



# North Coast Instream Flow Policy: Scientific Basis and Development of Alternatives Protecting Anadromous Salmonids

## Task 3 Report *Administrative Draft*

*Prepared for:*

California State Water Resources Control Board  
Division of Water Rights

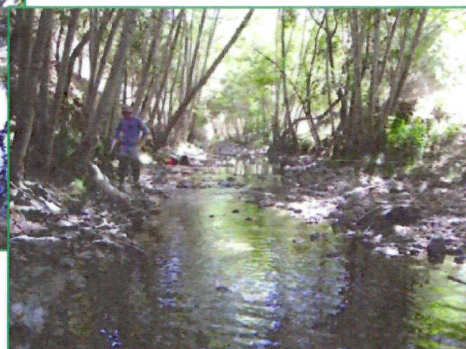
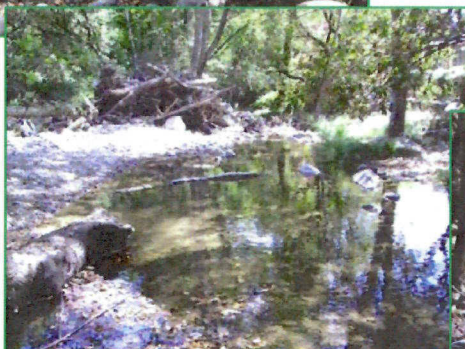
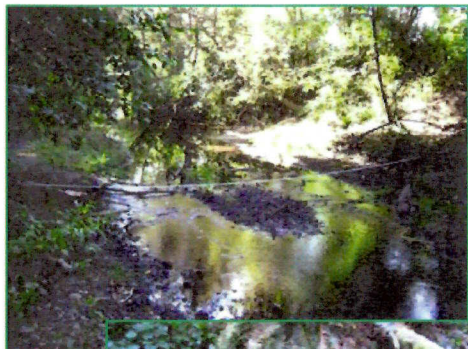
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Stetson Engineers, Inc.

August 6, 2007

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# **APPENDIX C**

## **Summary of Important Biological Characteristics of Target Anadromous Salmonid Species**



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## APPENDIX C

### SUMMARY OF IMPORTANT BIOLOGICAL CHARACTERISTICS OF TARGET ANADROMOUS SALMONID SPECIES

#### C.1 STEELHEAD TROUT

NMFS has identified two steelhead ESUs in the Policy area: the Northern California ESU and the Central California Coastal ESU. Figure C-1 depicts the range of critical habitat designated by NMFS in 2005 for both ESUs (70 FR 52488). The Northern California ESU was federally-listed as a threatened species on June 7, 2000 (65 FR 36074); its threatened status was reaffirmed on January 5, 2006 (71 FR 834; DFG 2006). The ESU includes populations in coastal river basins from Redwood Creek in Humboldt County southward to the Gualala River. The Central California Coastal steelhead ESU was federally listed as a threatened species on August 18, 1997 (62 FR 43937); its threatened status was also reaffirmed on January 5, 2006 (71 FR 834; DFG 2006). The ESU includes populations from the Russian River south to Aptos Creek (Santa Cruz Co.), and the drainages of San Francisco, San Pablo, and Suisun Bays.

There are two basic life history types of steelhead: summer (stream-maturing) steelhead, which return to fresh water between March and June with immature gonads and consequently must spend several months in the stream before they are ready to spawn; and winter (ocean-maturing) steelhead, which mature in the ocean and spawn relatively soon after re-entry into fresh water in late fall and early winter (Moyle 2002; McEwan and Jackson 1996). Steelhead in the Policy area are primarily winter steelhead. Summer steelhead are found only in the Mattole River within the Policy area (Moyle 2002).

Figure C-2 depicts the general life history timing, or lifestage periodicity of winter steelhead. Winter steelhead typically begin moving upstream after late fall and early winter rains increase base flow. In some streams, this results in the breaching of sandbars blocking the mouth of lagoons, thereby permitting passage through lower reaches (McEwan and Jackson 1996). Upstream migration tends to begin slightly later in streams that are south of Point Reyes (in December) compared to those north of Point Reyes (in November; Figure C-2). The run can stretch out beyond the coho spawning season, with waves of fish migrating with higher flow events (Shapovalov and Taft 1954). January and February appear to be the peak migration months, extending into March in the Russian River basin where some adults have farther to swim to spawning grounds (Figure C-2). Winter steelhead spawn within a few weeks to a few months from the time they enter fresh water. Peak spawning occurs during January through March, but can extend into spring and early summer months (Figure C-2). After spawning and depending on water temperature, the eggs hatch in approximately 3 to 4 weeks, with fry emerging from the gravel 2 to 3 weeks later. The fry then move to shallow protected areas associated with the stream margin for several weeks (Moyle 2002). They soon move to other areas of the stream and establish feeding locations. Most juveniles inhabit riffles, but some of the larger ones will inhabit pools or deeper runs (Barnhart 1986; Moyle 2002).

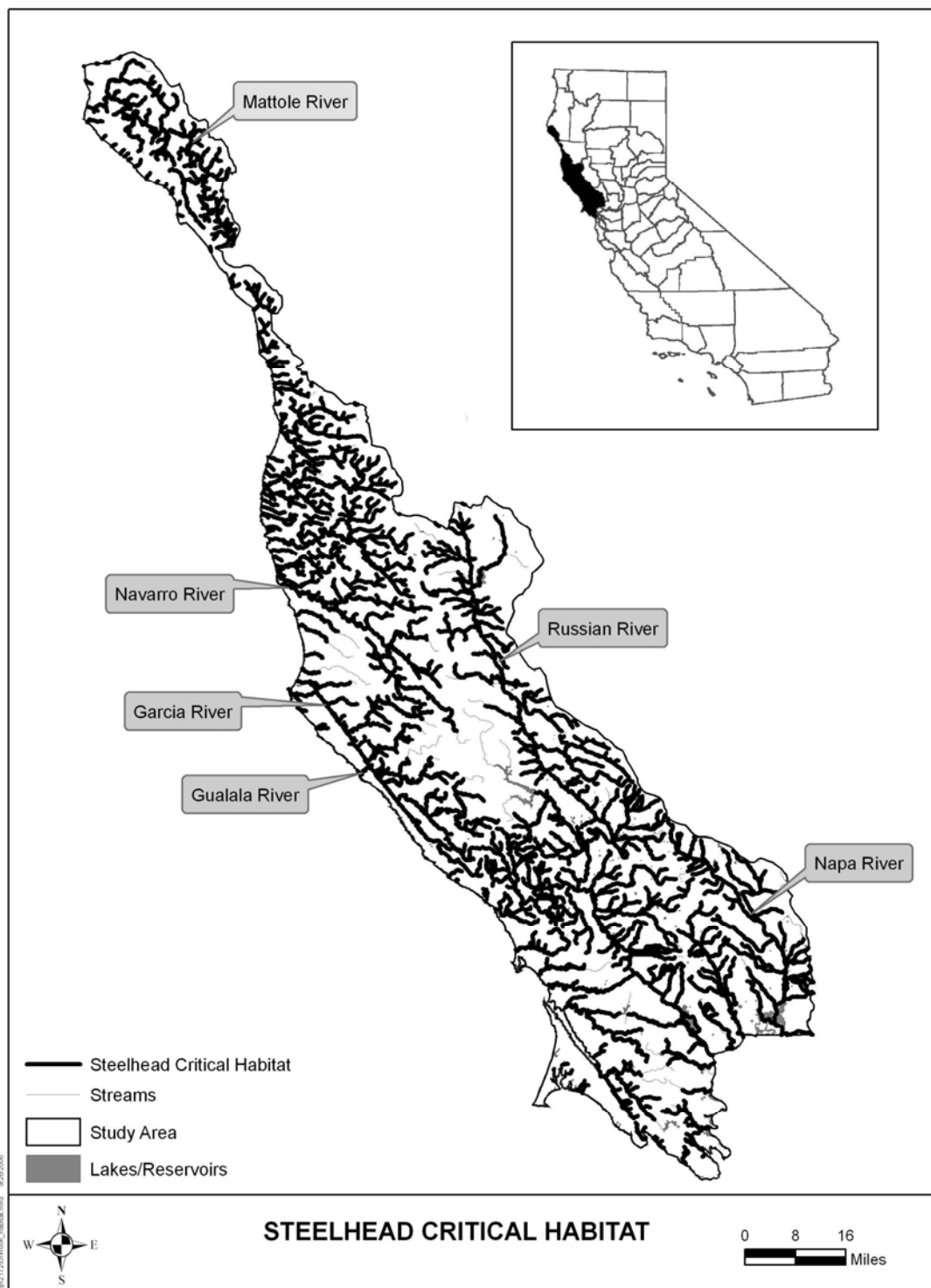


Figure C-1. Federal critical habitat designated for winter steelhead within the Policy area.

### Winter Steelhead

Life Stage	River	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Upstream Migration	North Coast												
	Mattole R												
	Noyo R												
	Navarro R												
	Brush Cr												
	Russian R <sup>1</sup>												
	Lagunitas Cr												
	Redwood Cr												
	Napa R												
	Waddell Cr												
Spawning	North Coast												
	Noyo R												
	Navarro R												
	Brush Cr												
	Russian R												
	Lagunitas Cr												
	Redwood Cr												
	Napa R												
Incubation	Navarro R												
	Brush Cr												
	Russian R												
	Lagunitas Cr												
	Napa R												
Rearing	California												
Outmigration	Navarro R												
	Brush Cr												
	Russian R												
	Lagunitas Cr												
	Napa R												

<sup>1</sup> - Adults noted in mainstem in all months (Entrix 2002)

Figure C-2. Periodicities of winter steelhead life stages in the Policy area (Sources: Shapovalov and Taft 1954; Snider 1984; Snider 1985; Smith 1986; SWRCB 1995, 1997, 1998; Steiner 1996; Stohrer 1998; Gallagher 2000; NCRWQCB 2000; Downie et al. 2002; Entrix 2002, 2004; Chase et al. 2003). Periods of greatest activity are indicated by darker shade, when available in literature reviewed.



Summer steelhead enter the Mattole River between March and June. Fish hold over the summer in clear, cool, deep pools until late winter and spring of the following year before spawning (Downie et al. 2002). Shapovalov and Taft (1954) noted that California summer run steelhead enter predominantly snowmelt runoff streams in April and May and spawn predominantly in November and December.

Steelhead typically spend 2 years in freshwater, but freshwater residence time can range from 1 to 4 years (McEwan and Jackson 1996; Moyle 2002). Emigration in the Policy area usually occurs in late winter and spring, with timing depending on flow and water temperatures (Entrix 2002). Some emigration also occurs in the late fall months (Figure C-2). Steelhead typically spend 1 to 2 years in the ocean before returning to spawn for the first time. Unlike Pacific salmon that spawn only once (semelparous), steelhead are iteroparous and may return to the ocean and spawn again in a later year.

## **C.2 COHO SALMON**

NMFS has identified two coho ESUs in the Policy area: the Central California Coast (CCC) ESU and the Southern Oregon/Northern California Coast (SONCC) ESU. The CCC ESU extends from the San Lorenzo River in Santa Cruz County north to Punta Gorda in Humboldt County. The ESU was federally listed as threatened on October 31, 1996 (61 FR 56138) and state listed as endangered on March 30, 2005 (DFG 2006); it was federally reclassified as endangered on June 28, 2005 (70 FR 37160). The SONCC coho ESU ranges from Punta Gorda north, and includes only the Mattole River basin within the Policy area. The SONCC coho ESU was federally listed as threatened on May 6, 1997 (62 FR 24588), and was later listed by the state as threatened on March 30, 2005 (DFG 2006). Its federal threatened status was reaffirmed on June 28, 2005 (70 FR 37160). Federal critical habitat was designated by NMFS as any accessible stream within the current range for both ESUs on May 5, 1999 (64 FR 24049; Figure C-3). Specific stream segments have yet to be identified to the same level as for steelhead and Chinook. Sustainable coho salmon populations were likely distributed as far south as San Francisco, with occasional ephemeral year-classes farther south in some coastal streams in response to stray spawning and intermittent favorable environmental conditions. Most of the time, floods and dry summers have precluded successful establishment of perennial populations (Kaczynski and Alvarado 2006).

Coho salmon in California have a relatively strict 3-year life cycle, spending about half of their lives in fresh water and half in salt water (Moyle 2002). Figure C-4 depicts the general life history periodicity of coho in the Policy area. Coho do not ascend as far upstream as steelhead or Chinook (Shapovalov and Taft 1954). They spawn mainly in streams that flow directly into the ocean, or in lower tributaries of large rivers within the Policy area. Coho salmon typically enter estuaries after heavy late fall or winter rains breach the sand bars that form at the mouths of many California coastal streams, allowing fish to move into the lagoons (Moyle 2002). Upstream migration begins earlier farther North in the Policy area (Figure C-4). They typically migrate upstream in response to an increase in stream flows caused by fall storms, especially in small streams when water temperatures are around 4-14°C (Moyle et al. 1995; Trihey and Associates, Inc. 1996). When flow conditions are unsuitable, returning adults may wait near the stream mouth for weeks or, in the case of early-run fish, months for conditions to change (Sandercock 1991). Migrating coho salmon require deep and frequent pools for resting and to escape from shallow riffles where they are susceptible to predation.

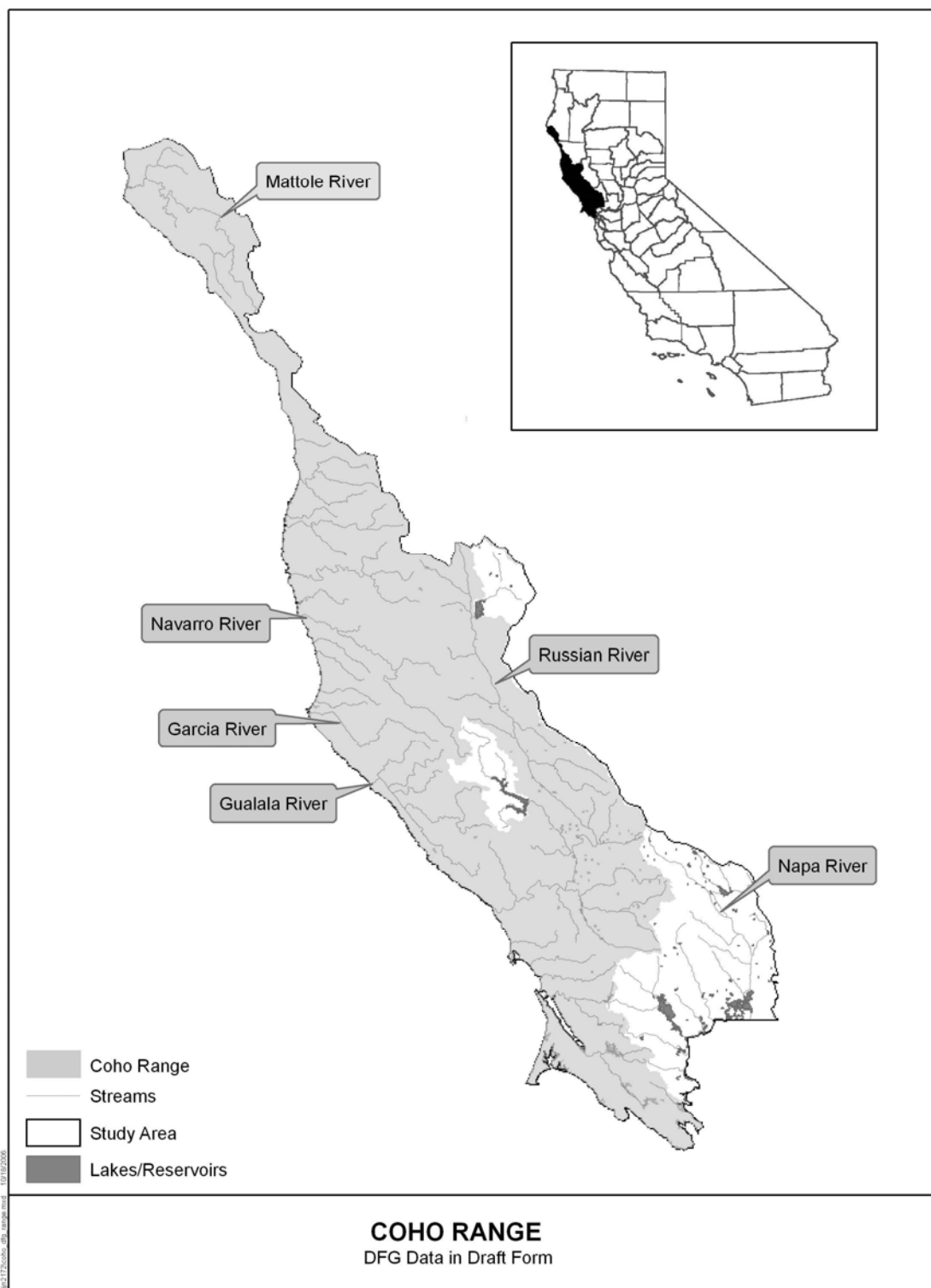


Figure C-3. General range of coho salmon within the Policy area.

Coho salmon spawn mostly in small streams in the Policy area, with peak spawning occurring during the months of December and January (DFG 2002; Figure C-4). On the spawning grounds, coho may seek out sites with groundwater upwelling in addition to favorable depths and velocities. Eggs hatch after incubating in the gravels for 8-12 weeks (Moyle 2002). After hatching, the alevins remain in the interstices of the gravel for 4-10 weeks depending on prevailing water temperatures. Upon emergence, coho salmon fry tend to move to shallow water areas where they feed and continue to grow into juveniles. Juvenile coho rear and overwinter in the stream until the following March or early April, when, after smoltification, they begin migrating downstream to the ocean. Peak downstream migration in California generally occurs from April to late May/early June (Weitkamp et al. 1995; Figure C-4). Stream flow is important in facilitating the downstream migration of coho salmon smolts. Emigration appears to occur earlier in years with low flows (DFG 2002).

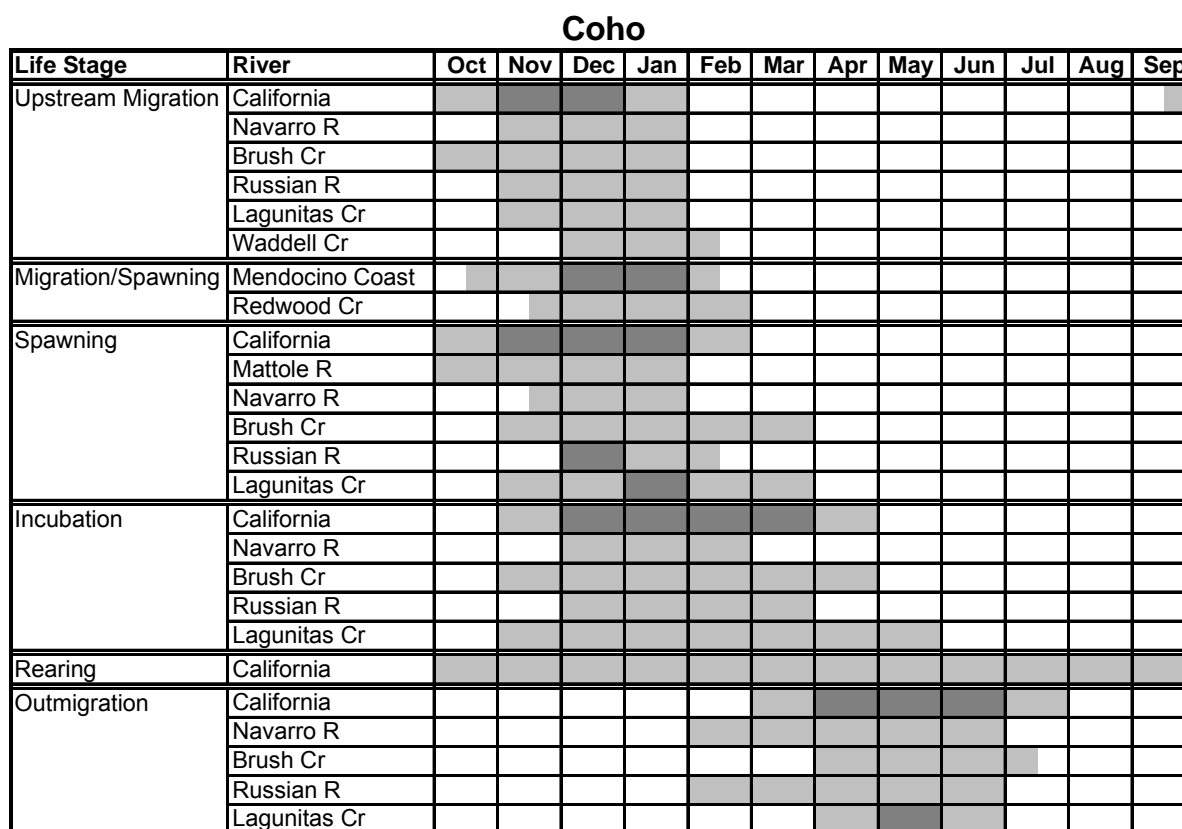


Figure C-4. Periodicities of coho salmon life stages in the Policy area (Sources: Shapovalov and Taft 1954; Snider 1984; DFG 1985, 1986, 2004, 2005, 2006, 2007, 2008; Bratovich and Kelley 1988; SWRCB 1995, 1997, 1998; Steiner 1996; NCRWQCB 2000; Downie et al. 2002; Entrix 2002, 2004). Periods of greatest activity are indicated by darker shade, when available in literature reviewed.

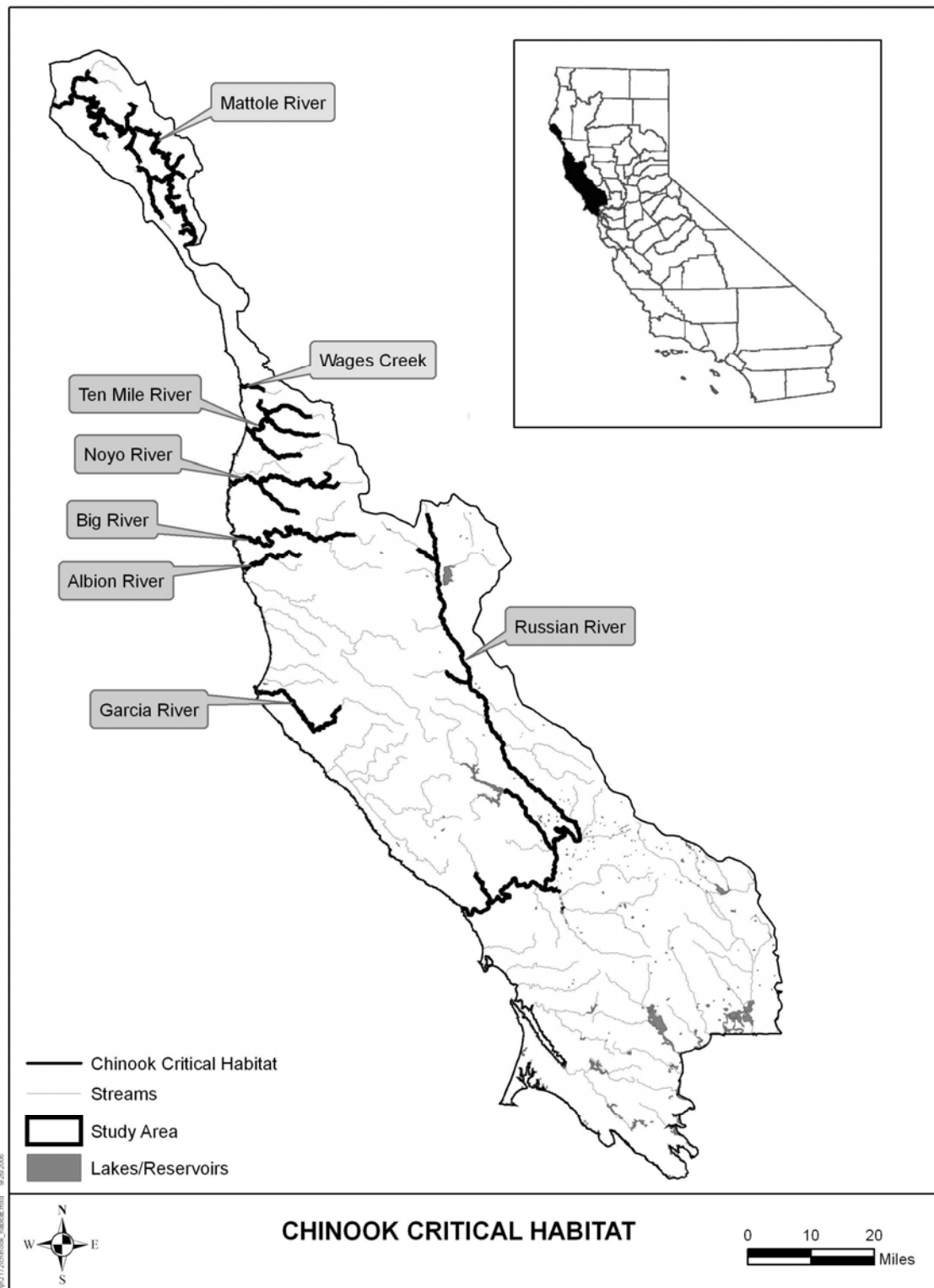


### **C.3 CHINOOK SALMON**

The California Coastal Chinook ESU was listed by NMFS as threatened on September 16, 1999; its threatened status was reaffirmed on June 28, 2005 (70 FR 37160). This ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River to the Russian River, California, as well as seven artificial propagation programs (Good et al. 2005). Federal critical habitat was designated by NMFS on September 2, 2005 (70 FR 52488; Figure C-5). ESU populations are strictly of the fall-run type (spring-run populations are considered to be extinct). Chinook are relatively low in numbers in the northern part of the ESU and are sporadically present in streams in the southern portion of the geographic region encompassing this ESU (NMFS 1999).

Fall-run Chinook salmon exhibit an ocean-type life history adapted for spawning in lowland reaches of big rivers and their tributaries and avoiding high summer temperatures (Moyle 2002; Cook 2003). In the Russian River, Chinook salmon spawn almost exclusively in the mainstem Russian River and in Dry Creek in reaches with gradients between 0.2%-1.0%.

Figure C-6 depicts the general life history periodicity of Chinook in the Policy area. Adult Chinook salmon begin returning to the Russian River earlier in the fall than coho and steelhead, as early as late August through January, but most upstream migration occurs in late October through mid-December (Steiner 1996; Chase et al. 2000, 2001). The location of spawning will vary from one year to another depending on the timing and amount of fall and winter rains (Flosi et al. 1998). Eggs hatch within 4 to 6 weeks and young salmon generally begin outmigration soon after they emerge from the substrate in spring. Initially, fry are typically washed downstream into back- or edge water areas of lower velocities and adequate cover and food. As juveniles grow larger, they move into deeper and faster water (Moyle 2002). In contrast with coho and steelhead, freshwater residence for juvenile Chinook in the Policy area usually ranges only from two to four months, from late February through June.



### Chinook

Life Stage	River	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Upstream Migration	Mattole R												
	Russian R												
	San Francisco Bay												
Spawning	Russian R												
	San Francisco Bay												
Incubation	Russian R												
Rearing	Russian R												
Outmigration	Russian R												

Figure C-6. Periodicities of Chinook salmon life stages in the Policy area (Sources: Steiner; Chase et al. 2001, 2003; Downie et al. 2002; Entrix 2002, 2004; SEC et al. 2004). Periods of greatest activity are indicated by darker shade, when available in literature reviewed.