002
1058	COHO	Sebbas Creek	2	1992 – 2002
1059	COHO	Unnamed trib; Sebbas Creek	1	2001
1060	COHO	Coulborn Creek	1	1991
1061	COHO	ANDERSON CREEK	4	1987 – 2002
1062	COHO	PIERCY CREEK	11	1984 – 2002
1063	COHO	STANDLEY CREEK	4	1991 – 2002
1064	COHO	McCOY CREEK	4	1984 – 2002
1066	COHO	BEAR PEN CREEK	4	1984 – 2002
1067		*CUB CREEK*		
1068	COHO	RED MOUNTAIN CREEK	2	2001 – 2002
1070	COHO	WILDCAT CREEK	4	1986 – 2002
1071	COHO	Bridges Creek	2	1939 – 1967
1072	COHO	Mill Creek	1	1991
1075	COHO	HOLLOW TREE CREEK	24	1979 – 2002
1076	COHO	MULE CREEK	5	1967 – 2001
1077	COHO	South Fork Mule Creek (aka South Fork Creek)	2	2000 – 2001
1078	COHO	Middle Creek	1	1991
1083		*WALTERS CREEK*		
1084	COHO	Bear Creek	1	1991
1085	COHO	REDWOOD CREEK	13	1982 – 2002
1086	COHO	South Fork Redwood Creek	5	1993 – 2001
1090	COHO	BOND CREEK	11	1986 – 2002
1091	COHO	MICHAELS CREEK	10	1980 – 2002
1092	COHO	Doctors Creek	4	1994 – 1999
1094	COHO	Unnamed trib; Michaels Creek	1	2001
1095	COHO	WALDRON CREEK	4	1987 – 2002
1097	COHO	HUCKLEBERRY CREEK	11	1989 – 2002
1098	COHO	Bear Wallow Creek	9	1988 – 2002
1099	COHO	Little Bear Wallow Creek	5	1992 – 2001
1100	COHO	BUTLER CREEK	10	1982 – 2002
1103	COHO	CEDAR CREEK	3	1987 – 2001
1105	COHO	Big Dann Creek	1	1958
1107	COHO	LOW GAP CREEK	5	1958 – 2002
1108	COHO	Little Low Gap Creek	1	1999
1109	COHO	RATTLESNAKE CREEK	1	1994

Eel River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
1111	COHO	Foster Creek	1	1967
1113	COHO	CUMMINGS CREEK	1	1967
1116	COHO	TENMILE CREEK	2	1987 – 2000
1117	COHO	GRUB CREEK	2	2001 – 2002
1118	COHO	STREETER CREEK	2	1987 – 1988
1120	COHO	BIG ROCK CREEK	3	1993 – 2002
1122	COHO	MUD SPRINGS CREEK	1	2001
1123	COHO	Little Case Creek	1	1968
1124	COHO	MILL CREEK	1	1968
1125	COHO	CAHTO CREEK	1	2001
1127	COHO	Unnamed trib (aka Barnwell Creek); South Fork Eel River	1	1968
1128	COHO	FOX CREEK	1	1968
1129	COHO	ELDER CREEK	5	1984 – 2002
1130	COHO	JACK OF HEARTS CREEK	11	1958 – 2004
1131	COHO	Dark Canyon Creek	1	2002
1132	COHO	DEER CREEK	1	1968
1133	COHO	LITTLE CHARLIE CREEK	2	2002 – 2004
1135	COHO	DUTCH CHARLIE CREEK	12	1958 – 2002
1138	COHO	REDWOOD CREEK	17	1958 – 2002
1140	COHO	ROCK CREEK	2	1958 – 2001
1142	COHO	KENNY CREEK	4	1958 – 2002
1143	COHO	HAUN CREEK		
1146	COHO	TAYLOR CREEK	4	1958 – 2002
1147	COHO	BEAR CREEK	2	2001 – 2002
1150	COHO	Unnamed trib; South Fork Eel River	1	1968
1155	COHO	NEWMAN CREEK	2	1938 – 1962
1181		*JEWETT CREEK*		
1182		*KEKAWAKA CREEK*		
1203		*BLUFF CREEK*		
1221		*MIDDLE FORK EEL RIVER*		
1231		*MILL CREEK*		
1233		*GRIST CREEK*		
1272		*RATTLESNAKE CREEK*		
1279		*ROCK CREEK*		
1292	COHO	OUTLET CREEK	4	1983 – 2000
1293	COHO	BLOODY RUN CREEK	2	1982 – 2001
1297	COHO	LONG VALLEY CREEK	4	1951 – 1995
1299	COHO	DUTCH HENRY CREEK		
1300	COHO	REEVES CANYON CREEK	1	1987
1302		*ROWES CREEK*		
1303	COHO	RYAN CREEK	12	1987 – 2001
1308	COHO	MILL CREEK	4	1984 – 2004
1309	COHO	WILLITS CREEK	5	1987 – 2004
1311	COHO	BAECHTEL CREEK (aka Baechtel Canyon)	6	1948 – 2001
1312	COHO	HAEHL CREEK	1	1987
1313	COHO	Unnamed trib; Haehl Creek	1	1987
1314	COHO	BROADDUS CREEK	4	1986 – 2000
1317		*INDIAN CREEK*		
1326	COHO	Tomki Creek	1	1948
1330	COHO	Cave Creek	1	1996
1332	COHO	Unnamed trib (aka 2nd Unnamed trib); Cave Creek	1	1996
1333	COHO	Unnamed trib (aka 3rd Unnamed trib); Cave Creek	1	1996
1336		*ROCKTREE CREEK*		
1337		*STRING CREEK*		
1338		*TARTAR CREEK*		

Mattole River				
ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
1420	COHO	MATTOLE RIVER	23	1971 – 2002
1422	COHO	Bear Creek	1	1981
1425	COHO	Mill Creek (Lighthouse)	15	1983 – 2001
1428		*NORTH FORK MATTOLE RIVER*		
1433	COHO	MILL CREEK (Petrolia) (aka East Mill - Goforth)	2	1999 – 2002
1434	COHO	CLEAR CREEK	1	1991
1435		*CONKLIN CREEK*		
1436		*McGINNIS CREEK*		
1437	COHO	INDIAN CREEK	1	1981
1439	COHO	SQUAW CREEK	3	1980 – 2002
1441		*PRITCHARD CREEK*		
1442		*GRANNY CREEK*		
1444		*SAUNDERS CREEK*		
1447	COHO	WOODS CREEK	1	2000
1449	COHOi	UPPER NORTH FORK MATTOLE RIVER	–	1965
1450	COHOi	OIL CREEK	–	1965
1452	COHO	DEVILS CREEK	1	1965
1453		*RATTLESNAKE CREEK*		
1454	COHO	HONEYDEW CREEK	1	2000
1455	COHO	BEAR TRAP CREEK		
1459		*DRY CREEK*		
1460		*MIDDLE CREEK*		
1461	COHO	WESTLUND CREEK	1	1998
1462		*GILHAM CREEK*		
1465	COHO	FOURMILE CREEK	1	2000
1467	COHO	SHOLES CREEK	1	2000
1468	COHO	HARROW CREEK	1	1964
1469	COHO	GRINDSTONE CREEK	1	2000
1471	COHO	MATTOLE CANYON	1	1971
1472	COHO	BLUE SLIDE CREEK	2	2001 – 2002
1474	COHO	BEAR CREEK	5	1995 – 2001
1476	COHO	North Fork Bear Creek	3	1987 – 1989
1478	COHO	SOUTH FORK BEAR CREEK	8	1987 – 2002
1480	COHO	Unnamed trib (aka Box Canyon Creek); Mattole River	1	1999
1484	COHO	BIG FINLEY CREEK	4	1993 – 1998
1485	COHO	EUBANK CREEK	5	1981 – 2001
1488	COHO	BRIDGE CREEK	6	1995 – 2002
1489	COHO	Unnamed trib (aka Robertson Creek); Bridge Creek	3	2000 – 2002
1490	COHO	McKEE CREEK	5	1980 – 2002
1492	COHO	VANAUKEN CREEK (aka Van Arken Creek)	3	1987 – 2002
1493	COHO	Anderson Creek	1	1995
1494	COHO	Unnamed trib (aka East Anderson Creek); Mattole River	2	2000 – 2001
1495	COHO	MILL CREEK (Headwaters)	4	1981 – 2002
1496	COHO	Harris Creek	1	1971
1498	COHO	Stanley Creek	1	1981
1499	COHO	BAKER CREEK	18	1971 – 2002
1500	COHO	THOMPSON CREEK	20	1971 – 2002
1501	COHO	Unnamed trib (aka Yew Creek; aka South Fork Thompson Creek)	17	1985 – 2002
1502	COHO	Unnamed trib (aka Danny's Creek; aka North Fork Thompson Creek); Thompson Creek	4	1997 – 2002

Mattole River (Continued)

ID[a]	Status[b]	Stream Name	Brood Years[c]	Date Range[d]
1503	COHO	Unnamed trib (aka Lost River; aka Lost Creek; aka Lost Man Creek); Mattole River	6	1995 – 2002
1504	COHO	Unnamed trib (aka Helen Barnum Creek); Mattole River	2	2001 – 2002
1506	COHO	Unnamed trib (aka Pipe Creek); Mattole River	1	1997
1510	COHO	Unnamed trib A (aka McNasty Creek); Mattole River	4	1984 – 2002
1511	COHO	Unnamed trib (aka Ancestor Creek); Unnamed trib (aka McNasty Creek); Mattole River	2	2001 – 2002

[a]ID: unique generic identifier for each particular stream or lagoon. This identifier is used to replace duplicate stream names (e. g. Mill Creek) with a unique value for maps and associated data tables in the report and appendices.
[b]Status: COHO = coho salmon presence substantiated with documentation; COHOi = implied presence (see methods).
[c]Brood Years: The number of unique year's coho salmon were documented using a particular stream based on lifestage.
[d]Date Range: The earliest and latest documentation of coho salmon using a particular stream based on lifestage.
[e]See footnotes in the [coho salmon streams by population and basin] section for further clarifications on these records.

Table 3. Modifications to the Brown and Moyle (1991) historic coho salmon stream list by individual basin for the California portion of the SONCC ESU.

	Number of streams			
Basin	Original[a/] Coho Streams	DFG Removed	DFG Addition	Net Total Coho Streams
Del Norte Coastal	8	0	9	17
Smith River	41	14	9	36
Klamath River	114	11	81	184
Humboldt Coastal	14	5	12	21
Redwood Creek	14	0	16	30
Mad River	23	4	3	22
Humboldt Bay Tributaries	19	1	22	40
Eel River	125	26	49	148
Mattole River	38	10	16	44
Totals:	396	71	217	542

[a/] Source data: Brown and Moyle (1991)

coho salmon observations in the brood year table by individual stream is also available in Garwood (2012).

Brown and Moyle (1991) originally identified 396 historic coho salmon streams in the study area. Based on this investigation, 71 streams (18%) from the original list were removed (Table 3) resulting in 325 remaining streams with confirmed coho salmon presence from the Brown and Moyle list. Four of the 71 streams were removed because they are redundant or are points on already listed streams (e.g., Klamathon Racks is a point on the Klamath River; Shasta River is listed twice, Eel River below Van Duzen River and Eel River near Pepperwood are redundant to Eel River). Coho salmon presence could not be verified for 67 other streams with the documentation examined (Garwood 2012), and through recent stream surveys conducted in this study (Table 3). Based on this investigation, an additional 217 streams were added to the historic coho salmon stream list confirmed by this study (Table 3).

Contemporary Coho Salmon Survey Results

A total of 628 surveys were completed in 301 streams from 2001 to 2003 across the California portion of the SONCC ESU. Individual results by stream are presented in Garwood (2012). Ninety eight (33%) streams were visited one year, 79 (26%) streams were visited two years and 124 (41%) streams were visited three years. Overall, coho salmon were detected in 153 (62%) of 245 sampled historic coho salmon streams recognized during the three year investigation (Tables 4 and 5). However, annual observed proportions of coho salmon in sampled streams varied from 31% to 62% (Table 4). The observed variation of annual coho salmon presence relative to the three-year

Table 4. Observed coho salmon presence based on contemporary field sampling, years 2001 to 2003, relative to historic coho salmon stream lists in the California portion of the SONCC ESU. Sampling effort and results vary based on unique stream list comparisons.

	Sampling Year(s)			
	2001	2002	2003	Entire Study (2001-2003)
Brown and Moyle (1991) SONCC ESU California coho salmon stream list				
Available Streams [a/]	392	392	392	392
Total Streams Sampled	167	198	235	301
Sampling rate	43%	51%	60%	77%
Total surveyed streams with coho salmon detected (%)	38 (23%)	96 (48%)	89 (38%)	146 (49%)
DFG updated (2011) SONCC ESU California coho salmon stream list				
Available Streams [b/]	542	542	542	542
Total Coho Streams Sampled [b/]	127	164	193	245
Sampling Rate	23%	30%	36%	45%
Total surveyed streams with coho salmon detected (%)	39 (31%)	102 (62%)	92 (48%)	153 (62%)

[a/] Brown and Moyle (1991) identified 396 historic coho salmon streams in California coastal watersheds north of Punta Gorda: four are dropped hence the reduction to 392 streams.

1. Klamathon Racks is a point on the Klamath River
2. Shasta River is listed twice
3. Eel River below Van Duzen River is redundant to Eel River
4. Eel River near Pepperwood is redundant to Eel River

[b/] Only includes verified coho salmon occurrence records defined by this investigation.

Table 5. Proportions of sampled historic coho salmon streams with contemporary coho salmon observations for the California portion of the SONCC ESU by individual basin, 2001 to 2003.

Basin	Total Historic Coho Streams Available	Historic Coho Streams Sampled (% of total)	Coho Observed	No Coho Observed	% of Sampled Streams With Coho
Del Norte Coastal	17	5 (29)	3	2	60
Smith River	36	23 (64)	18	5	78
Klamath River	184	63 (34)	41	22	65
Humboldt Coastal	21	4 (19)	0	4	0
Redwood Creek	30	8 (27)	7	1	88
Mad River	22	14 (64)	6	8	43
Humboldt Bay Tributaries	40	15 (38)	12	3	80
Eel River	148	86 (58)	49	37	57
Mattole River	44	27 (61)	17	10	63
Totals:	542	245 (45)	153	92	62

combined presence of 62% may be an artifact of several factors. For example, all streams were not sampled equally, with some sampled one, others two, and some all three years. In addition, the regional focal areas of annual surveys could suffer from spatial autocorrelation, that is, sampling streams occurring in close proximity may create annual sampling bias relative to the SONCC ESU.

Coho salmon observation rates were consistently higher in the DFG identified coho salmon streams, averaging 13% higher than Brown and Moyle identified streams (Table 4). This is likely an artifact of the additional 67 streams identified by Brown and Moyle (1991) which were eliminated from the revised list in this investigation. Fifty six of the 67 (84%) disputed streams were surveyed during this investigation and no coho salmon were detected.

Additional Aquatic Species Observations

Additional stream fauna recorded during this investigation's coho salmon stream surveys are presented for individual streams in Garwood (2012). More detailed information is also retained in the study's database. Some stream fauna could not be identified to species so for these cases genus or families are noted.

Fishes

Additional native fish species observed include: Chinook salmon (*O. tshawytscha*) (spring and fall run), rainbow trout/steelhead (*O. mykiss*), summer-run steelhead adults (*O. mykiss*), coastal cutthroat trout (*O. clarki clarki*), Sacramento sucker (*Catostomus occidentalis*), California roach (*Lavinia symmetricus*), speckled dace (*Rhinichthys osculus*), brook lamprey (*Lampetra richardsoni*), Pacific lamprey (*L. tridentata*), prickly sculpin (*Cottus asper*), riffle sculpin (*C. gulosus*), coastrange sculpin (*C. aleuticus*), staghorn sculpin (*Leptocottus armatus*), threespine stickleback (*Gasterosteus aculeatus*), and saddleback gunnel (*Pholis ornata*). Additional non-native fishes observed include: fathead minnow (*Pimephales notatus*), Sacramento pikeminnow (*Ptychocheilus grandis*), largemouth bass (*Micropterus salmoides*), and green sunfish (*Lepomis cyanellus*).

Herpetofauna

Native herpetofauna observed include: tailed frog (*Ascaphus truei*), Pacific treefrog (*Pseudacris regilla*), red-legged frog (*Rana aurora*), foothill yellow-legged frog (*R. boylii*), western toad (*Anaxyrus boreas*), rough-skinned newt (*Taricha granulosa*), Coastal giant salamander (*Dicamptodon tenebrosus*), garter snake (*Thamnophis sp*.), and western pond turtle (*Emys marmorata*). Additional non-native herpetofauna observed include: bullfrog (*Lithobates catesbeianus*).

Invertebrates

Invertebrates observed include: unidentified and freshwater clam/ mussel (Mollusca) and unidentified crayfish (Decapoda).

Coho Salmon Streams by Population or Basin

Basin summaries, from north to south, are as follows (additional documentation can be found in Garwood 2012):

Del Norte Coastal

This basin is comprised of streams in two Oregon draining basins (Rogue and Winchuck rivers) and waters in Del Norte County, California, tributary to the Pacific Ocean (excluding Smith River and Klamath River). Sampling data was reviewed for 29 streams and one coastal lagoon in the Del Norte Coastal basin (Table 2; Figure 3). Coho salmon presence was confirmed for all eight streams identified by Brown and Moyle (1991). Nine additional coho salmon waters were identified during this study through document review, resulting in 17 coho salmon waters (16 streams and one coastal lagoon), (Table 3). Overall, sparse stream sampling data exists for this basin. Thus, these results likely under represent actual historical distribution. Field surveys conducted by DFG for this study (2001-2003), from a subset of these coho salmon waters, documented coho salmon in three out of five (60%) streams surveyed (Table 5).

Smith River

Sampling data was reviewed for 80 streams in the Smith River basin resulting in 36 streams having coho salmon observations (Table 2; Figure 4). Coho salmon presence was confirmed for 27 streams originally identified by Brown and Moyle (1991). However, based on this study, 14 streams were removed because occurrence records could not be verified through document review or field surveys (Table 3). Unverified streams include: Muzzleloader Creek [63], Buck Creek [64], Williams Creek [67], Prescott Fork [68], Hardscrabble Creek [70], Unnamed trib (aka Peridotite Creek [73]), Still Creek [74], Diamond Creek [75], Eighteenmile Creek [83], Twelvemile Creek [87], Elevenmile Creek [88], Tenmile Creek [90], West Fork Patrick Creek [92], and Packsaddle Creek [98] from the original 41 streams identified by Brown and Moyle (1991). One stream, Unnamed trib (aka Hamilton Creek); Mill Creek [9999], could not be placed on a map[5]. Seven additional coho salmon streams were identified through document review, and two creeks (Jordon Creek [19] and First Gulch [39]) were added based on recent sampling (Garwood, unpublished data, Garwood and Reneski 2012). Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in 18 out of 23 (78%) of streams surveyed (Table 5). The headwater streams of the North Fork Smith River occur in Oregon (Figure 4) and were not researched in this study. However, coho salmon have been found recently in this area by the US Forest Service (USFS 2006). Future collaborations with NOAA and the Oregon Department of Fish and Wildlife are needed to consider population-level assessments and monitoring for Smith River coho salmon.

[5] Reasons include: sampling locations are poorly or not described; a stream can be identified but it is not in the hydrography (if time allows the stream should be digitized and added to the hydrography, or the stream name is another local name for a stream already listed.

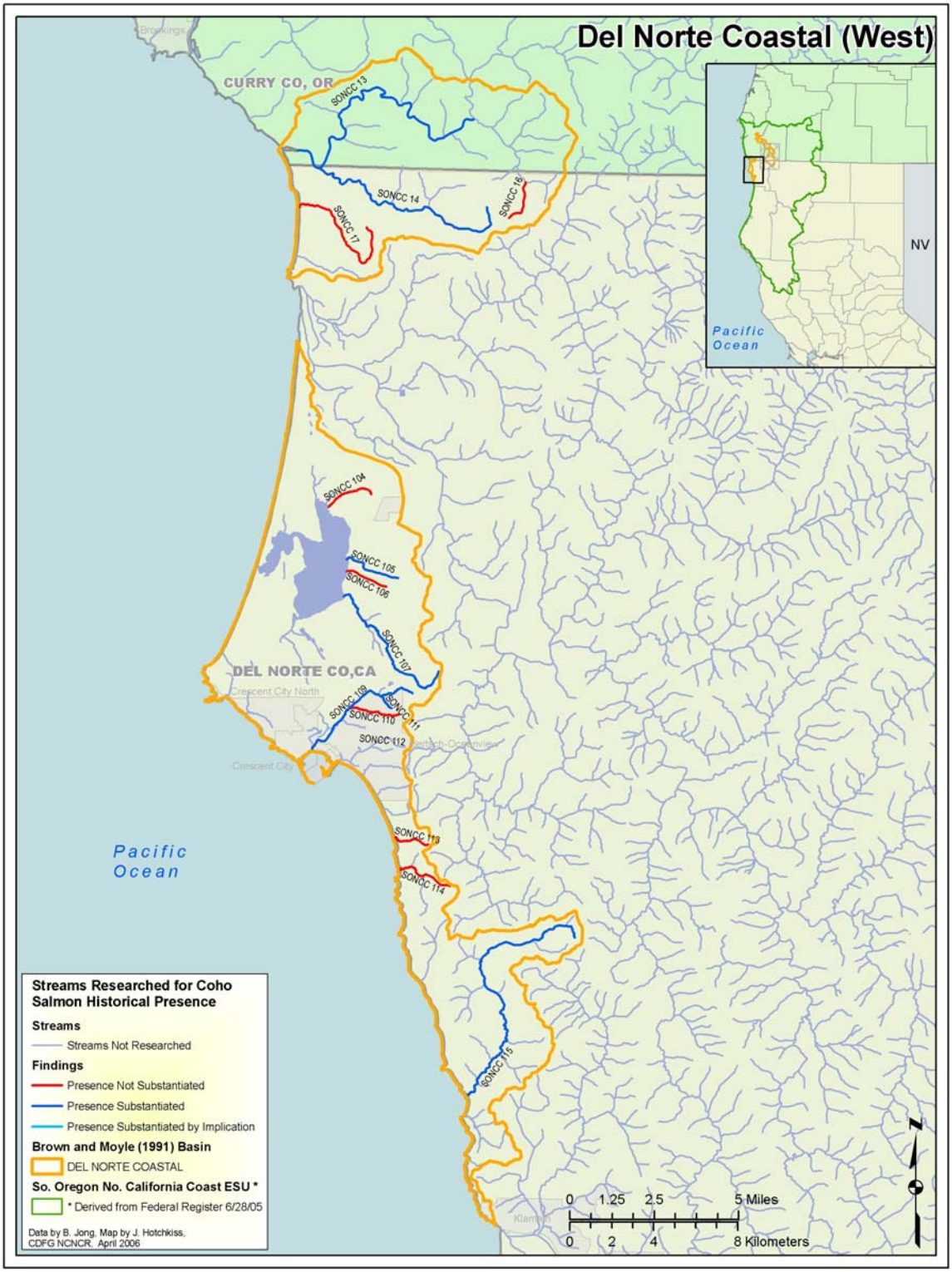

Figure 3a. Map of all streams researched and location of known coho salmon streams in the western portion of the Del Norte Coastal basin. Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

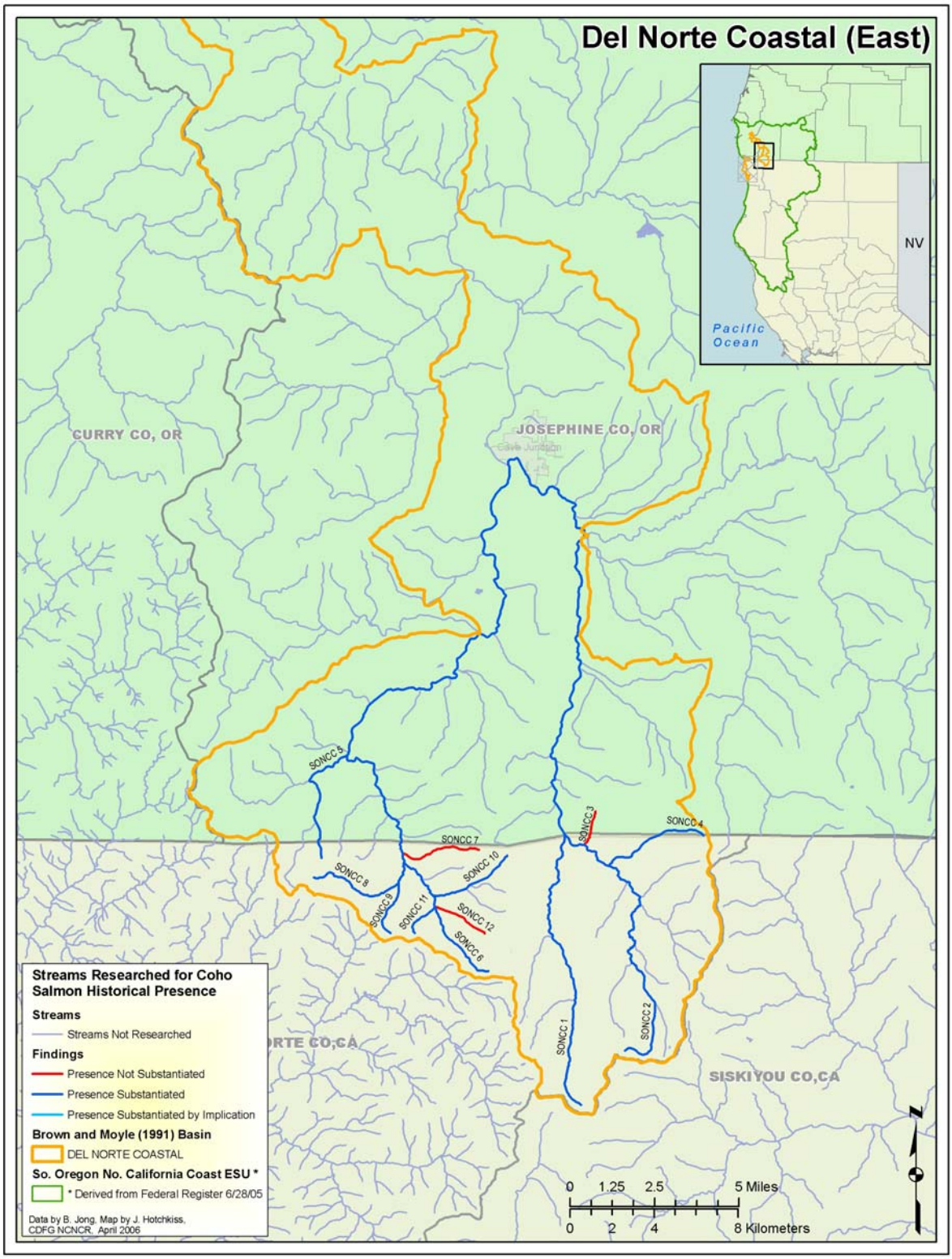

Figure 3b. Map of all streams researched and location of known coho salmon streams in the eastern portion of the Del Norte Coastal basin. Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

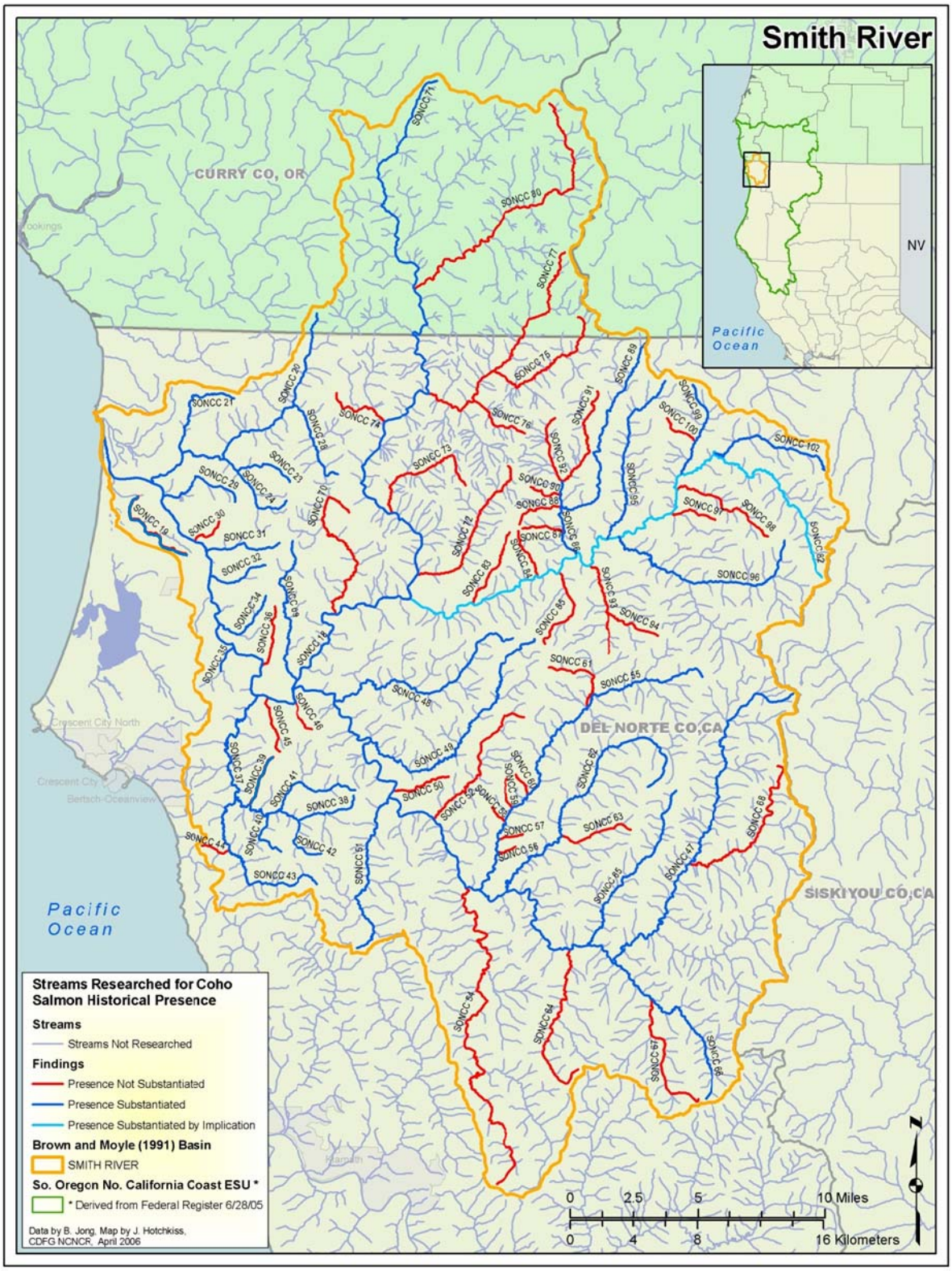

Figure 4. Map of all streams researched and location of known coho salmon streams in the Smith River basin. Streams are labeled using the Stream ID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

Klamath River

Sampling data was reviewed for 430 streams in the Klamath River basin, including all major tributaries (Trinity, Salmon, Scott and Shasta rivers) and tributaries occurring above major dams. Coho salmon presence was confirmed for 180 streams (Table 2; Figure 5). Coho salmon presence could not be confirmed in Hayfork Creek [221], Salt Creek [246], Moffett Creek [528] or Unnamed trib A; Crescent City Fork Blue Creek [149]. However, coho salmon presence is implied in these four streams due to presence in tributary streams: Philpot Creek [247][6] implicates both Hayfork Creek and Salt Creek (Figure 5d); McAdam Creek [529] implicates Moffett Creek (Figure 5o); and Unnamed trib (aka Doctor Rock Creek); Unnamed trib A; Crescent City Fork Blue Creek [150] implicates Unnamed trib A; Crescent City Fork Blue Creek [149] (Figure 5a). The addition of these four streams brings the total number of historic coho salmon streams in the Klamath River basin to 184 (Table 3). Two of these streams, Jenny Creek [615] and Fall Creek [616] are located above Iron Gate Dam (Figure 5s).

Brown and Moyle (1991) identified 114 historic coho salmon streams in the Klamath River basin. Coho salmon presence was confirmed for 103 streams originally identified by Brown and Moyle (1991). However, based on this study, 11 Brown and Moyle identified streams could not be verified through document review or field surveys (Table 3). Two entries were eliminated based on redundancy. These included the Klamathon Racks (redundant to a specific location along the Klamath River) and the Shasta River (represented twice in the stream list). The remaining nine streams were removed because occurrence records could not be verified through document review or field surveys (Table 3). Unverified streams include: Potato Patch Creek [145], Miners Creek [179], Little Pine Creek [183], Rattlesnake Creek [288], North Russian Creek [420], South Russian Creek [421], Taylor Creek [437], Ukonom Creek [456], and Barkhouse Creek [571].Two streams, North Branch East Fork Bear Creek [9999] and Unnamed trib (aka East Fork Bear Creek); Bear Creek [9999], could not be placed on a map[7]. The 77 remaining historic coho salmon streams were identified through document review. Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in 41 out of 63 (65%) of streams surveyed (Table 5).

Humboldt Coastal

Sampling data was reviewed for 80 waters in the Humboldt Coastal basin (Table 2; Figure 6). This basin is comprised of small basins and tributaries to the Pacific Ocean located in Humboldt County from its northern boundary to Punta Gorda (excluding Redwood Creek, Mad, Eel, and Mattole rivers, and Humboldt Bay tributaries). Coho salmon presence was

[6] Coho salmon presence in Philpot Creek [247] was reported for the 2003 sampling year (Doc 11682). This occurrence represented a major extension of their known range in the Hayfork Creek drainage. Within three weeks of the initial report, independent follow-up surveys were conducted by CDFG (Doc 0396) and US Forest Service (Doc 11478). Both surveys failed to confirm coho salmon presence.

[7] Reasons include: sampling locations are poorly or not described; a stream can be identified but it is not in the hydrography (if time allows the stream should be digitized and added to the hydrography, or the stream name is another local name for a stream already listed.

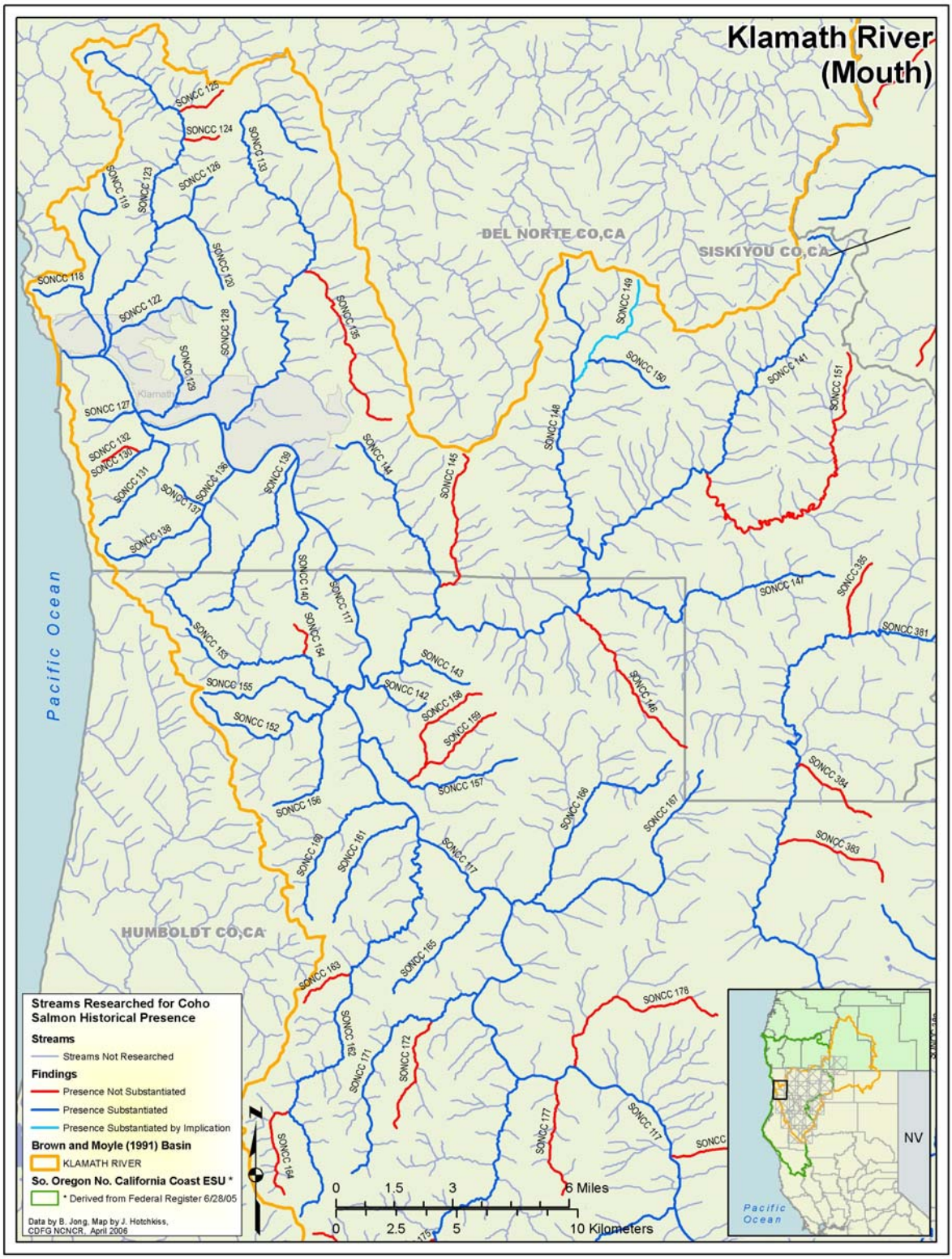

Figure 5a. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (vicinity of Klamath River mouth). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

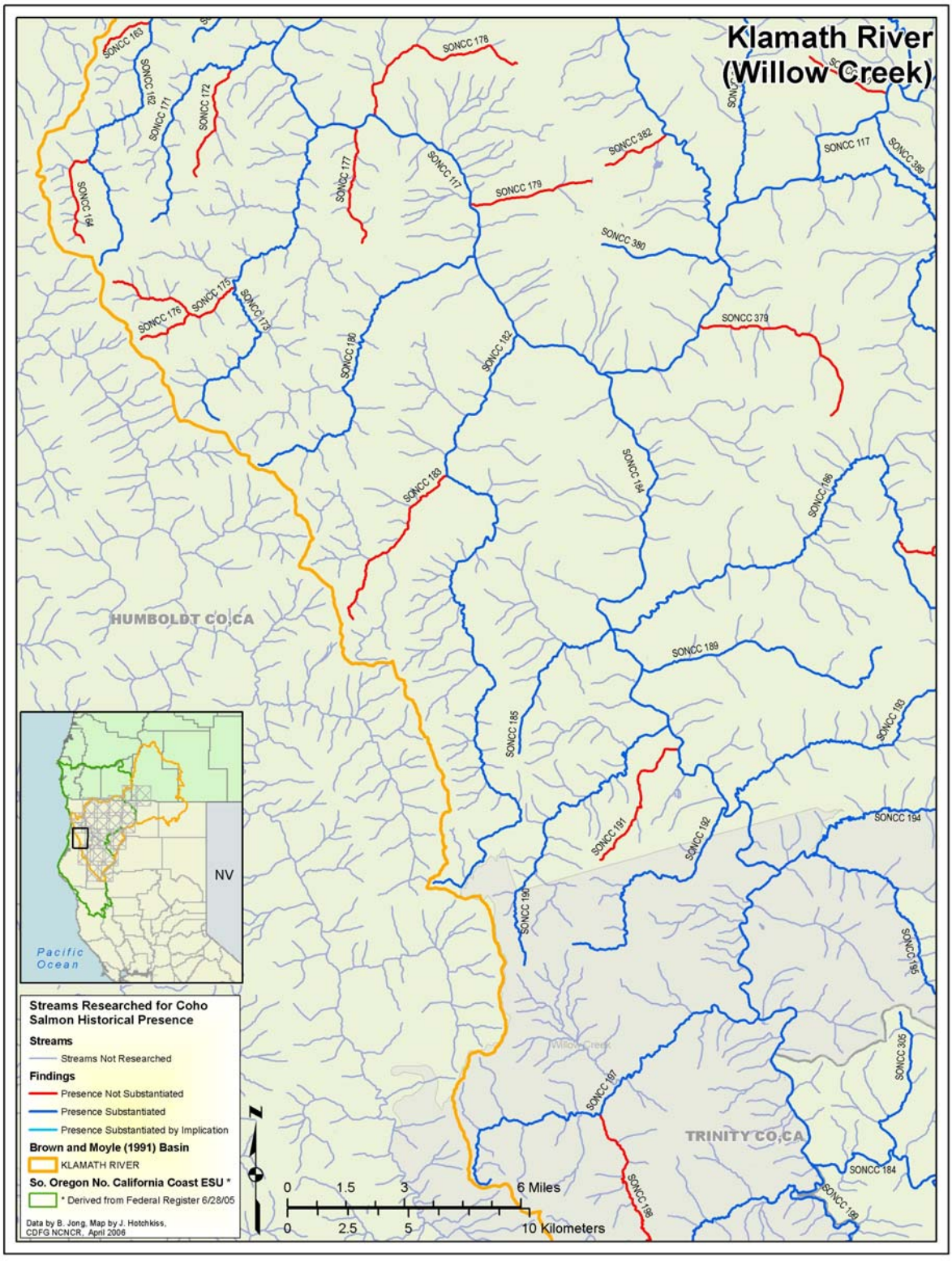

Figure 5b. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Willow Creek portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

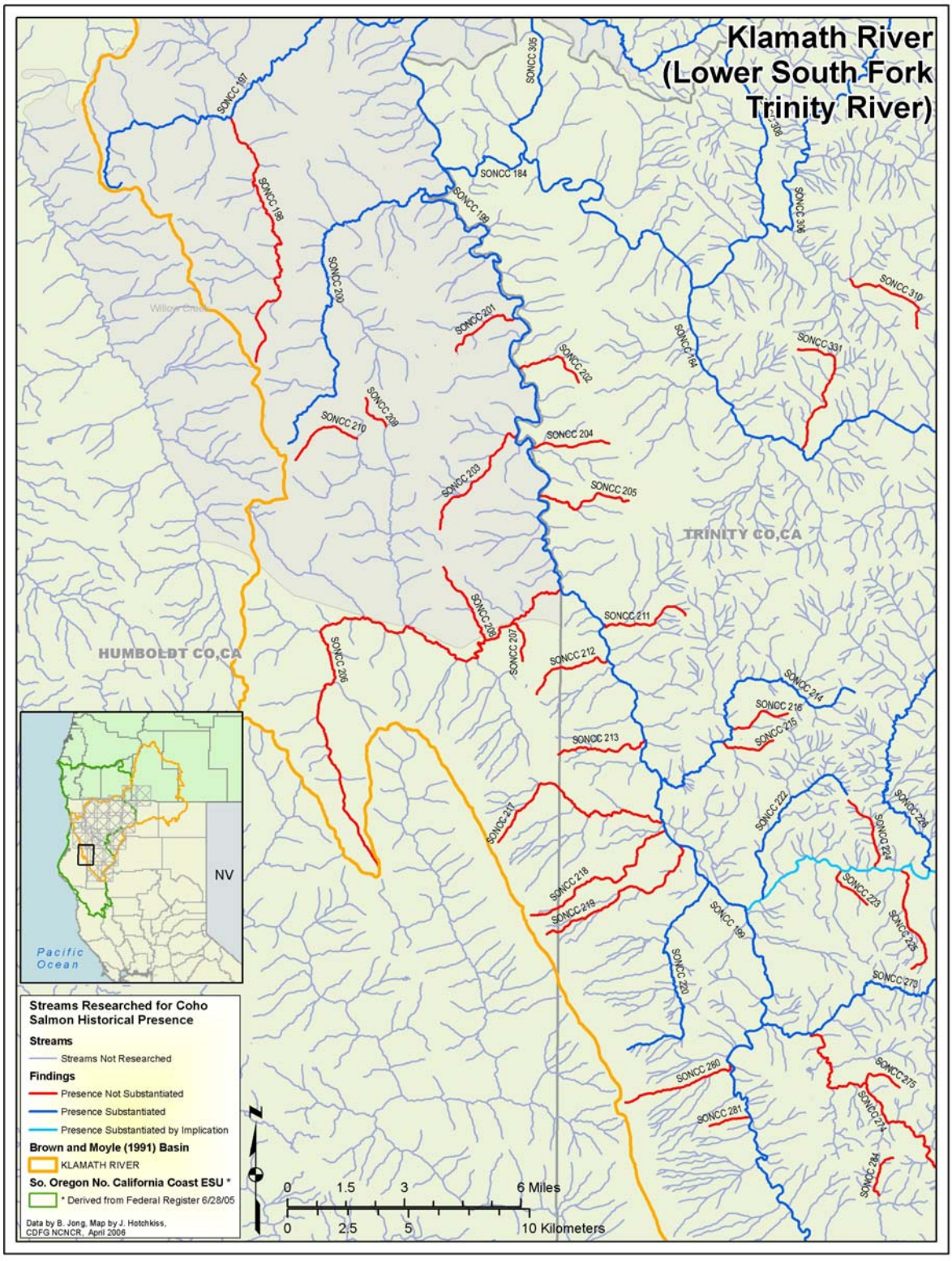

Figure 5c. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (lower South Fork Trinity River portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

Figure 5d. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (upper South Fork Trinity River portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

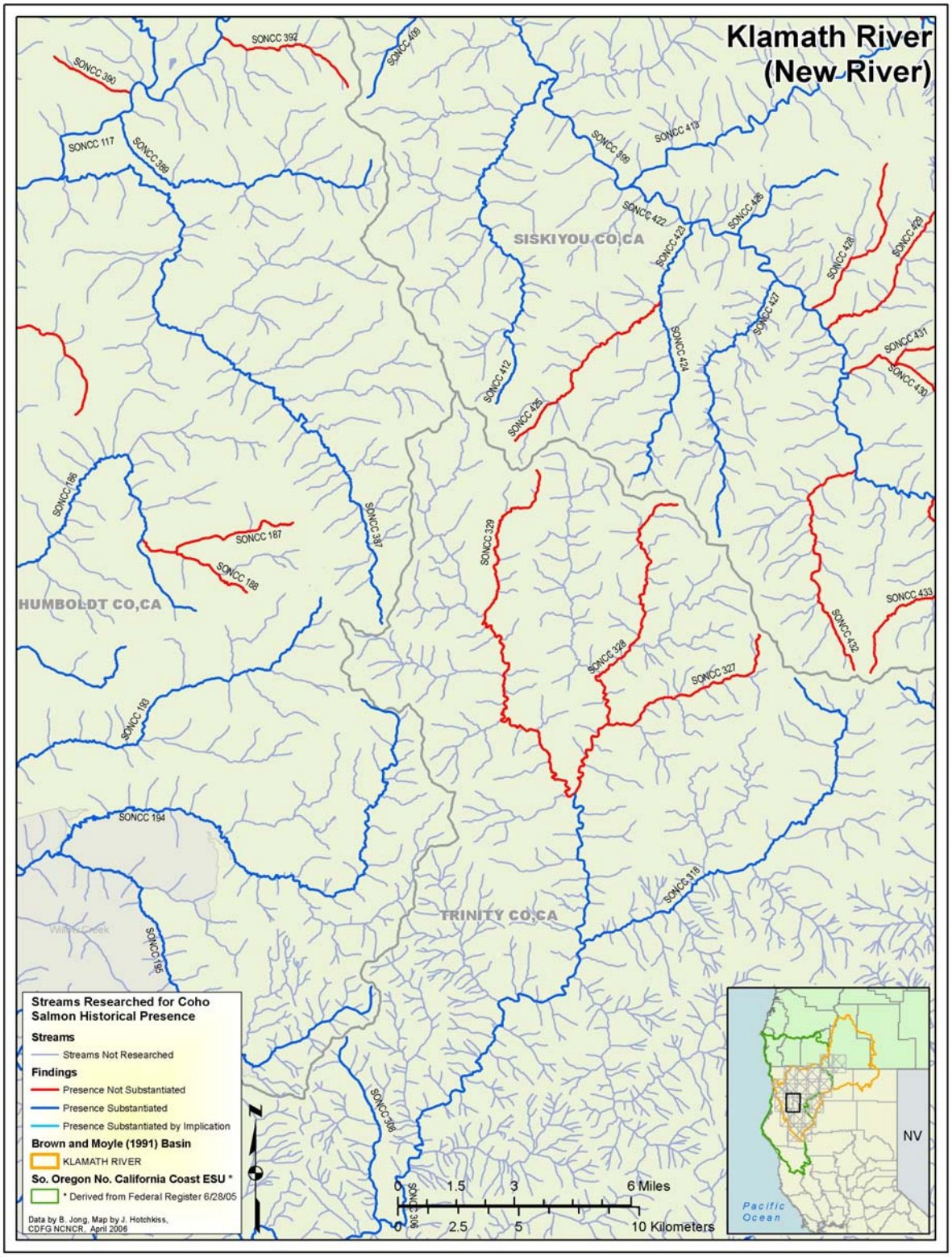

Figure 5e. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (New River portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

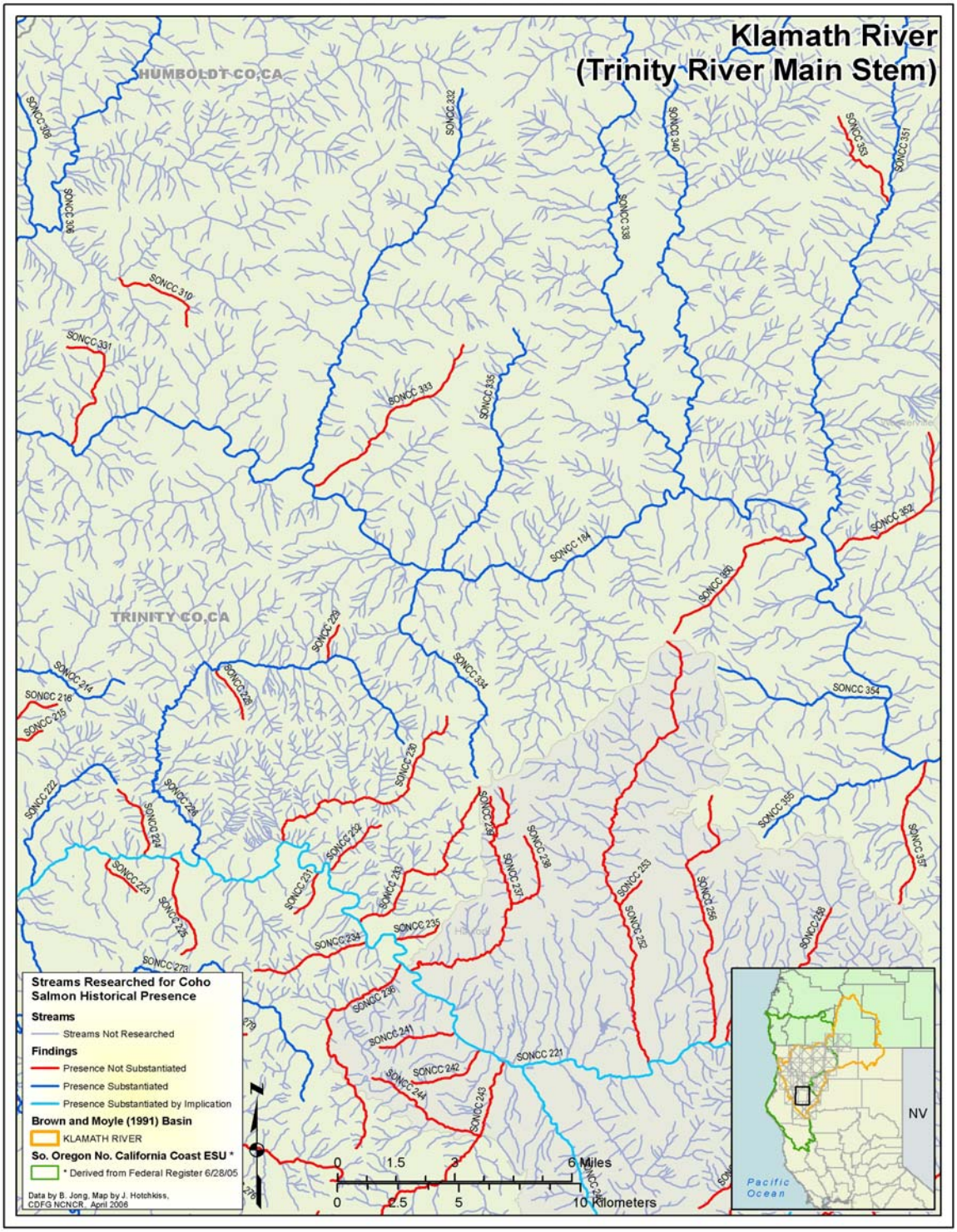

Figure 5f. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Trinity River main stem portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

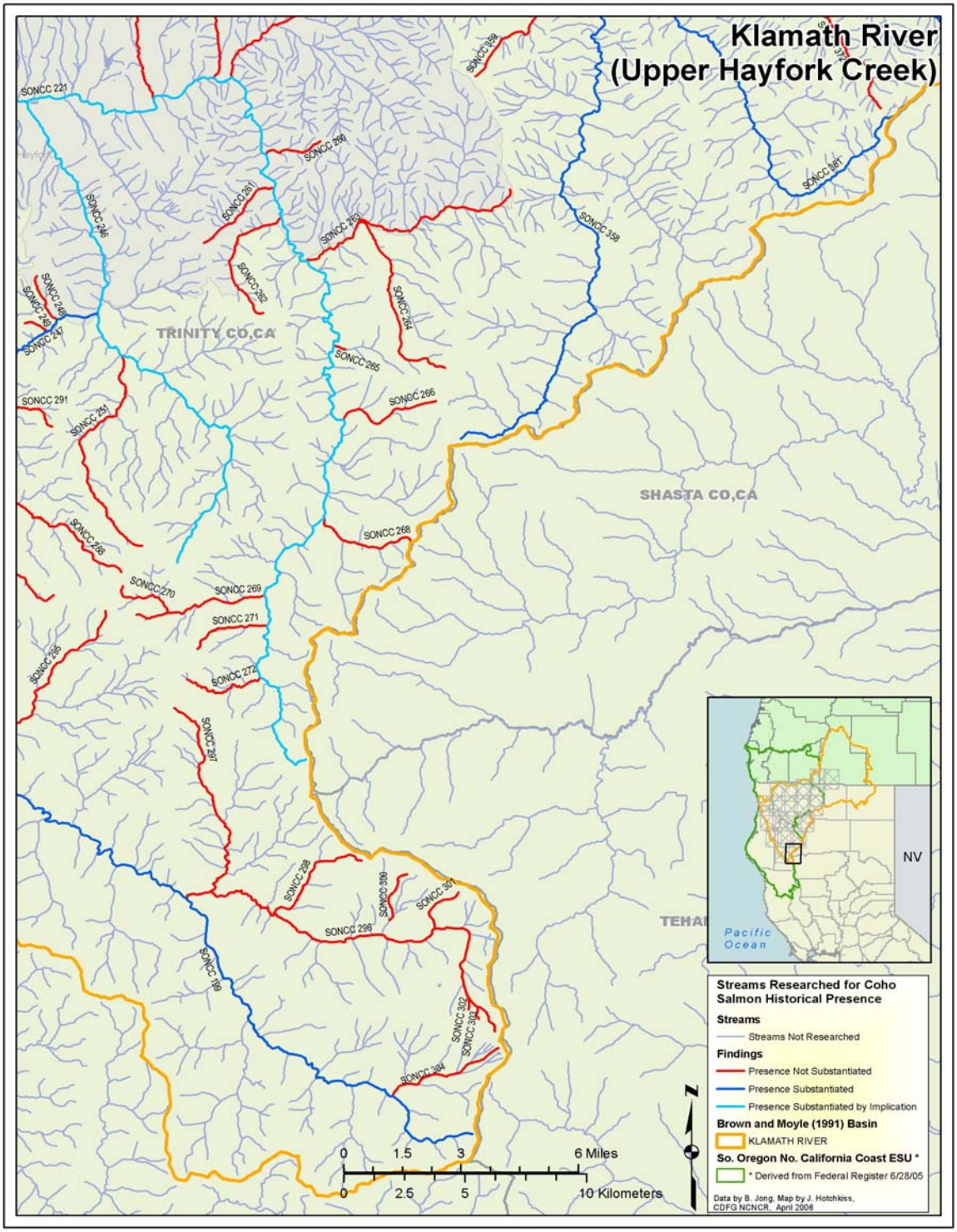

Figure 5g. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (upper Hayfork Creek portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

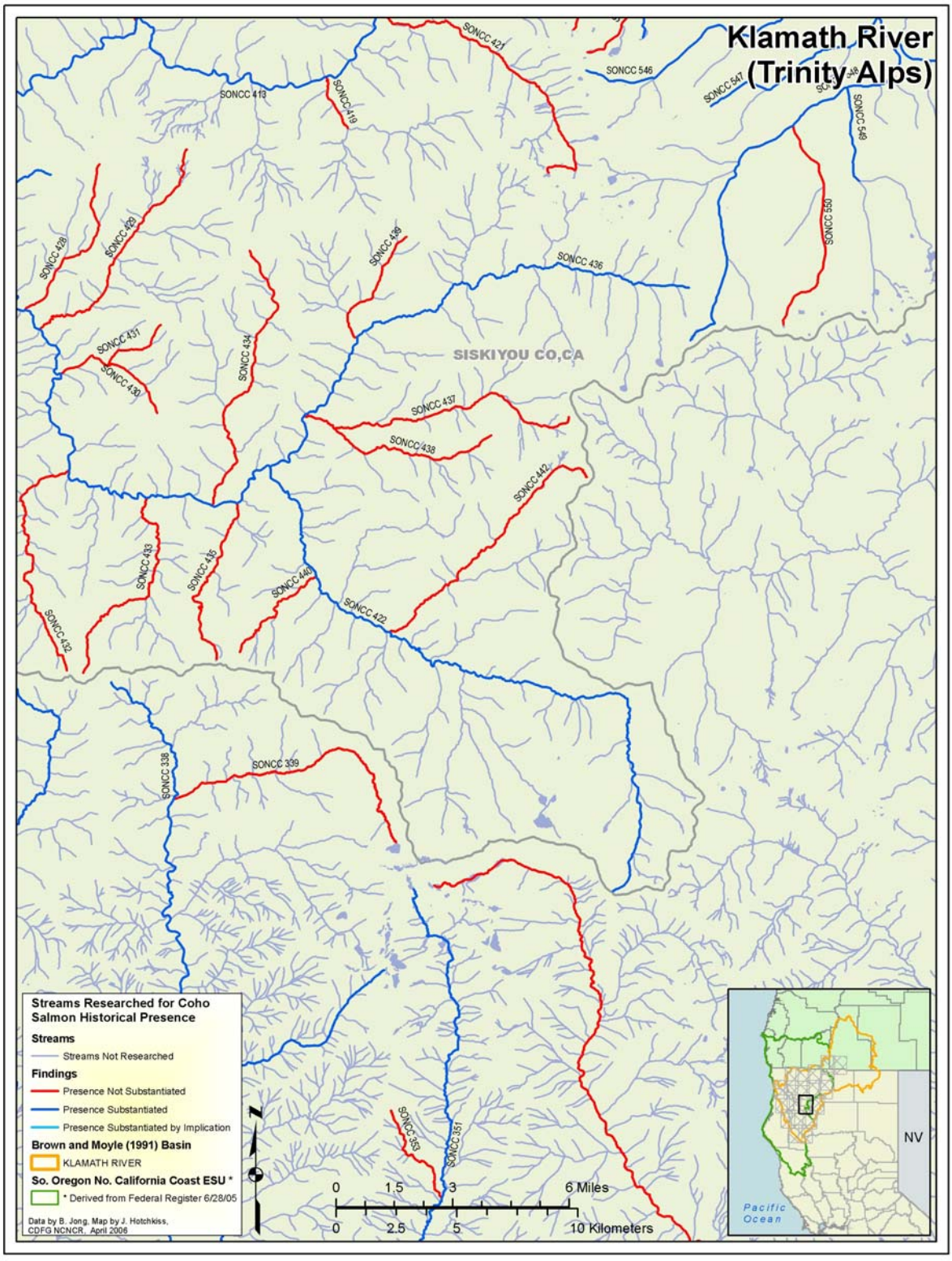

Figure 5h. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Trinity Alps portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

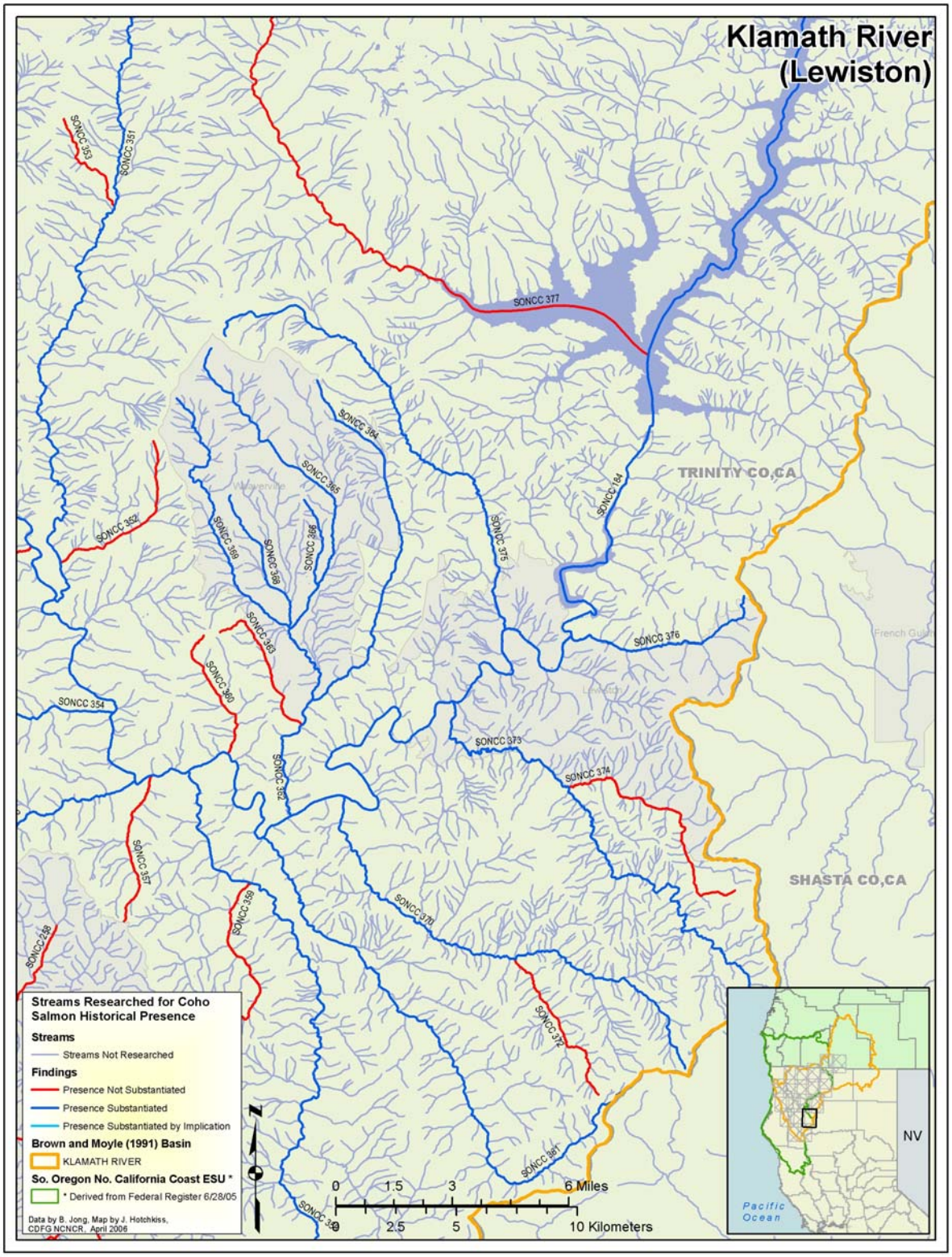

Figure 5i. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Lewiston portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

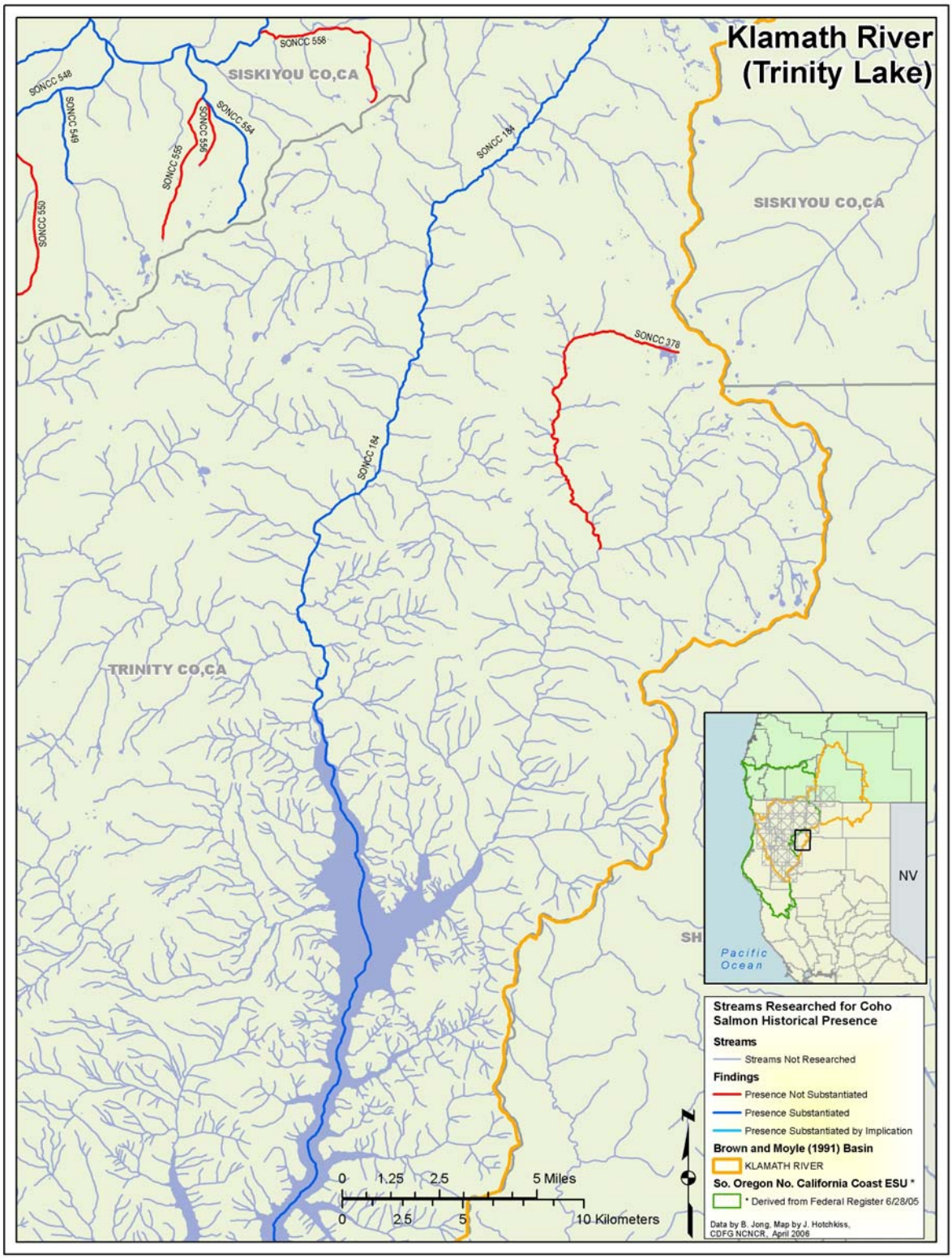

Figure 5j. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Trinity Lake portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

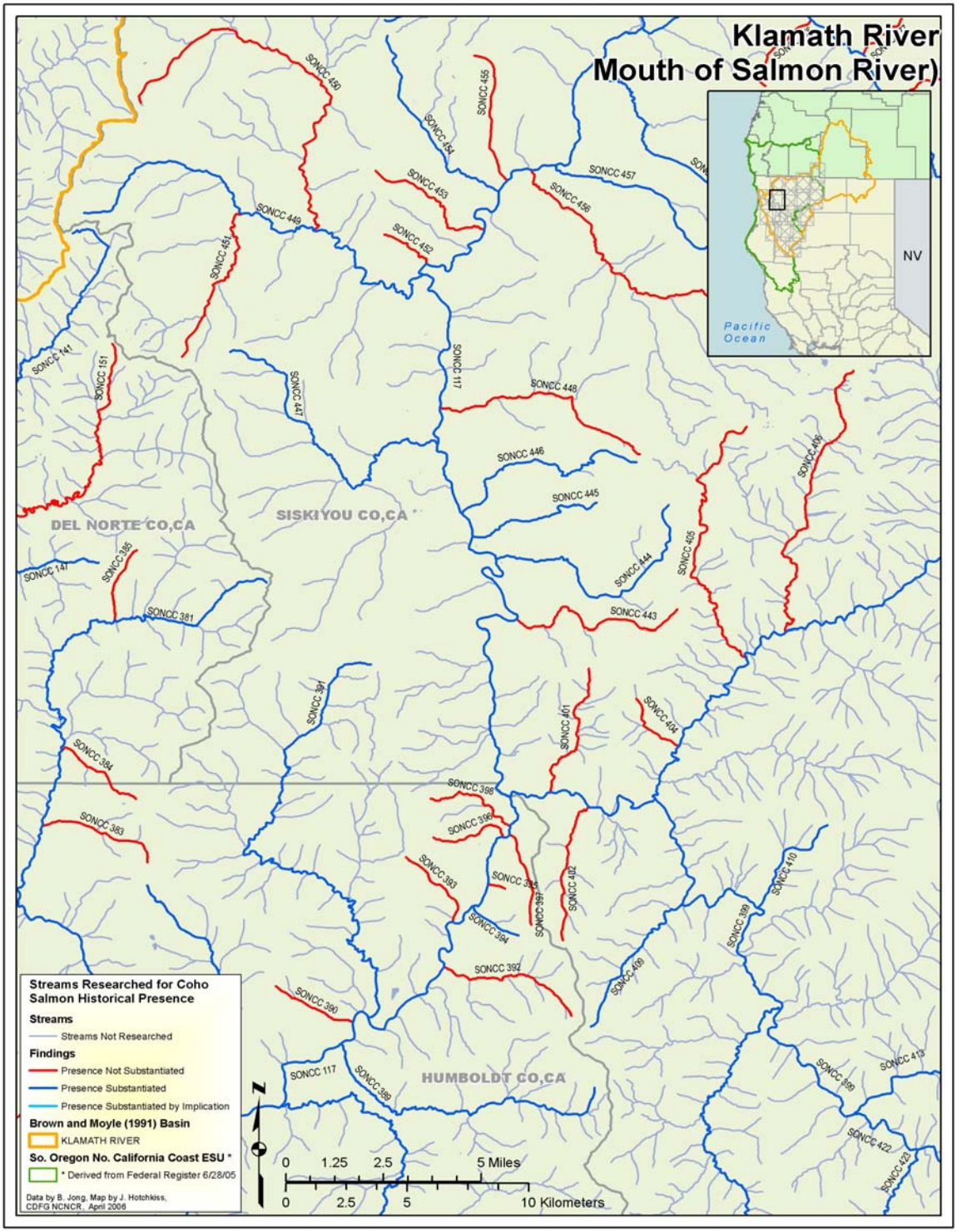

Figure 5k. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (vicinity of mouth of Salmon River). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

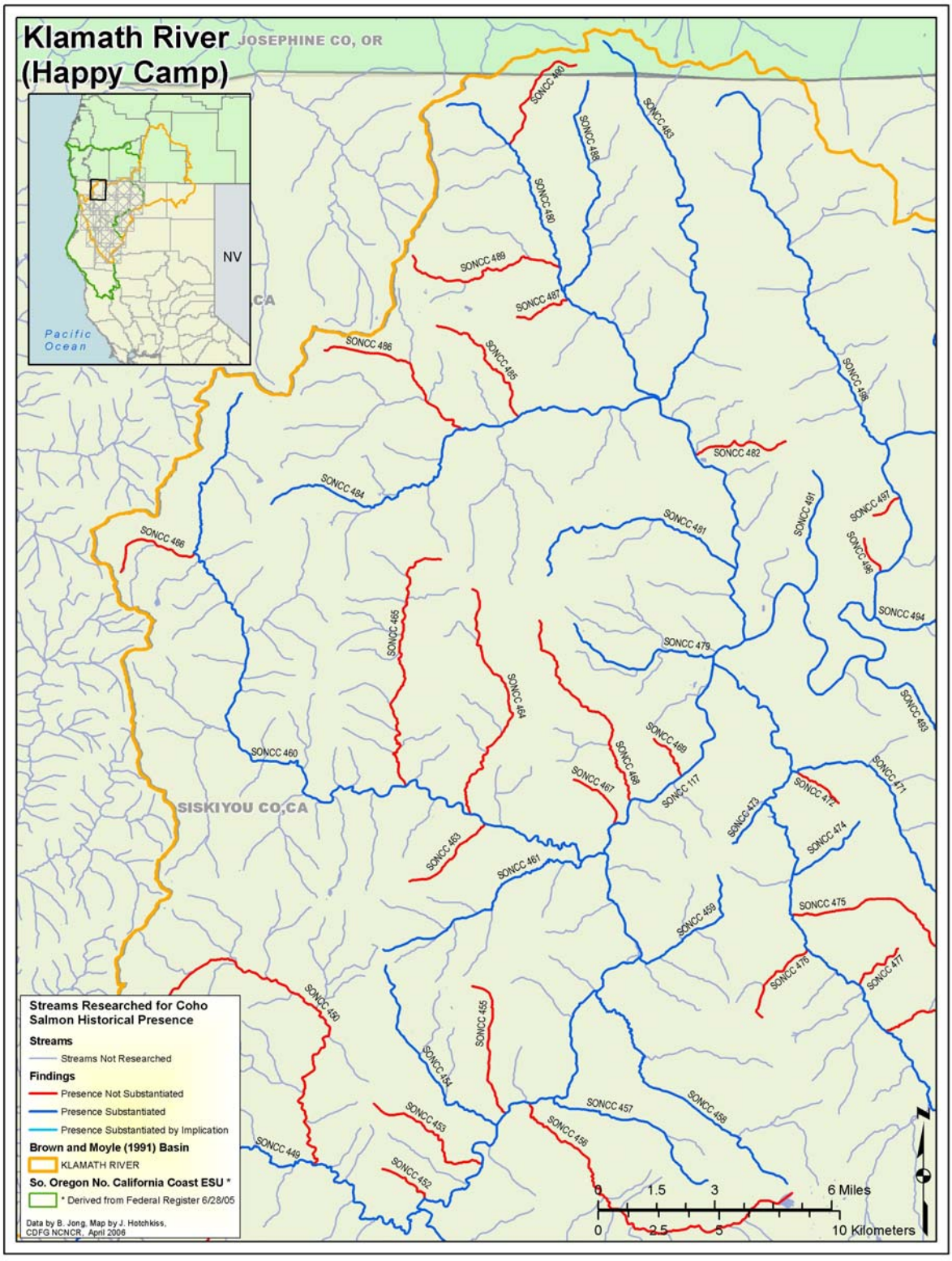

Figure 5l. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Happy Camp portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

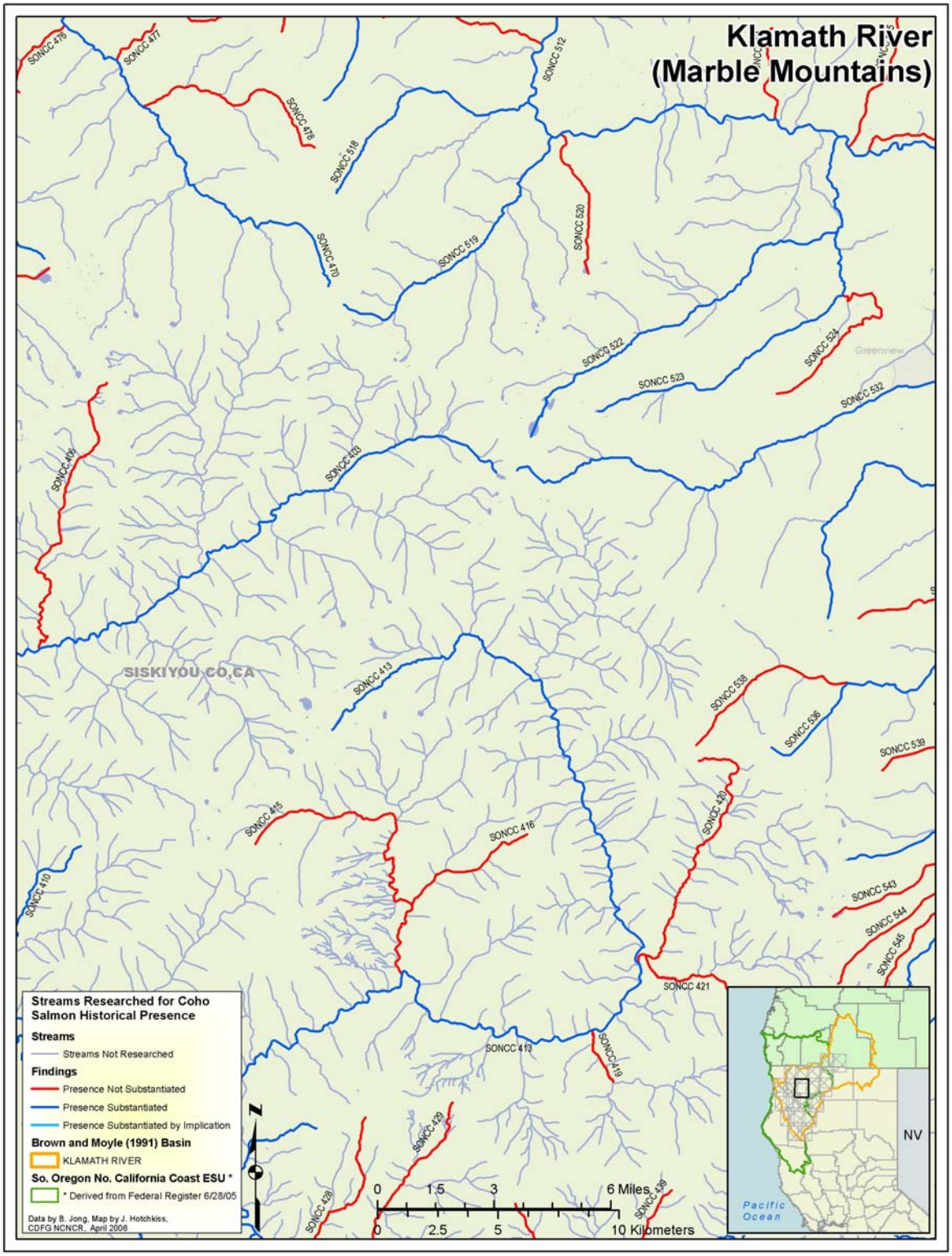

Figure 5m. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Marble Mountains portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

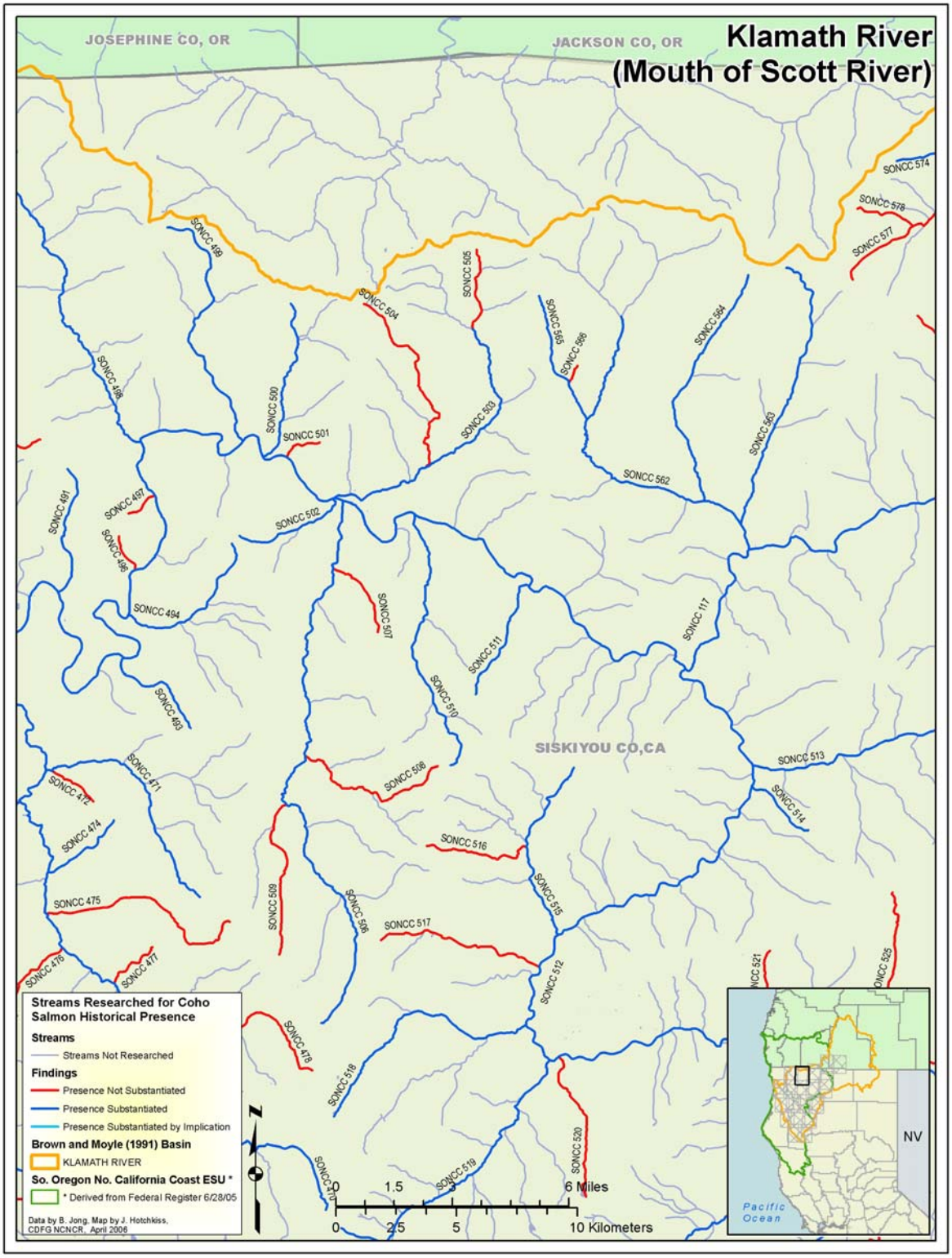

Figure 5n. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (mouth of Scott River portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

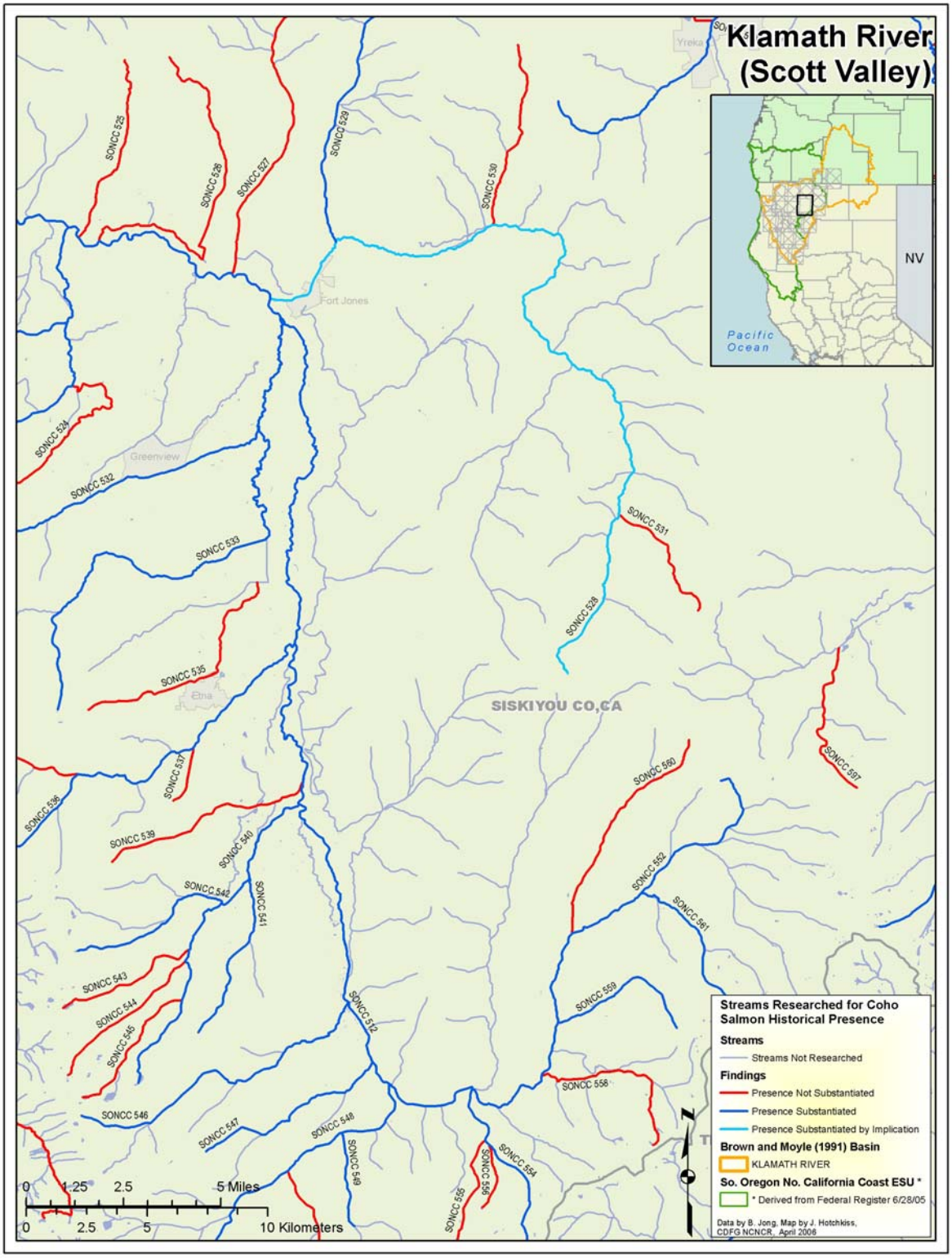

Figure 5o. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Scott Valley portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

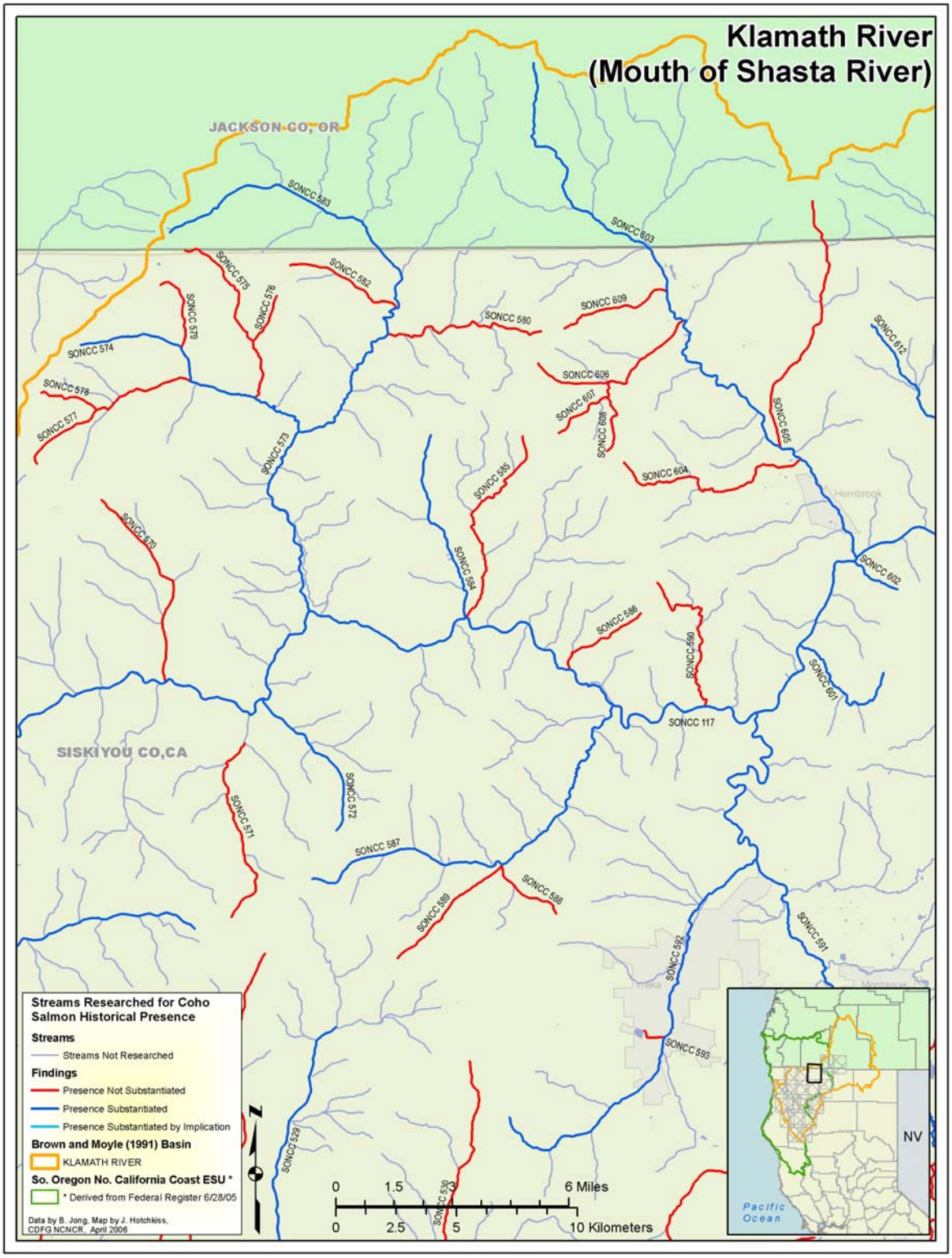

Figure 5p. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (mouth of Shasta River portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

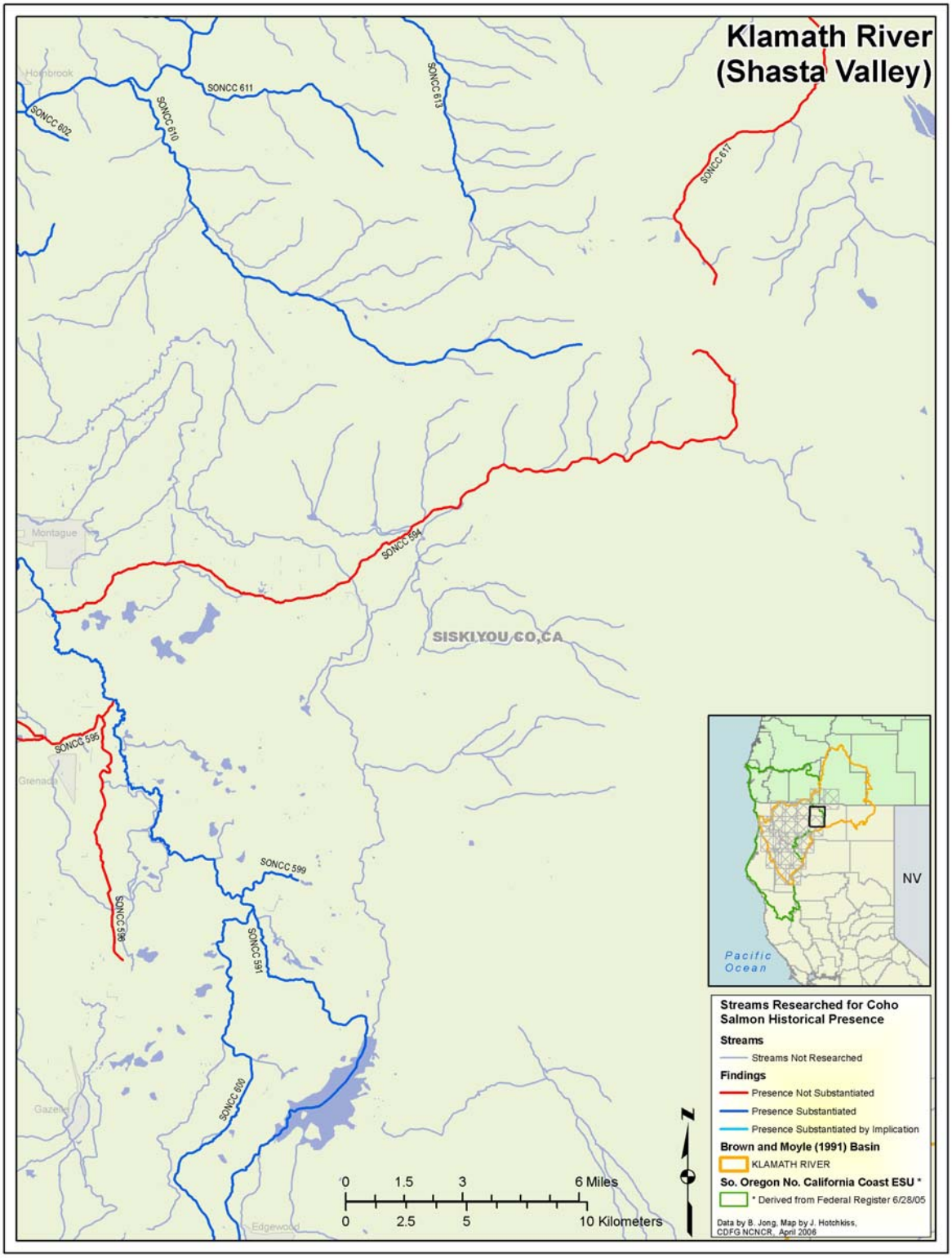

Figure 5q. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Shasta Valley portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual observed coho salmon distribution.

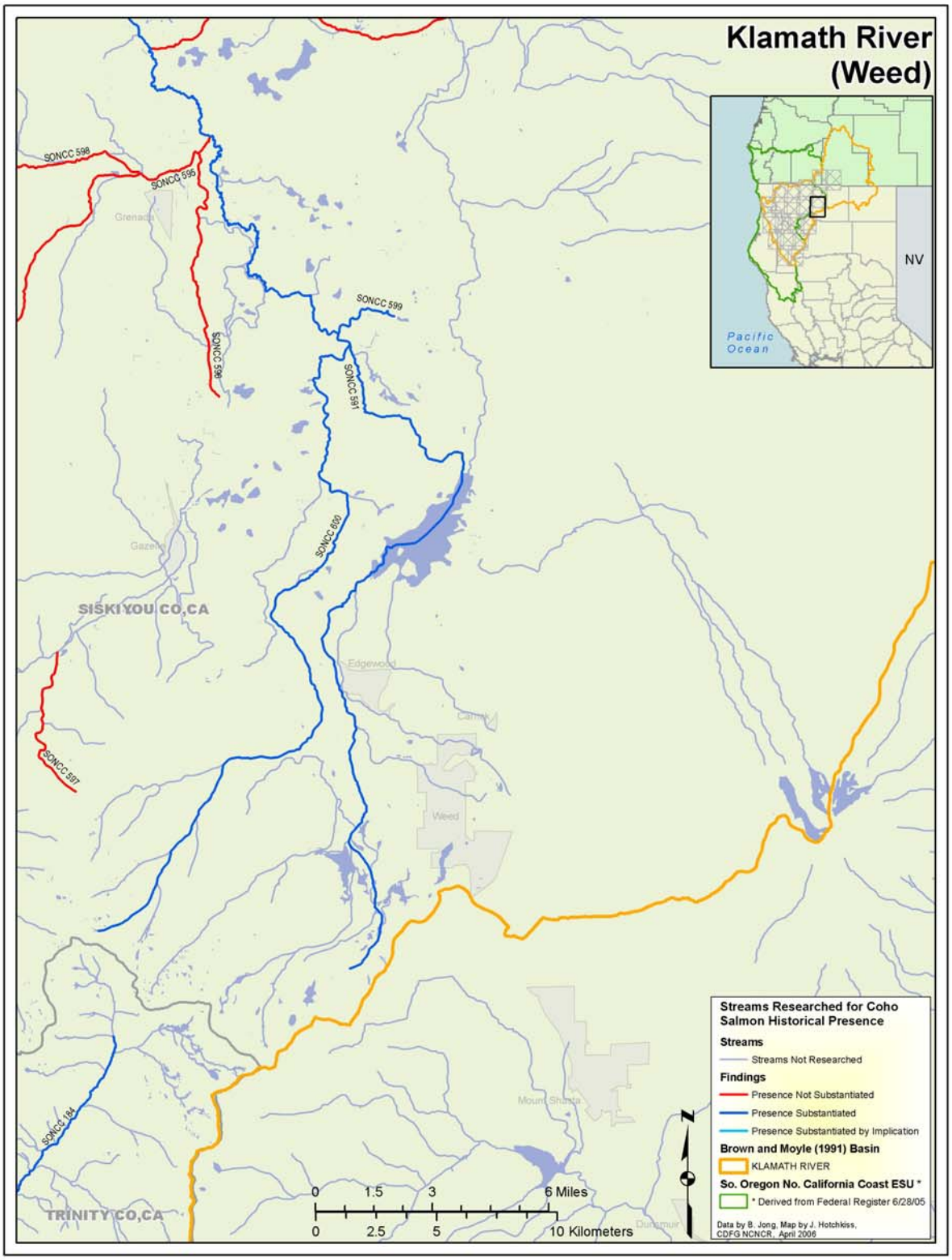

Figure 5r. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Weed portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

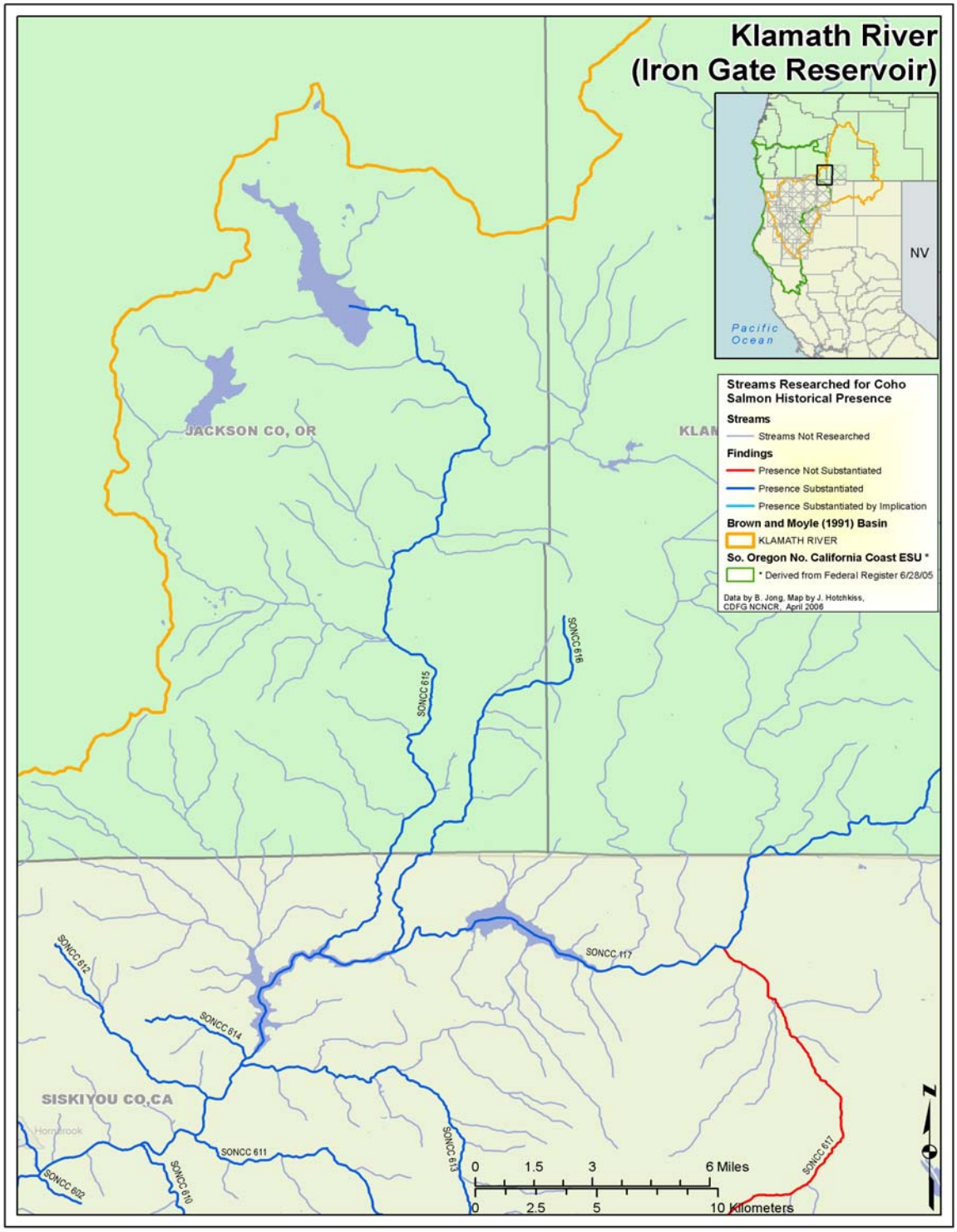

Figure 5s. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Iron Gate Reservoir portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

Figure 5t. Map of all streams researched and location of known coho salmon streams in the Klamath River basin (Klamath Falls portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

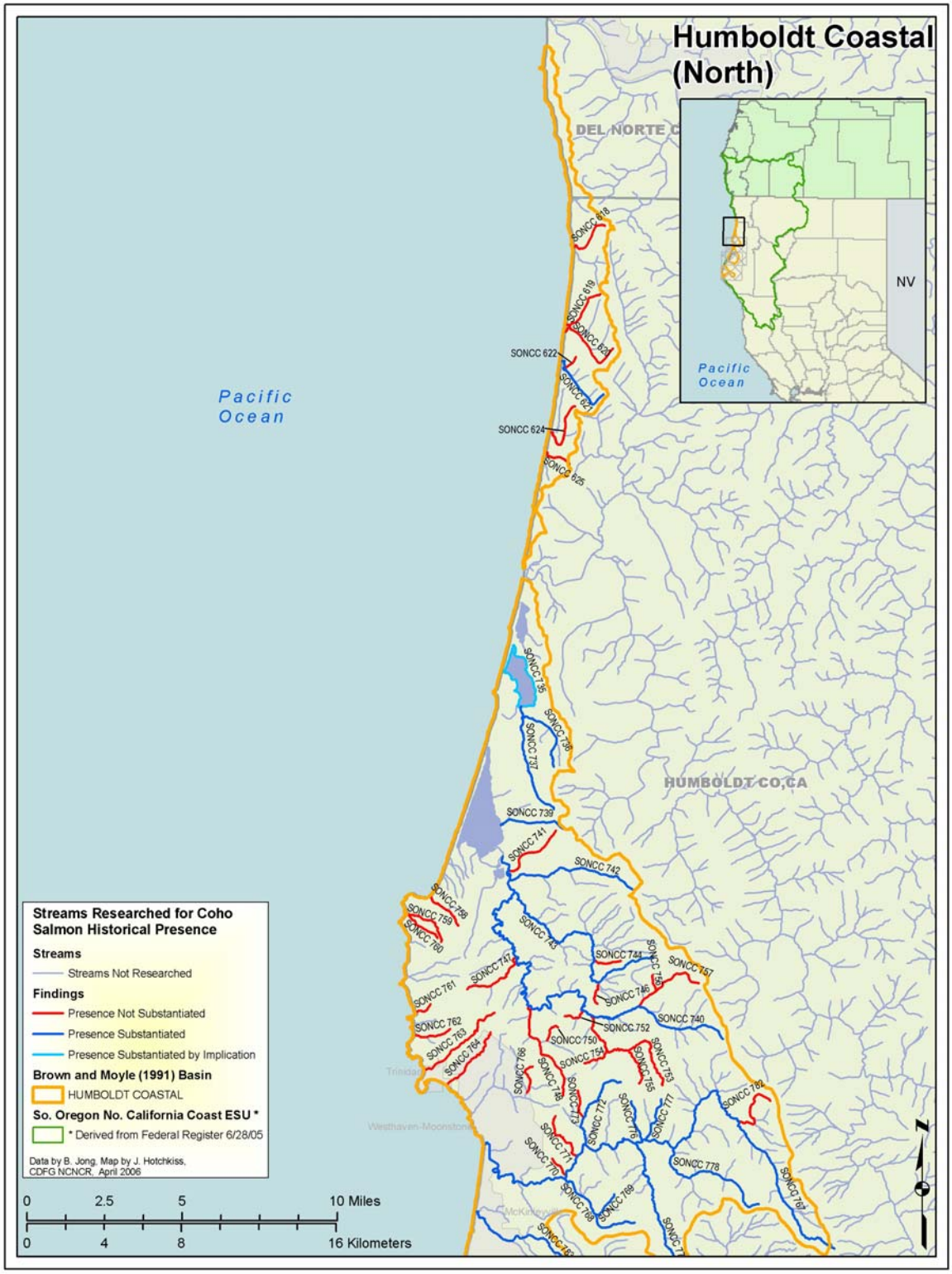

Figure 6a. Map of all streams researched and location of known coho salmon streams in the Humboldt Coastal (north of Punta Gorda, northern portion) basin. Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

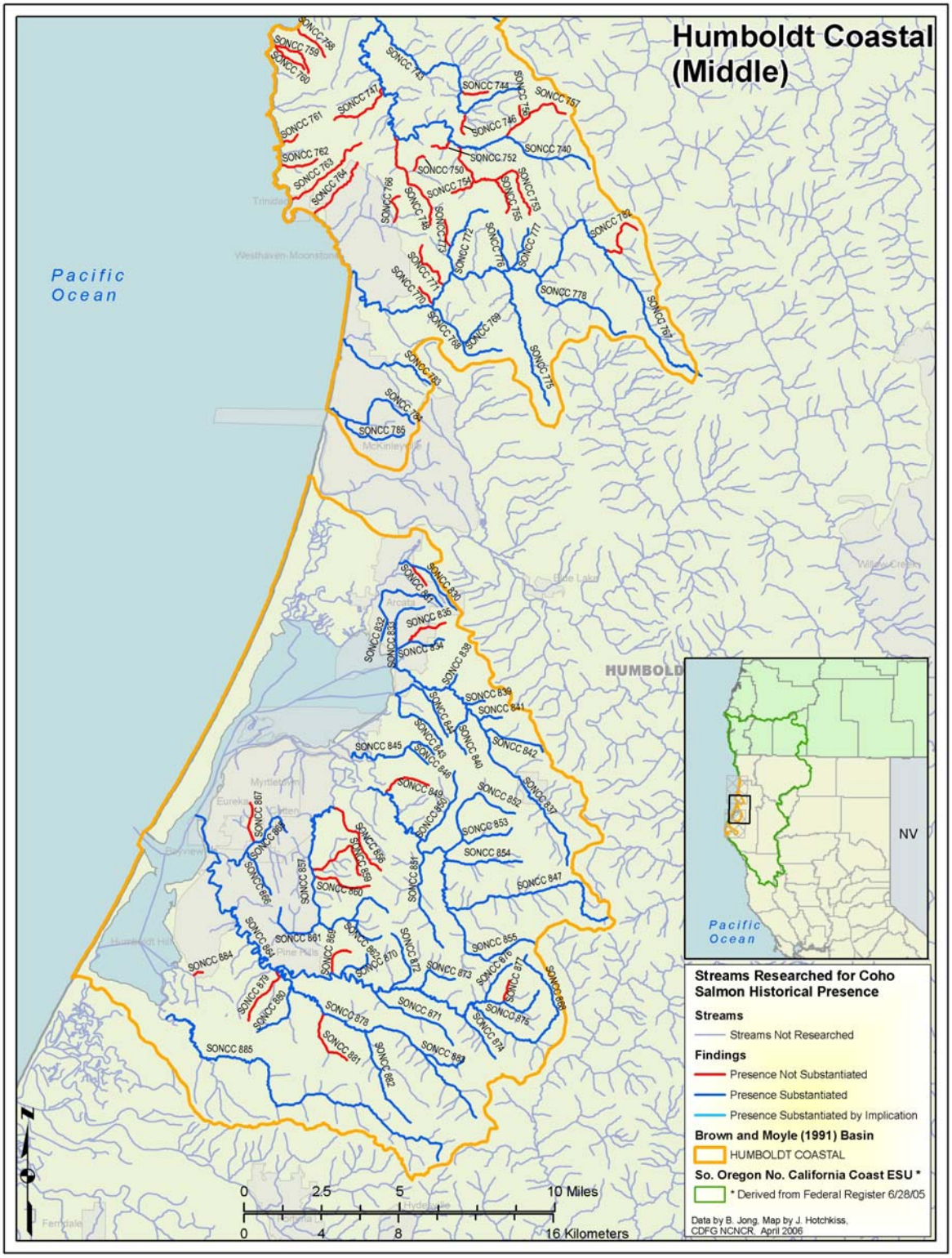

Figure 6b. Map of all streams researched and location of known coho salmon streams in the Humboldt Coastal (north of Punta Gorda, middle portion) and Humboldt Bay Tributaries basins. Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

Figure 6c. Map of all streams researched and location of known coho salmon streams in the Humboldt Coastal (north of Punta Gorda, southern portion) and Humboldt Bay Tributaries basins. Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

confirmed for 21 waters (19 streams and two coastal lagoons) (Table 3). Eight streams and one lagoon originally identified by Brown and Moyle (1991) were confirmed coho salmon waters through this study. However, five streams were removed from the original 14 streams identified by Brown and Moyle (1991) because occurrence records could not be verified through document review or field surveys (Table 3). Unverified streams include: Bear River [1388], Bonanza Gulch [1389], South Fork Bear River [1390], Hollister Creek [1392], and McNutt Gulch [1418]. The remaining 11 coho salmon streams and one coastal lagoon were identified through document review. Field surveys conducted for this study did not detect coho salmon in four streams surveyed from 2001 to 2003 (Table 5).

Redwood Creek

Sampling data was reviewed for 100 streams in the Redwood Creek basin (Table 2; Figure 7) resulting in 30 streams having coho salmon observations (Table 3). All 14 streams originally identified by Brown and Moyle (1991) were confirmed coho salmon waters through this study (Table 3). The remaining 16 coho salmon streams were identified through document review. Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in seven out of eight (88%) of streams surveyed (Table 5).

Mad River

Sampling data was reviewed for 34 streams in the Mad River basin (Table 2; Figure 8) resulting in 22 streams having coho salmon observations (Table 3). Coho salmon presence was confirmed for 19 streams originally identified by Brown and Moyle (1991). However, based on this study, four streams were removed because occurrence records could not be verified through document review or field surveys (Table 3). Unverified streams include: Mill Creek [802], Palmer Creek [807], Long Prairie Creek [811], and Quarry Creek [816]. The remaining three coho salmon streams were identified through document review. Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in 6 out of 14 (43%) of streams surveyed (Table 5).

Humboldt Bay Tributaries

Sampling data was reviewed for 52 streams in the Humboldt Bay Tributaries basin resulting in 40 streams having coho salmon observations (Table 2; Figure 6b). Coho salmon presence was confirmed for 18 streams originally identified by Brown and Moyle (1991). However, based on this study, one stream (College of the Redwoods Creek [884]) was removed (Table 2) from the original 19 streams identified by Brown and Moyle (1991) because the occurrence record could not be verified through document review or field surveys (Table 3). The 22 remaining coho salmon streams were identified through document review. Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in 12 out of 15 (80%) of streams surveyed (Table 5).

Eel River

Sampling data was reviewed for 393 streams in the Eel River basin resulting in 144 streams having coho salmon observations (Table 2; Figure 9). Fish Creek [910], tributary to the Eel River, was added to the coho salmon stream list in 2010 based on recent field

Figure 7a. Map of all streams researched and location of known coho salmon streams in the Redwood Creek basin (northern portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

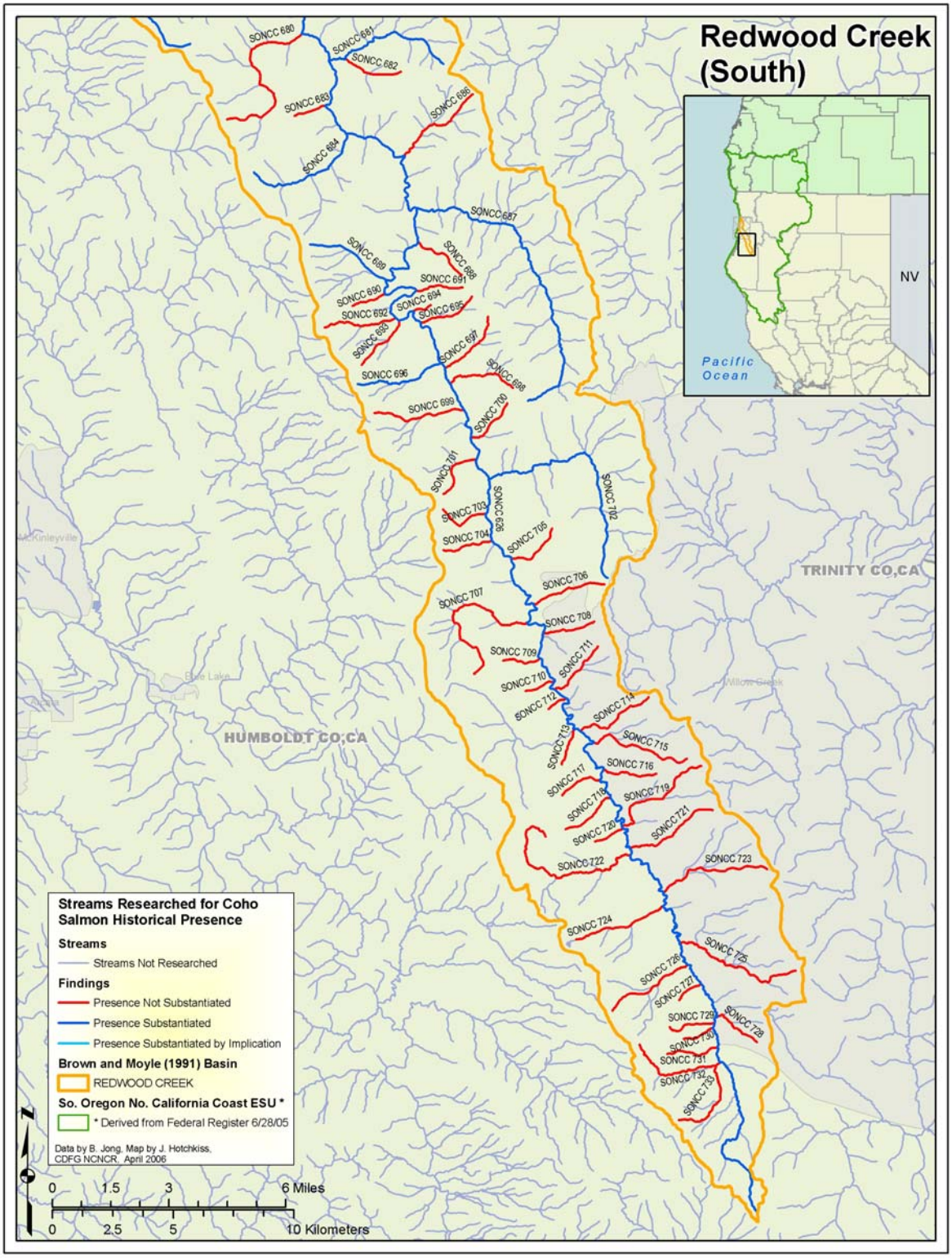

Figure 7b. Map of all streams researched and location of known coho salmon streams in the Redwood Creek basin (southern portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

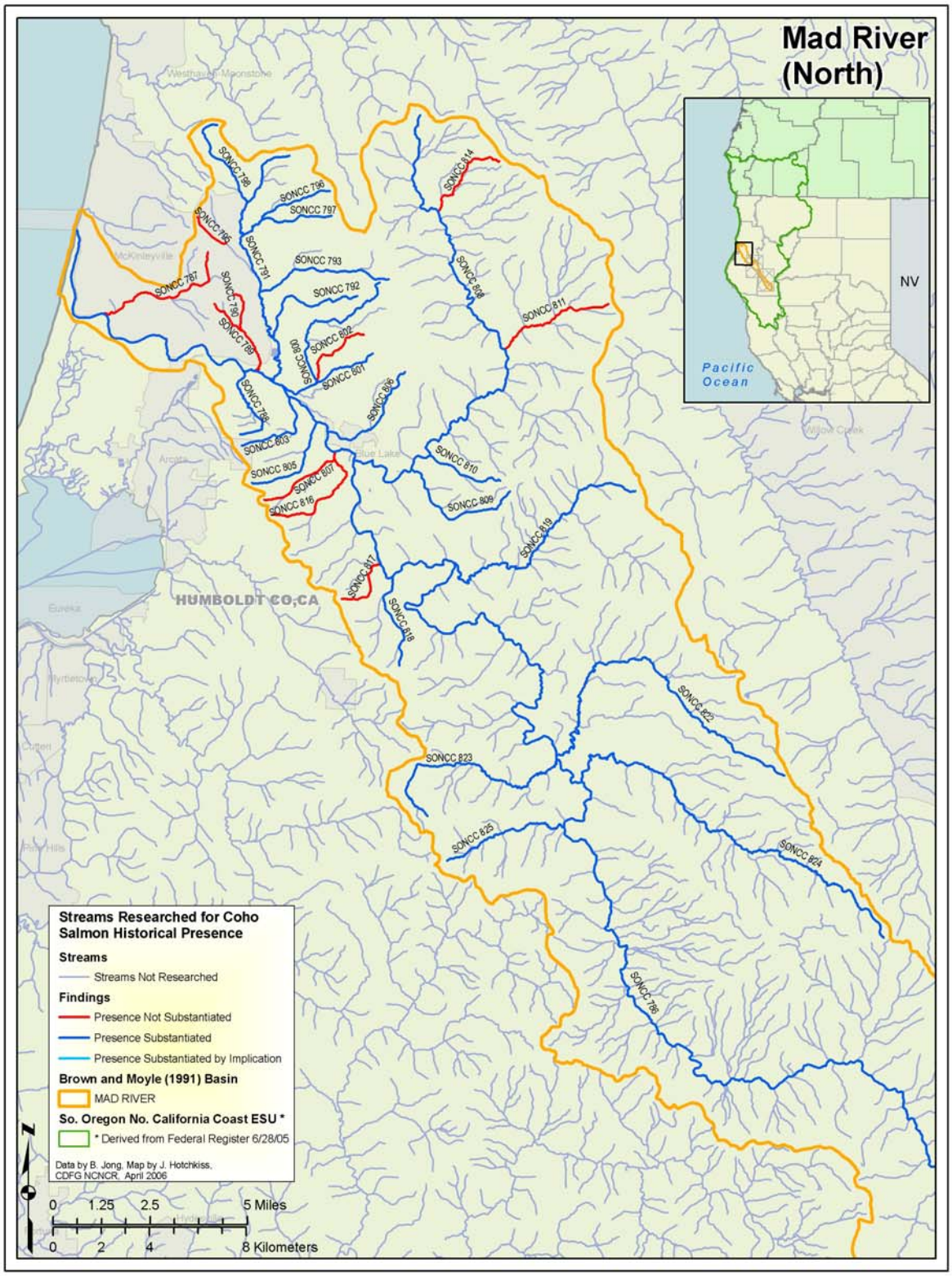

Figure 8a. Map of all streams researched and location of known coho salmon streams in the Mad River basin (northern portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

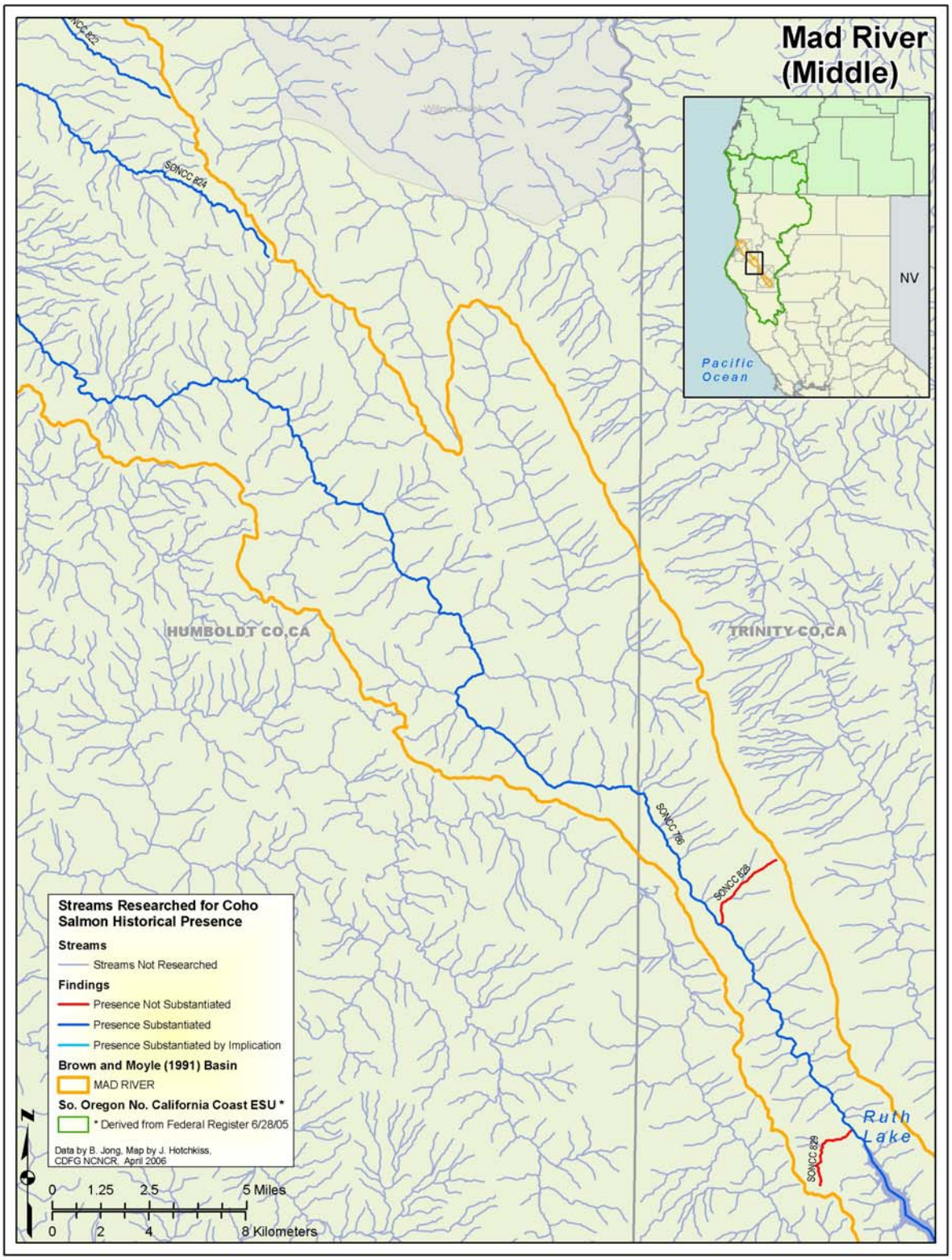

Figure 8b. Map of all streams researched and location of known coho salmon streams in the Mad River basin (middle portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

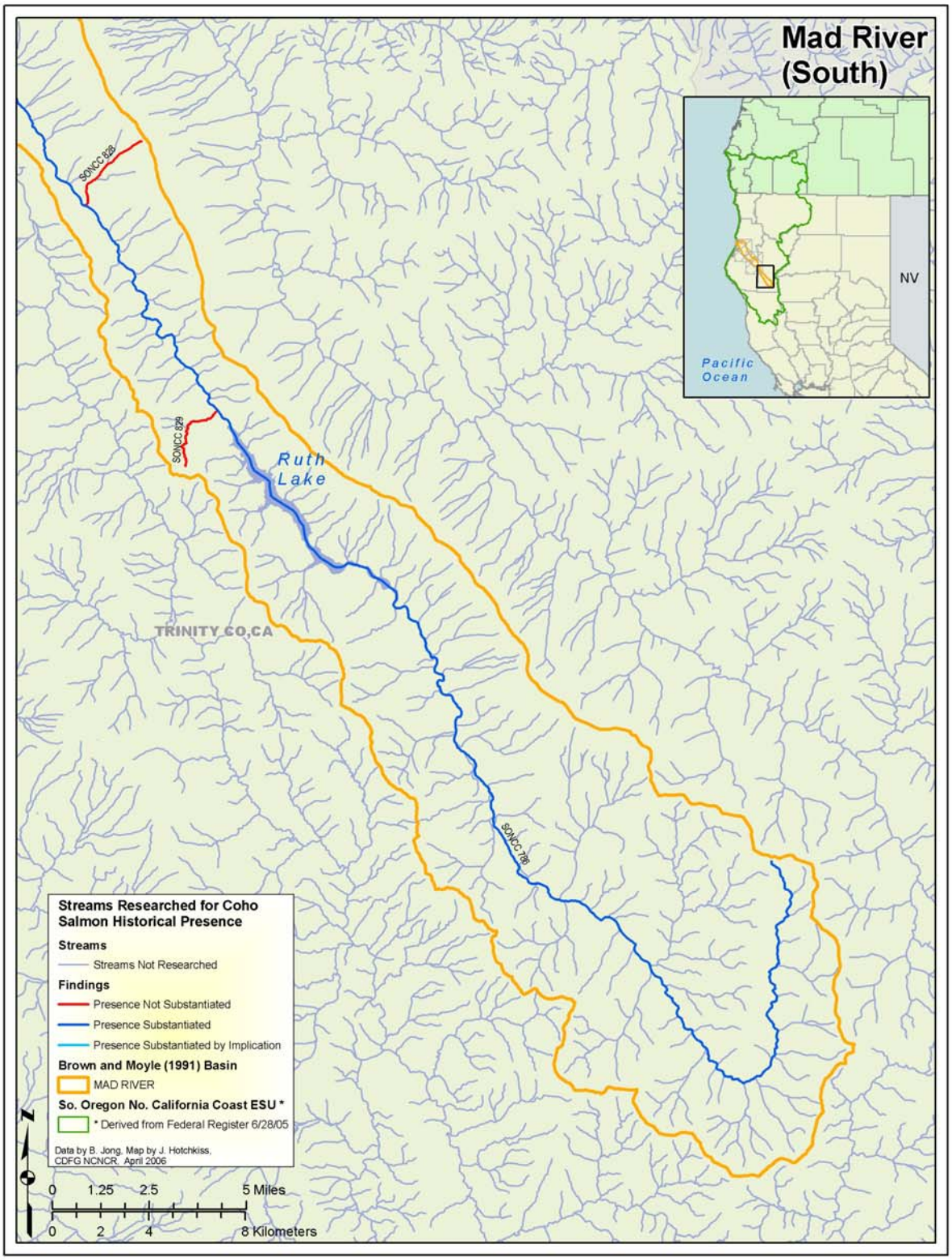

Figure 8c. Map of all streams researched and location of known coho salmon streams in the Mad River basin (southern portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

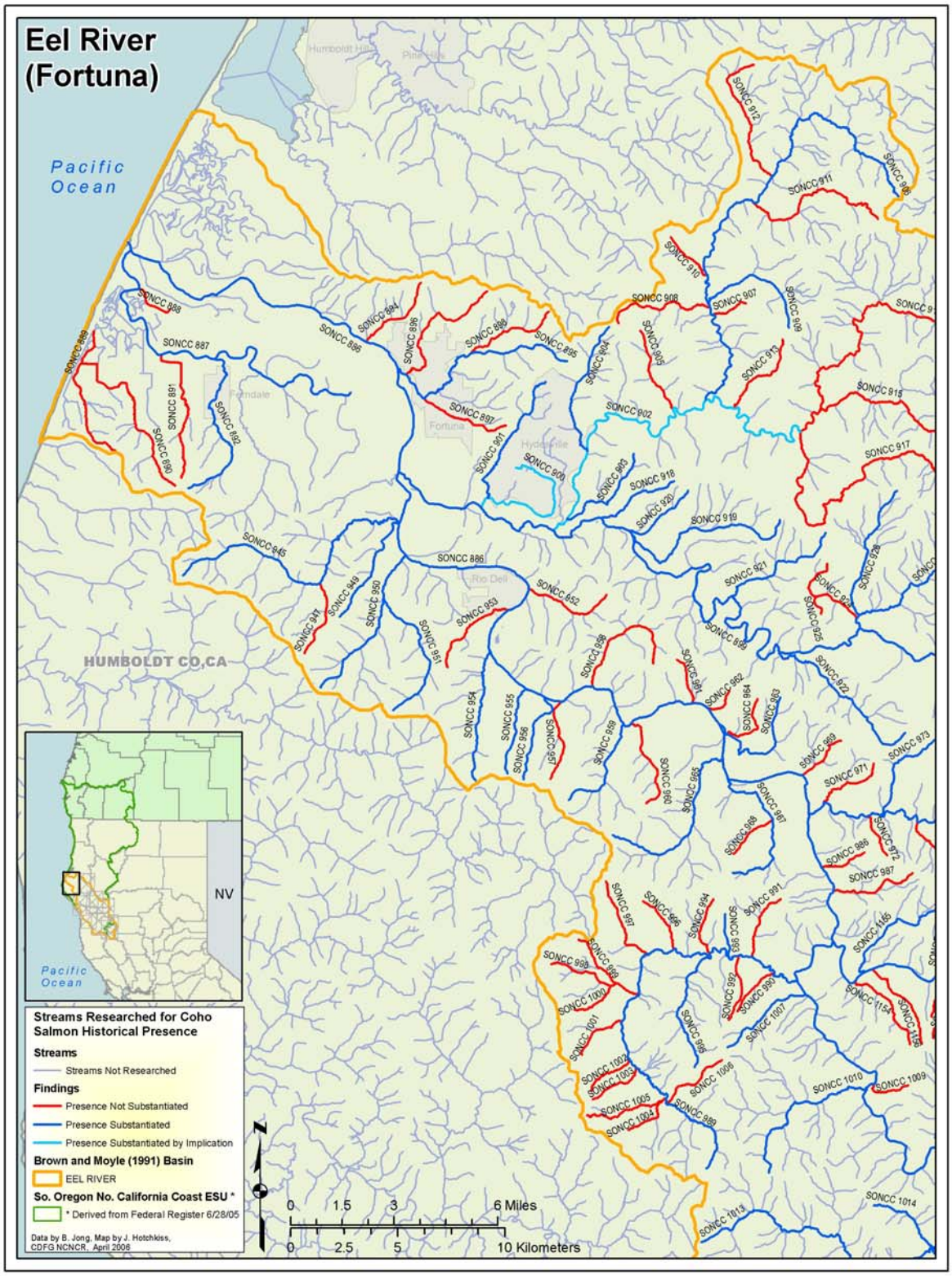

Figure 9a. Map of all streams researched and location of known coho salmon streams in the Eel River basin (Fortuna portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

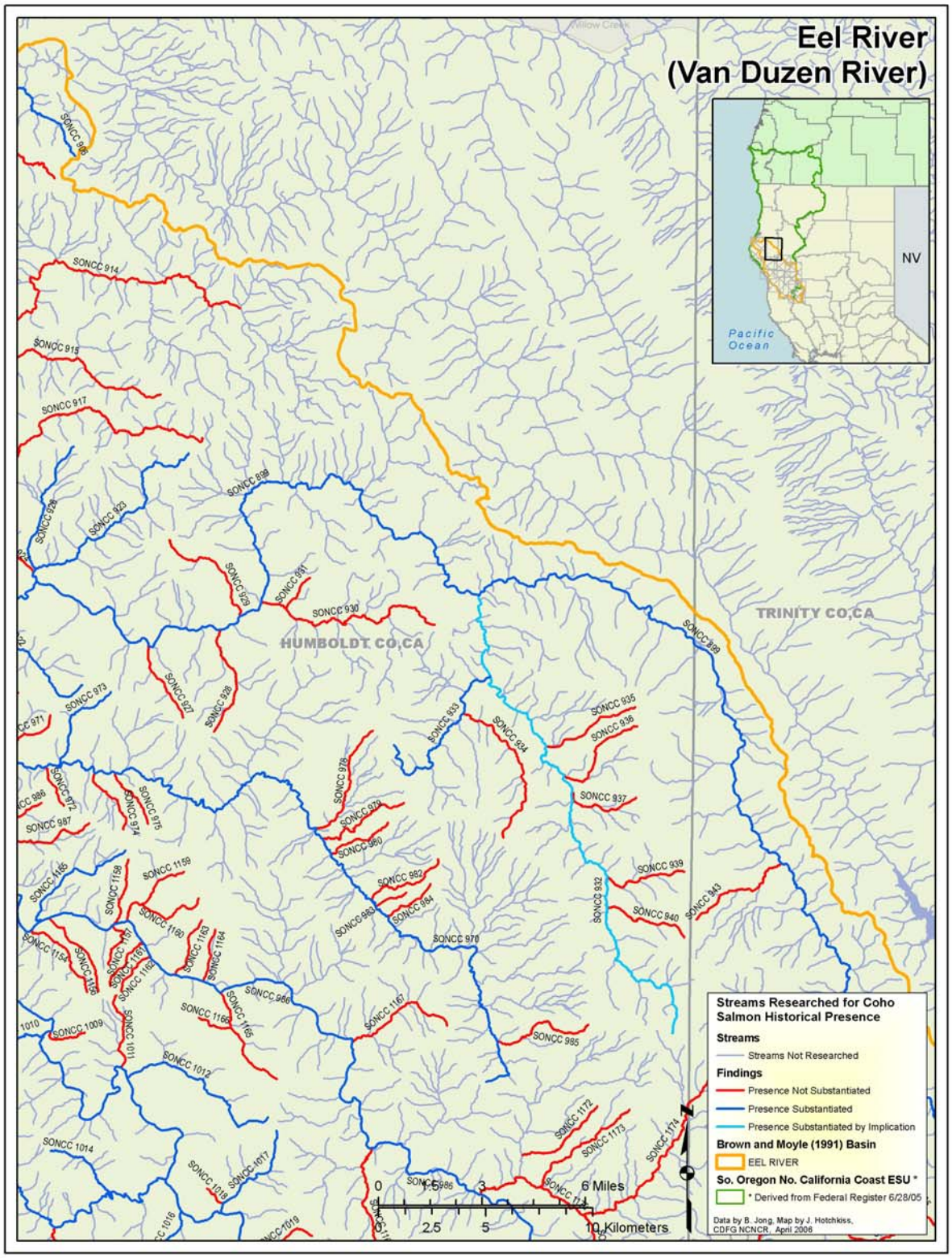

Figure 9b. Map of all streams researched and location of known coho salmon streams in the Eel River basin (Van Duzen River portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

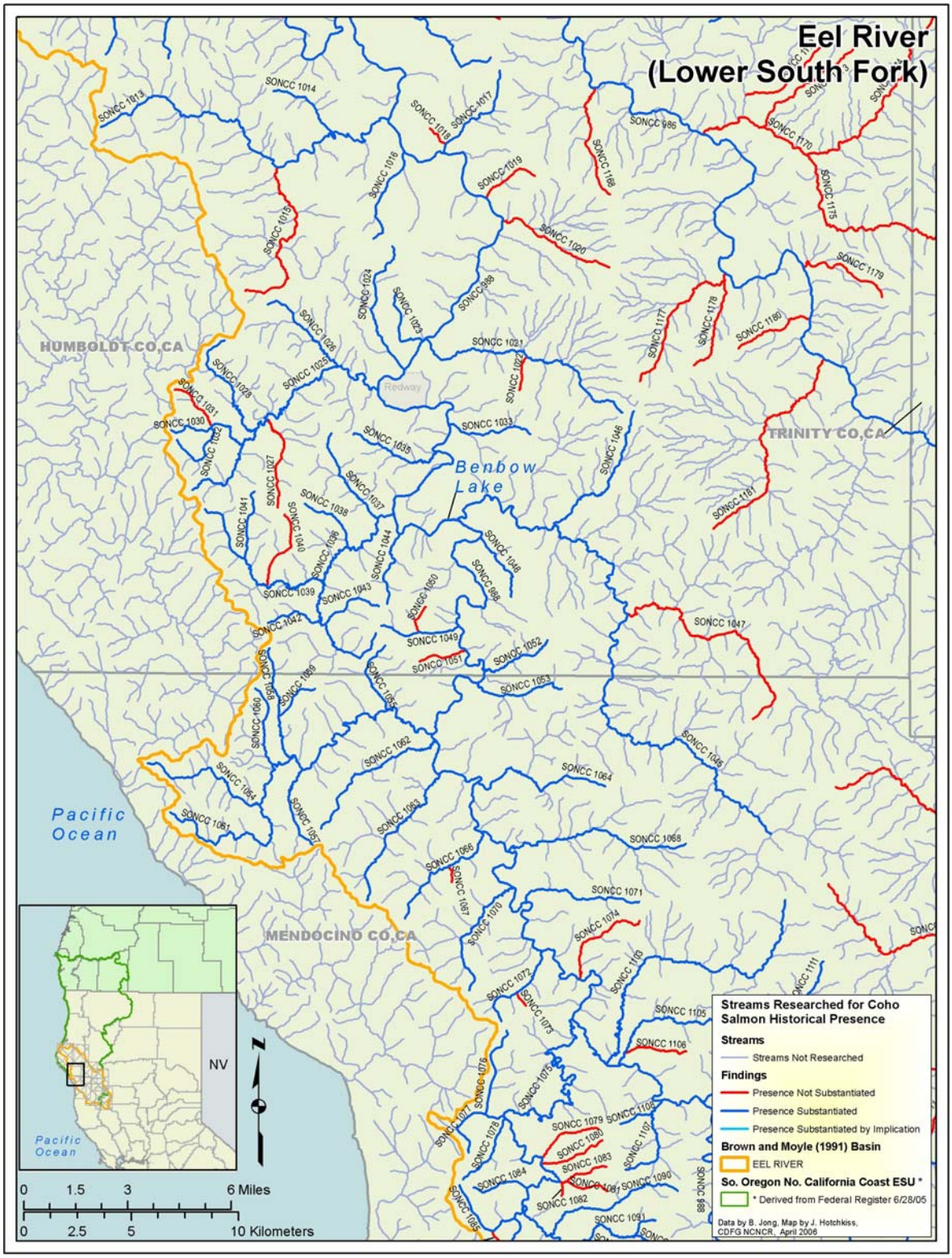

Figure 9c. Map of all streams researched and location of known coho salmon streams in the Eel River basin (lower South Fork portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

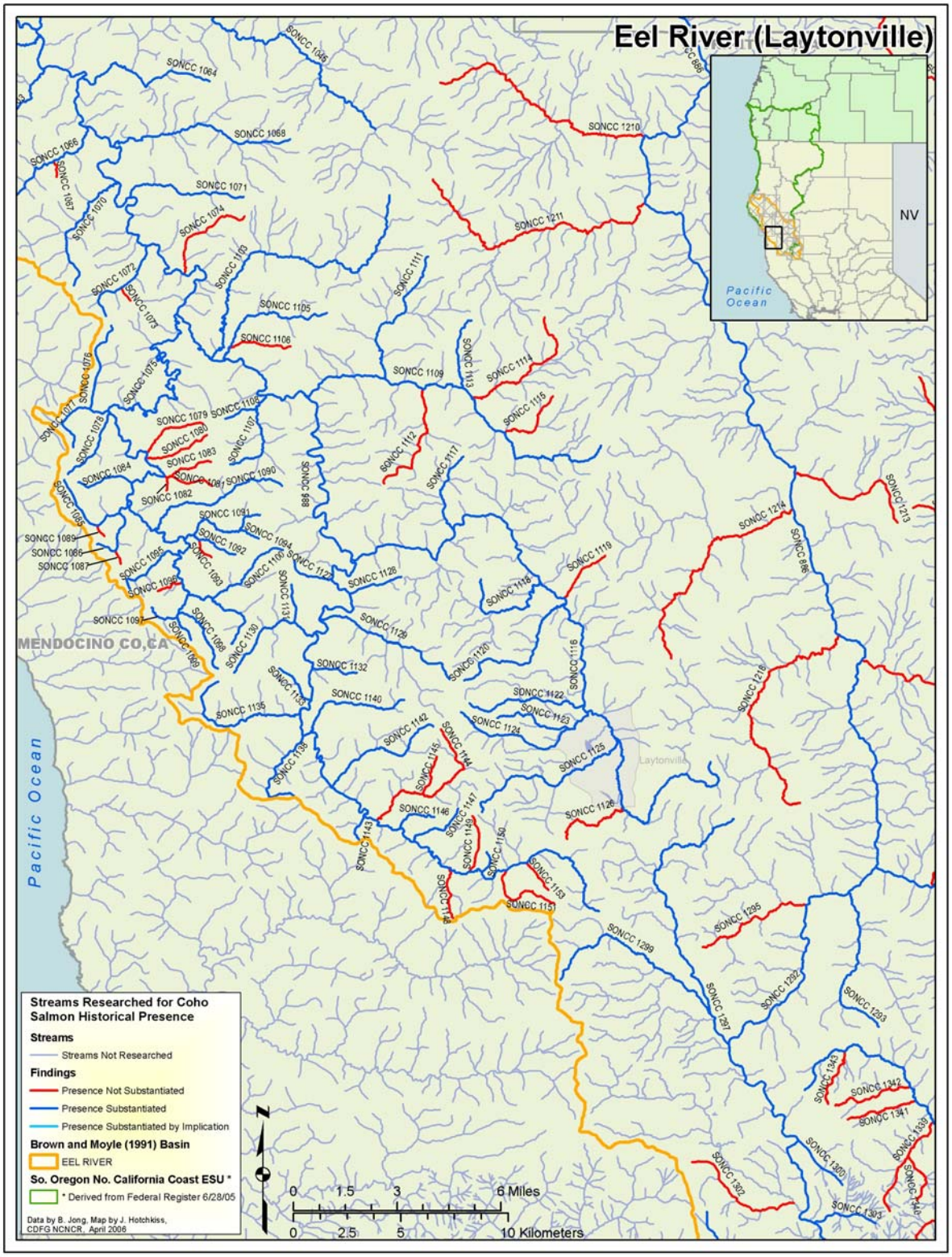

Figure 9d. Map of all streams researched and location of known coho salmon streams in the Eel River basin (Laytonville portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

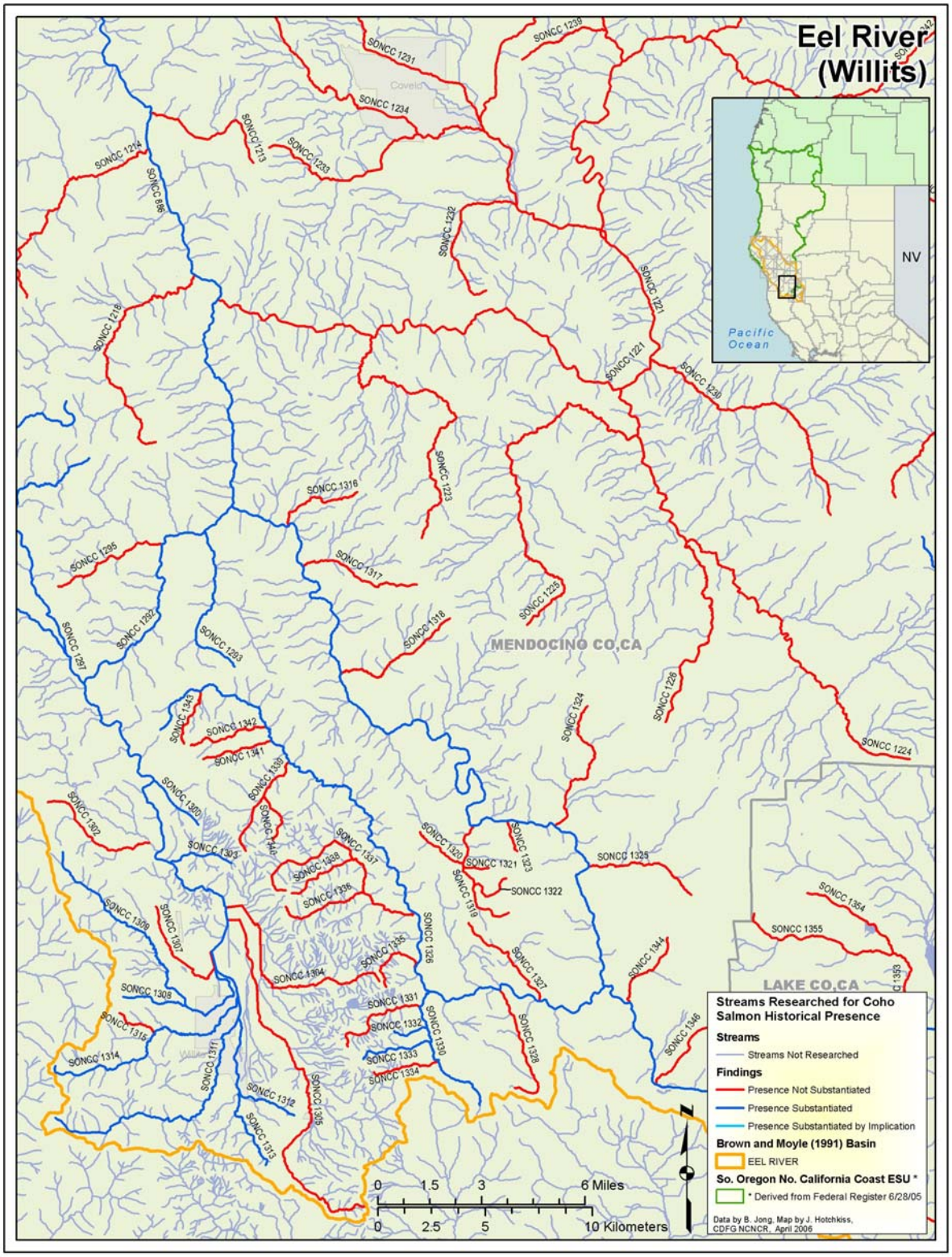

Figure 9e. Map of all streams researched and location of known coho salmon streams in the Eel River basin (Willits portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

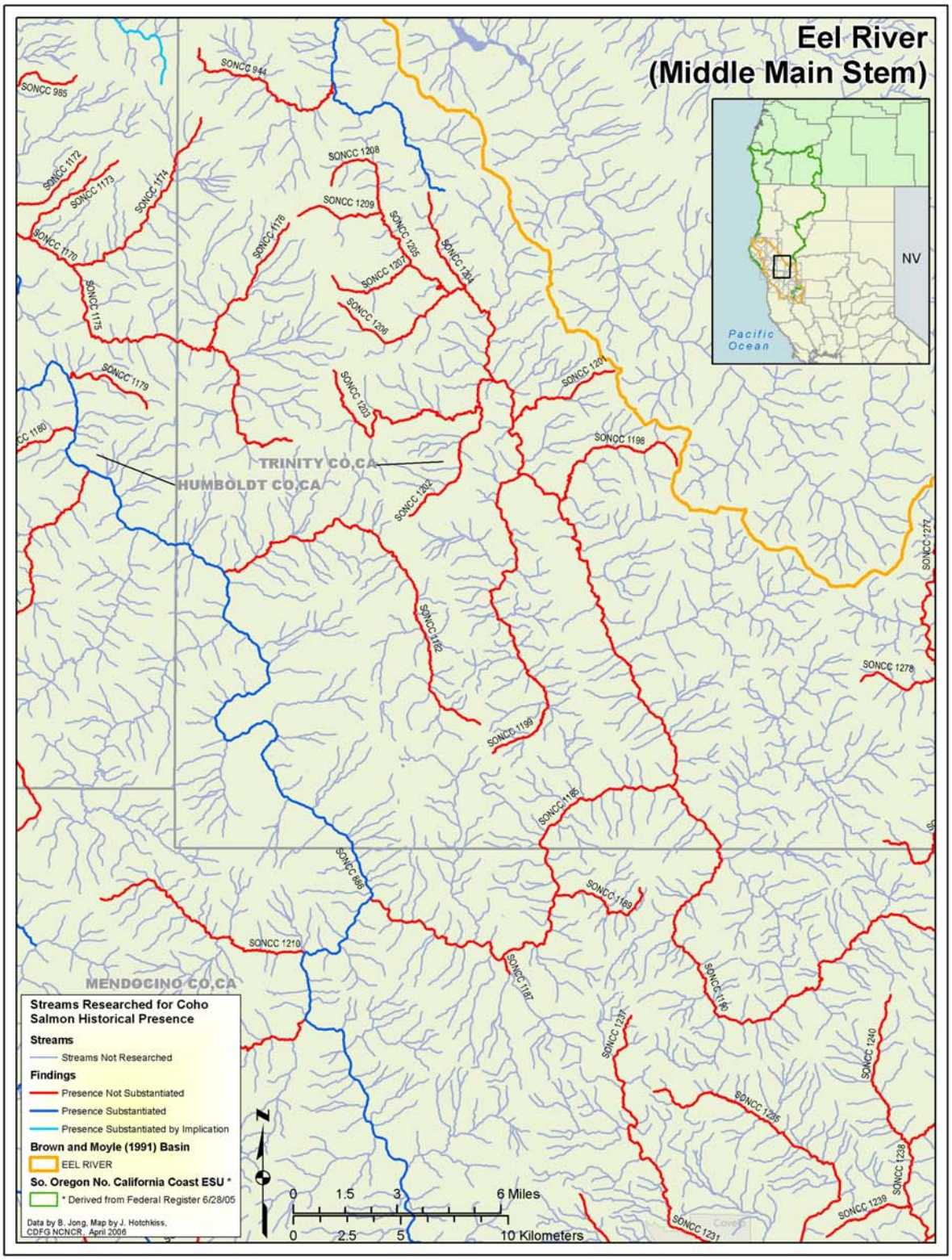

Figure 9f. Map of all streams researched and location of known coho salmon streams in the Eel River basin (middle main stem portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

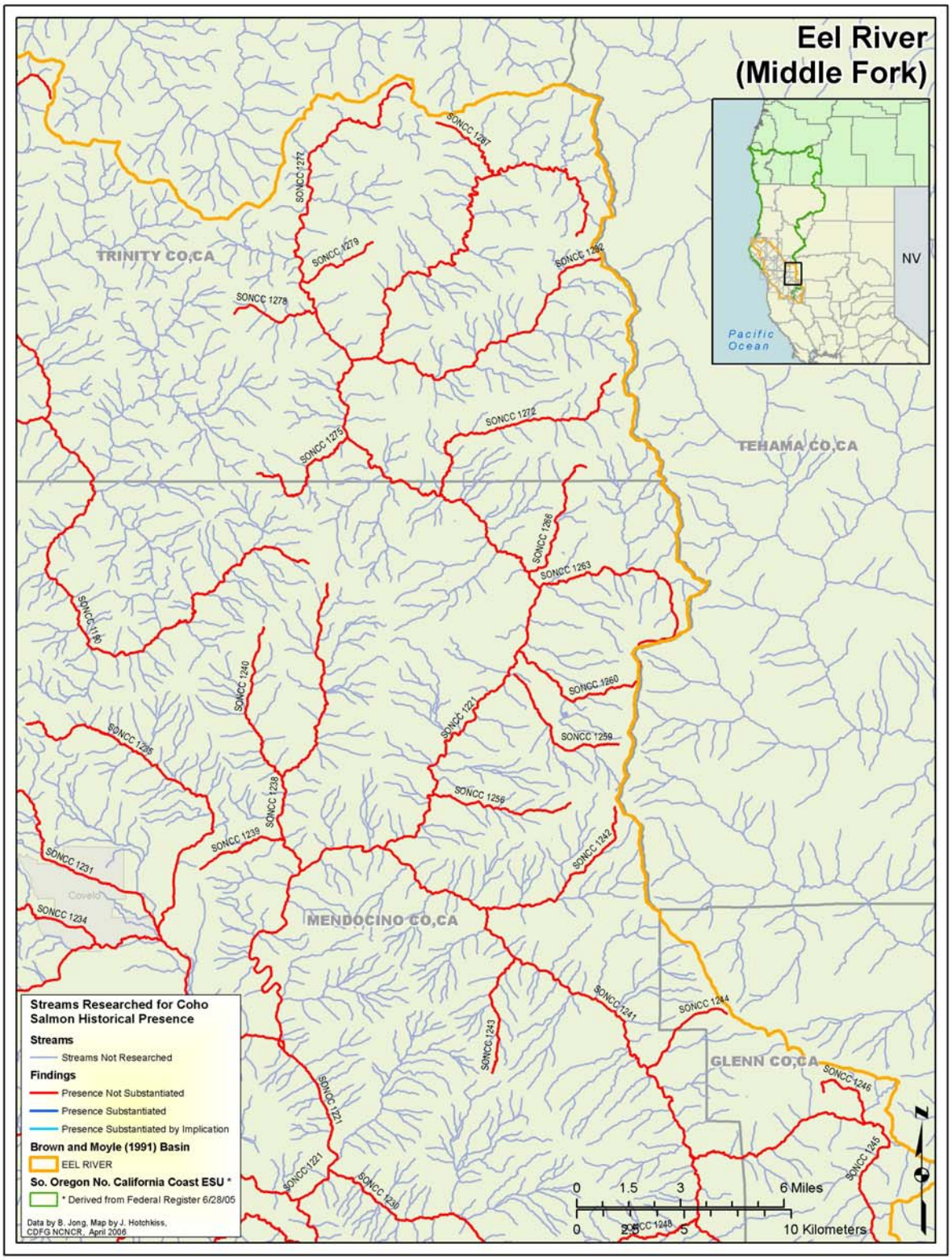

Figure 9g. Map of all streams researched and location of known coho salmon streams in the Eel River basin (Middle Fork portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

Figure 9h. Map of all streams researched and location of known coho salmon streams in the Eel River basin (headwaters portion). Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

observations conducted by DFG biologists (Monday 2010, Tollefson 2011). Coho salmon presence could not be confirmed in three streams: Yager Creek [902], Little Van Duzen River [932], and Barber Creek [900]. However, coho salmon presence is implied in these three streams due to presence in tributary streams: Shaw Creek [909] and Fish Creek [910] implicates Yager Creek; Butte Creek [933][8] implicates Little Van Duzen River; and Wolverton Gulch [901] implicates Barber Creek (Figure 9a). With these additions, 147 coho salmon streams are identified in the Eel River basin (Table 3).

In contrast, Brown and Moyle (1991) identified 125 Coho salmon streams in the Eel River basin. Coho salmon presence was confirmed for 99 streams originally identified by Brown and Moyle (1991). However, based on this study, 26 streams were removed from the original stream list developed by Brown and Moyle (1991). Two entries were eliminated based on being redundant to specific locations along the Eel River (i.e. Eel River below Van Duzen River, Eel River near Pepperwood). The remaining 24 streams were removed because occurrence records could not be verified through document review or field surveys (Table 3). Unverified streams include: Russ Creek [890], Reas Creek [891], Palmer Creek [894], Rohner Creek [896], Hoagland Creek [928], Little Larabee Creek [930], Albee Creek [996], Mill Creek [997], Bridge Creek [1011], Cub Creek [1067], Walters Creek [1083], Jewett Creek [1181], Kekawaka Creek [1182], Bluff Creek [1203], Middle Fork Eel River [1221], Mill Creek [1231], Grist Creek [1233], Rattlesnake Creek [1272], Rock Creek [1279], Rowes Creek [1302], Indian Creek [1317], Rocktree Creek [1336], String Creek [1337], and Tartar Creek [1338]. The 48 remaining coho salmon streams were identified through document review. Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in 49 out of 86 (57%) of streams surveyed (Table 5).

Mattole River

Sampling data was reviewed for 90 streams in the Mattole River basin resulting in 42 streams having coho salmon observations (Table 2; Figure 10). Coho salmon presence could not be confirmed in two streams: Upper North Fork Mattole River [1449] and Oil Creek [1450]. However, coho salmon presence is implied in these two streams due to presence in a tributary: Devils Creek [1452] (Figure 10). The addition of these two streams brings the total number of coho salmon streams in the Mattole River basin to 44 (Table 3). In contrast, Brown and Moyle (1991) identified 38 Coho salmon streams in the Mattole River basin. Coho salmon presence was confirmed for 28 streams originally identified by Brown and Moyle (1991). However, based on this investigation, 10 streams were removed because occurrence records could not be verified through document review or field surveys (Table 3). Unverified streams include: North Fork Mattole River [1428], Conklin Creek [1435], McGinnis Creek [1436], Pritchard Creek [1441], Granny Creek [1442],

[8] Butte Creek [933] coho salmon presence is supported by one aquatic species sampling study from 1983 (Doc 9591). This record is disputed by some DFG biologists familiar with the Van Duzen watershed. Additionally some length data provided for a number of sampled fish, identified as coho salmon, appear to be largely out of the normal range typical for young of year coho salmon around the given sampling date. However, some length data provided was within the normal range. Based on the standardized protocol used in this study to define coho salmon streams, this observation was retained because some of the original data could not be eliminated based on the evidence provided.

Figure 10. Map of all streams researched and location of known coho salmon streams in the Mattole River basin. Streams are labeled using the StreamID found in Table 2. Entire stream extents are highlighted and thus do not represent actual coho salmon distribution.

Saunders Creek [1444], Rattlesnake Creek [1453], Dry Creek [StreamID 1459], Middle Creek [1460], and Gilham Creek [1462]. One stream, Unnamed trib; East Branch North Fork Mattole River [9999], could not be placed on a map[9]. The 16 remaining coho salmon streams were identified through document review. Field surveys conducted by DFG for this study (2001-2003) found coho salmon occurring in 17 out of 27 (63%) of streams surveyed (Table 5).

DISCUSSION

The threatened status of coho salmon populations in the SONCC ESU remains unchanged 14 years since Federal ESA protections were established, (Federal Register 1997, Federal Register 2011). State and federal agencies are tasked to recover coho salmon populations to a level where the risk of extinction is negligible. Thus, bold recovery actions and robust population monitoring programs are needed. This updated list of 542 coho salmon streams provides the best available synthesis of known historic and current coho salmon distribution in the California portion of the SONCC ESU. These results have practical applications in designing monitoring, restoration, and recovery programs. Furthermore, these results can be used to compare future coho salmon stream distributions to the historic record.

Historic SONCC ESU Coho Salmon Streams

Generally, the amount of available historical fisheries data for individual streams in the study area was low (< 300 streams) until the mid 1970's (Figure 11). Subsequently, fisheries data for individual streams has increased substantially (>1200 streams) over the past 30 years as directed research, monitoring, and conservation measures have focused on various species of declining salmonids. Documented coho salmon streams follow a similar trend as the available stream fisheries data (Figure 11) indicating historic records vastly under represent our current knowledge of coho salmon distribution. Based on the overall increasing trend of documented coho salmon streams, current and future studies will also identify new coho salmon streams. This study coupled recent with historic coho salmon distribution data and represents a better empirical understanding of historic population-level spatial structure and stream habitat use. Although current records do not prove a stream was used historically by coho salmon, historic presence can be implied since the stream remains hospitable in contemporary times.

Previous SONCC ESU Coho Salmon Reviews

Many previous efforts have cataloged coho salmon distribution in the SONCC ESU (Table 1). Since this study added another 217 streams to the verified 325 coho salmon streams

[9] Reasons include: sampling locations are poorly or not described; a stream can be identified but it is not in the hydrography (if time allows the stream should be digitized and added to the hydrography, or the stream name is another local name for a stream already listed.

from previous literature, this has implications on how we interpret occupancy results from previous distribution studies. Most previous compilations relied on earlier published reports as supporting evidence, not the original evidence itself. Every attempt was made

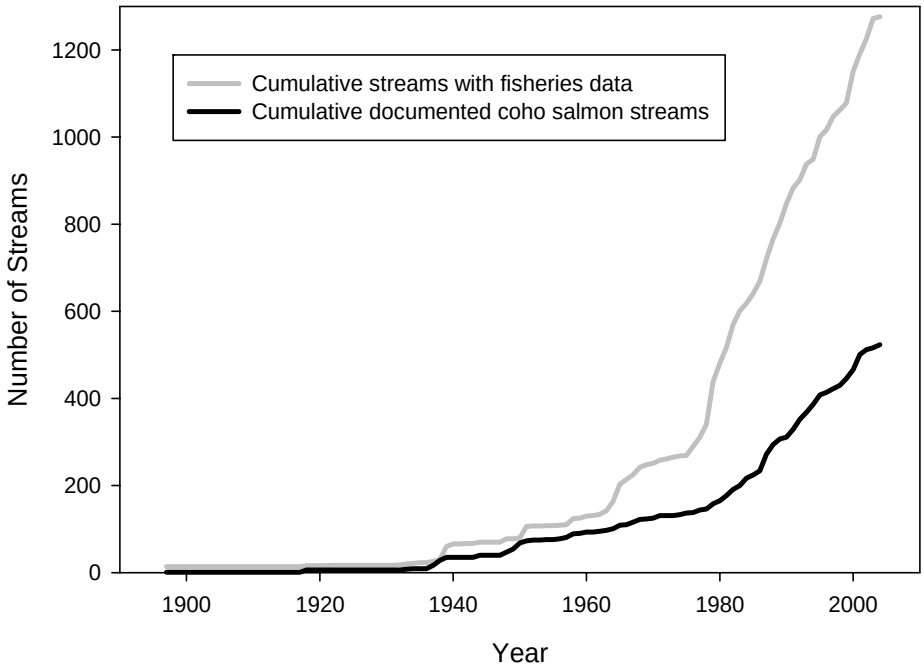

Figure 11. Cumulative number of streams having documented coho salmon and available fisheries data within the SONCC ESU for over 100 years based on this literature review study.

in this study to replicate the coho salmon distribution results reported in previous studies with a standardized protocol focusing on first-hand observations. The 67 streams identified in previous coho salmon stream lists were removed from the current stream list based on an extensive review of all supporting evidence. The current list does not mean the 67 streams are not used; we just have no empirical data supporting original claims found in the literature. However, this investigation sampled 84% of these disputed streams in 2001 to 2003 and failed to find any coho salmon. In contrast, this study found coho salmon occurring in 62% of sampled historic streams verified by this study. Unless supporting information becomes available, these 67 streams should not be considered as part of the defined historic and current coho salmon spatial structure in the SONCC ESU.

Limitations of Presence Data

Coho salmon have complex habitat requirements based on specific age class, season, and environmental cues. For example, some streams may only represent temporary juvenile rearing habitats for individuals emigrating from their natal streams (Henning et al. 2006). Habitats, such as intermittent streams, may not be traditionally viewed as supporting coho salmon; however, recent studies challenge these perceptions (Henning et al. 2006,

Wigington et al. 2006). The stream list provided by this study is a simple interpretation of known of coho salmon distribution. The list is not intended to provide inference on the dynamic life history of coho salmon. Demographic and habitat attributes need to be considered when designing future protections and for establishing research, restoration, monitoring programs. For example, spatial data derived from this study was supported with habitat modeling to create unbiased sampling frames for adult coho salmon in the SONCC ESU (Garwood and Ricker 2011).

Contemporary Coho Salmon Surveys

The surveys conducted during this study represent the most widespread fisheries data collection effort to date in the SONCC ESU. Nearly half (45%) of the coho salmon streams identified in this study were surveyed in 2001 to 2003. Sampling was distributed throughout the study area so results generally represent the entire California portion of the SONCC ESU. It's unclear if design-based randomized sampling approach would have resulted in an observed coho salmon proportion much different than 62%. However, most of the survey effort was focused on streams originally identified by Brown and Moyle (1991). Therefore, many of the additional 217 streams identified through document review were not visited. The least sampled populations (<30% of historic streams sampled) included Del Norte Coastal, Humboldt Coastal, and Redwood Creek. Many of these streams could not be surveyed because they occur on private lands where access was not granted. However, Redwood Creek had other stream surveys for coho salmon occurring simultaneously (*see* McCanne and Reisberger 2003). For these reasons, and the reality that individual survey detection rates were overlooked, the results can only be interpreted as a minimum stream occupancy rate for SONCC ESU coho salmon.

Future Use of Presence Surveys

The California Coastal Salmonid Monitoring Plan (CMP) provides a framework to monitor the viability of four population parameters: abundance, productivity, spatial structure and diversity (Adams et al. 2011). Measures of abundance and productivity are outlined in the CMP with specific robust sampling designs focused on capture-mark-recapture methods in select independent population units and individual streams. These studies are generally expensive to conduct and are only being completed in a limited number of spatially chosen populations.

In contrast to monitoring abundance and productivity, extensive monitoring for both spatial structure and diversity traits, need to be assessed more broadly at both the population and ESU levels (Adams et al. 2011). The CMP proposes using snorkel surveys incorporating a randomized sampling scheme, as a cost effective method to sample for population spatial structure. Furthermore, the CMP proposes that detection be incorporated into the snorkel survey study design to account for observation uncertainties. Based on the larger scale of spatial structure monitoring, the results provided from this study can provide a baseline distribution for designing large-scale juvenile coho salmon surveys throughout the California portion of the SONCC ESU.

ACKNOWLEDGEMENTS

The dedicated efforts by Bill Jong, Larry Preston, and Michelle Gilroy are responsible for the framework, design, data collection and data validation for this study. Without Bill Jong's specific unwavering dedication to this project, we would know much less about the true historic record of coho salmon in California.

Field surveys, EndNote Library, GIS, and document review procedures were conducted by DFG Fish and Wildlife Scientific Aids and Pacific States Marine Fisheries Commission contract Fisheries Technicians. This group acquired and reviewed thousands of documents and snorkeled hundreds of stream reaches throughout northern California to develop the dataset used in this study. Individuals include: (in alphabetical order) Kimberly Baker, Linda Battin, Angela Bolton, Kelley Breen, Jason Chenoweth, Charlene Chow, Jason Coburn, Alex Corum, Robert Duncan, Robert Gerbi, Michael Gilmore, Erin Gleason, Michael Gorman, Jeffrey Gubac, Shawn Gulling, Cory Hamilton, Anne Jeffrey, Jennifer Jenkins, Jill Jensen, Christine Keil, Mary-Claire Kier, Scott Kochiyama, Kristen Metcalfe, Joseph Pecharich, Jr., Evonne Reese, Mariya Schilz, Tara Smith, Christina Sousa, Spencer Stiff, and Jolyon Walkley. DFG Biologists Scott L. Harris and Dennis Maria also conducted field surveys or secured access to private lands. Mike Wallace, Michelle Gilroy, Kevin Shaffer, and Stafford Lehr provided helpful comments to earlier versions of the manuscript.

GIS and database support were provided by members of DFG's Northern Region Information Services Branch including: Eric Haney, Doug Burch, Tom Christy, Jim Hotchkiss, Connie Shannon, and Linda Miller. Administrative support from Brenda Tuel, Stan Allen, Jerilynn Riordan, and Mary Kuehner was critical to the success of the projects operations. The DFG extends its appreciation to all cooperating landowners for access to private lands to conduct our surveys and to all of the agencies (local, state, federal, tribal), industrial landowners, consulting firms, universities, and individuals who provided access to their data.

Last, thanks to Dr. Larry Brown and Dr. Peter Moyle for producing the first comprehensive California coho salmon distribution list back in 1991. Although much more information has been gathered since their publication, their initial work is largely responsible for all that has followed in understanding the status of coho salmon in California. Thanks specifically to Dr. Peter Moyle for the time he spent discussing his status review report and for granting this project access to his file materials.

This work was supported in part by the DFG Fisheries Restoration Grants Program (pursuant to Contract No. P0330414 with Pacific States Marine Fisheries Commission, Portland, Oregon), Federal Aid in Sport Fish Restoration Act (F-51-R, Project 62, Job 1), DFG Preservation Fund, and the California Conservation Corps.

LITERATURE CITED

Adams, P. B., Boydstun, L. B. et al. 2011. California coastal salmonid population monitoring: strategy, design, and methods. California Department of Fish and Game, Fish Bulletin 180: 81 p.

Agrawal, A., R. Schick, et al. 2005. Predicting the potential for historical coho, Chinook and steelhead habitat in California. NOAA-TM-NMFS-SWFSC-379: 34 p.

Boberg, J. and C. Kenyon. 1979a. Department of Fish and Game Stream Inventory: Del Norte County. California Department of Fish and Game, Sacramento, CA.

Boberg, J. and C. Kenyon. 1979b. Department of Fish and Game Stream Inventory: Humboldt County. California Department of Fish and Game, Sacramento, CA.

Boberg, J. and C. Kenyon. 1979c. Department of Fish and Game Stream Inventory: Trinity County. California Department of Fish and Game, Sacramento, CA.

Boberg, J. and C. Kenyon 1979d. Department of Fish and Game Stream Inventory: Siskiyou County. California Department of Fish and Game, Sacramento, CA.

Brown, L. R. and P. B. Moyle. 1991. Status of coho salmon in California. UC Davis, Department of Wildlife and Fisheries Biology: 131 p.

Brownell, N. F., W. M. Kier, et al. 1999. Historical and current presence and absence of coho salmon in the northern California portion of the southern Oregon-northern California evolutionarily significant unit. Kier & Associates, Sausalito, CA: 59 p.

Burnett, K., G. Reeves, et al. 2003. A first step toward broad-scale identification of freshwater protected areas for Pacific salmon and trout in Oregon, USA. Pages 144–154 in J. P. Beumer, A. Grant, and D. C. Smith, editors. Aquatic Protected Areas: what works best and how do we know? Proceedings of the 3rd World Congress on Aquatic Protected Areas. Australian Society for Fish Biology, Cairns, Australia.

CDFG. 2002. Status review of California coho salmon north of San Francisco. Report to California Fish and Game Commission.

CDFG. 2004 Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. California Department of Fish and Game, Sacramento, CA: 594 p.

Cherr, G. and F. Griffin. 1979. Department of Fish and Game Stream Inventory: Mendocino County. California Department of Fish and Game, Sacramento, CA.

Ellis, R. H. 1997. The proposed listing of coho salmon as threatened in the Southern Oregon/ Northern California Evolutionarily Significant Unit. Comments to National Marine Fisheries Service. California Forestry Association and California Forest Resources Council. Estacada, OR: 41 p.

Federal Register. 1997. Endangered and threatened species; threatened status for Southern Oregon/ Northern California Coast Evolutionarily Significant Unit of coho salmon. Federal Register, Washington D.C. 62:24588-24609.

Federal Register. 2011. Endangered and threatened species; 5-year reviews for five evolutionarily significant units of Pacific salmon and one distinct population segment of steelhead in California. Federal Register, Washington D.C. 76:50447-50448.

Frey, J. K. 2006. Inferring species distributions in the absence of occurrence records: An example considering wolverine (*Gulo gulo*) and Canada lynx (*Lynx canadensis*) in New Mexico. Biological Conservation 130: 16-24.

Garwood, J. M. and S. R. Ricker. 2011. Spawner survey sample frame development for monitoring adult salmonid populations in California. California Department of Fish and Game, Arcata CA. 17p.

Garwood, J.M. 2012. Supporting evidence in defining historic and recent occurrence of Coho Salmon (*Oncorhynchus kisutch*) in California streams within the Southern Oregon/ Northern California Evolutionary Significant Unit. California Department of Fish and Game, Arcata, CA: 317 p.

Garwood, J. M. and M. R. Reneski. 2012. Juvenile Coho salmon (*Oncorhynchus kisutch*) occurrence in habitats along the Smith River coastal plain and estuary, Del Norte County, California. California Department of Fish and Game, Arcata, CA.

Hassler, T. J., C. M. Sullivan, et al. 1988. Distribution of coho salmon in California. California Cooperative Fishery Research Unit, Humboldt State University, Arcata, CA: 21 p.

Hassler, T. J., C. M. Sullivan, et al. 1991. Distribution of coho salmon in California. Final Report. Humboldt State University, California Cooperative Fisheries Research Unit, Arcata, CA: 24 p.

Henning, J. A., R. E. Gresswell, et al. 2006. Floodplain emergent wetlands as a rearing habitat for juvenile salmonids. North American Journal of Fisheries Management 26: 367-376.

Mackenzie, D. I., J. D. Nichols, et al. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83: 2248-2255.

McCanne, D. and B. Reisberger. 2003. Presence of coho salmon in 40 streams in the Mad River- Redwood Creek Hydrologic Unit. Institute for Forest and Watershed Management, Arcata, CA. Contract Number P0010018: 11 p.

McKelvey, K. S., K. B. Aubry, et al. 2008. Using anecdotal occurrence data for rare or elusive species: the illusion of reality and a call for evidentiary standards. BioScience 58: 549-555.

Mills, T. 1983. Appendix H: Utilization of Eel River tributary streams by anadromous salmonids. *In*, F. L. Reynolds, editor. Status report of California wild and scenic river salmon and steelhead fisheries. California Department of Fish and Game, Sacramento, CA: 45 pp.

Monday, S. 2010. Field Note: Coho salmon observations in tributaries of the Eel River, CA. California Department of Fish and Game, Fortuna, CA: 3p.

National Marine Fisheries Service. 2001. Status review update for coho salmon (*Oncorhynchus kisutch*) from the Central California Coast and the California portion of the Southern Oregon/ Northern California Coasts Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz, CA: 103p.

Thompson W. L. 2004. Sampling rare or elusive species. Island Press, Washington, DC: 429 p.

Tollefson, T. 2011. Field Note: Spawner survey observations in Fish Creek, Eel River basin, CA. California Department of Fish and Game, Fortuna, CA: 3p.

USFS. 2006. Upper North Fork Smith River 2006 level two stream survey. Rogue River-Siskiyou National Forest, Gold Beach, OR: 32p.

Webster, R. A., K. H. Pollock, et al. 2005. A new protocol for detection of juvenile coho salmon in small streams in northern California. Final Report to the California Department of Fish and Game: 46 p.

Wigington, P. J., J. L. Ebersole, et al. 2006. Coho salmon dependence on intermittent streams. Frontiers in Ecology and Environment 4: 513-518.

Williams, T. H., E. P. Bjorkstedt, et al. 2006. Historical population structure of coho salmon in the Southern Oregon / Northern California Coasts Evolutionarily Significant Unit. U. S. Department of Commerce, NOAA Technical Memorandum NMFSSWFSC- 390: 71 p.

Williams, T. H., B. C. Spence, et al. 2008. Framework for assessing viability of the threatened coho salmon in the southern Oregon/Northern California coast evolutionarily significant unit. NOAA Technical Memorandum NMFSSWFSC- 432: 96 p.