STATE OF CALIFORNIA RESOURCES AGENCY DEPARTMENT OF FISH AND GAME

Recovery Strategy for California Coho Salmon

Report to the California Fish and Game Commission

PREPARED BY
The California Department of Fish and Game

Species Recovery Strategy 2004-1

FEBRUARY 2004

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2.2.2 CENTRAL CALIFORNIA COAST COHO ESU

Coho salmon populations in streams in the northern portion of this ESU seem to be relatively stable or are not declining as rapidly as those to the south. However, the southern portion, where widespread extirpation has occurred, is a significant portion of the range of coho salmon in this ESU. Widespread extirpation or local extinctions have already occurred within some larger stream systems (e.g., Gualala and Russian rivers), or over broad geographical areas (e.g., Sonoma County coast, San Francisco Bay tributaries, streams south of San Francisco).

Most abundance trend indicators for streams in the CCC Coho ESU suggest a decline since the late 1980s. However, some streams of the Mendocino County coast showed an upward trend in 2000 and 2001. Time-series analyses for these streams show a declining trend and predict that this trend will continue, despite the recent increases.

Small population size, along with large-scale fragmentation and collapse of range, indicate that metapopulation structure may be severely compromised and remaining populations may face greatly increased threats of extinction. For this reason, the Department concluded that coho salmon in the CCC Coho ESU are in serious danger of extinction throughout all or a significant portion of their range.

2.3 PRESENT DISTRIBUTION

Coho salmon distribution is described as the streams within the range where the species can be, or has been, detected. The Department has mapped the present distribution of coho salmon in the SONCC Coho ESU (Figure 2-3) and the CCC Coho ESU (Figure 2-4). Present distribution is based on the most recently available information and includes streams where coho salmon are still believed to exist.

The Department used a conservative approach when determining the upper extent of coho salmon distribution. Where data were present, the upper mapped extent was defined as that point furthest upstream where coho were last observed. This uppermost point on the map does not preclude coho usage further upstream, only that they have not been documented as yet in those areas.

The full extent of a stream was mapped when the data available indicated coho existed there, but had no location information. An exception to this was when there was a known limit to anadromy. Known limits to anadromy include natural (e.g., waterfalls) as well as man-made barriers (e.g., dams). Some of these known man-made barriers may be removed or modified to allow access to more of the stream, increasing the limit of anadromy.

Waterways that are not indicated as coho streams may still support populations or provide seasonal refugia, but as yet have no usage documented. Therefore the known present distribution for coho salmon will change with new information.

2.4 LIFE HISTORY

Adult coho salmon enter fresh water from September through January in order to spawn. In the short coastal streams of California, migration usually begins between mid-November and mid-January (Baker and Reynolds 1986). Coho salmon move upstream after heavy rains have opened the sand bars that form at the mouths of many California coastal streams, but may enter larger rivers earlier. On the Klamath River, coho salmon begin entering in early to mid-September and reach a peak in late September to early October. On the Eel River, adult coho salmon return four to six weeks later than on the Klamath River (Baker and Reynolds 1986). Arrival in the upper reaches of these streams generally peaks in November and December. Timing varies by stream and/or flow (Neave 1943; Brett and MacKinnon 1954; Ellis 1962) (Figure 2-5).

Generally, coho salmon spawn in smaller streams than do Chinook salmon. In California, spawning occurs mainly from November to January, although it can extend into February or March if drought conditions are present (Shapovalov and Taft 1954). In the Klamath and Eel rivers, spawning occurs in November and December (USFWS 1979). Shapovalov and Taft (1954) note that females usually choose spawning sites near the head of a riffle, just below a pool, where the water changes from a laminar to a turbulent flow and there is a medium to small gravel substrate. The female digs a redd (nest) by turning partly on her side and using powerful, rapid movements of the tail to dislodge the gravels, which are transported a short distance downstream by the current. Repeating this action creates an oval-to-round depression at least as deep and as long as the fish. Eggs and milt (sperm) are released into the redd, where, because of the hydrodynamics of the redd, they tend to remain until they are buried. Approximately one-hundred or more eggs are deposited in each redd. The fertilized eggs are buried by the female digging another redd just upstream. The flow characteristics of the redd location usually ensure good aeration of eggs and embryos, and the flushing of waste.

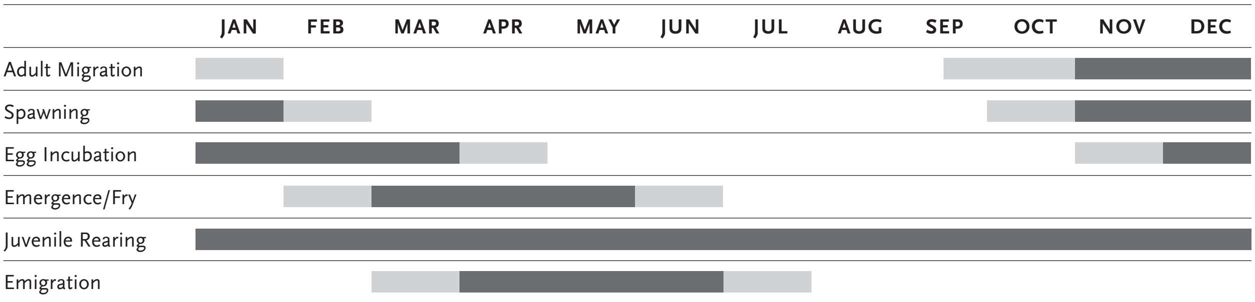
Larger coho salmon produce more eggs and there is a definite tendency for fecundity to increase from California to Alaska (Sandercock 1991). Average coho salmon fecundities, as determined by various researchers working on streams in British Columbia, Washington, and Oregon, range from 1,983 to 2,699 and average 2,394 eggs per female (Sandercock 1991). The fecundity of coho salmon in Washington streams ranged from 1,440 to 5,700 eggs for females that were 44 cm to 72 cm in length (Scott and Crossman 1973).

In California, eggs incubate in the gravels from November through April. The incubation period is inversely related to water temperature. California coho salmon eggs hatch in about forty-eight days at 48°F, and thirty-eight days at 51.3°F (Shapovalov and Taft 1954). After hatching, the alevins (hatchlings) are translucent in color (Shapovalov and Taft 1954; Laufle et al. 1986; Sandercock 1991). This is the coho salmon's most vulnerable life stage, during which they are susceptible to siltation, freezing, gravel scouring and shifting, desiccation, and predation (Sandercock 1991; Knutson and Naef 1997; Pacific Fisheries Management Council [PFMC] 1999). Alevins remain in the interstices of the gravel for two to ten weeks until their yolk sacs have been absorbed, at which time their color changes to that more characteristic of fry (Shapovalov and Taft 1954, Laufle et al. 1986, Sandercock 1991). The fry are silver to golden with large, vertical, oval, dark parr marks along the lateral line that are narrower than the spaces between them.

Fry emerge from the gravel between March and July, with peak emergence occurring from March to May, depending on when the eggs were fertilized and the water temperature during development (Shapovalov and Taft 1954). They seek out shallow water, usually moving to the stream margins, where they form schools. As the fish feed heavily and grow, the schools generally break up and individual fish set up territories. At this stage, the fish are termed parr (juveniles). As the parr continue to grow and expand their territories, they move progressively into deeper water until July and August, when they inhabit the deepest pools (CDFG 1994a). This is the period when water temperatures are highest, and growth slows (Shapovalov and Taft 1954). Food consumption and growth rate decrease during the winter months of highest flows and coldest temperatures (usually December to February). By March, parr again begin to feed heavily and grow rapidly.

Rearing areas used by juvenile coho salmon are low-gradient coastal streams, lakes, sloughs, side channels, estuaries, low-gradient tributaries to large rivers, beaver ponds, and large slackwaters (PFMC 1999). The most productive juvenile habitats are found in smaller streams with low-gradient alluvial channels containing abundant pools formed by large woody

FIGURE 2-5: Calendar indicating the seasonal presence of coho salmon in California coastal watersheds



NOTE: Dark shading indicates months of peak activity for a particular life stage; the lighter shading indicates months of lesser activity.

debris (LWD). Adequate winter rearing habitat is important to successful completion of coho salmon life history.

After one year in fresh water, smolts begin migrating downstream to the ocean in late March or early April. In some years emigration can begin prior to March (CDFG unpublished data) and can persist into July (Shapovalov and Taft 1954; Sandercock 1991). Weitkamp et al. (1995) indicate that peak downstream migration in California generally occurs from April to early June. Factors that affect the onset of emigration include the size of the fish, flow conditions, water temperature, dissolved oxygen (DO) levels, day length, and the availability of food. In Prairie Creek, Bell (2001) found that a small percentage of coho salmon remain more than one year before emigrating to the ocean. Low stream productivity, due to low nutrient levels or cold water temperatures, can contribute to slow growth, potentially causing coho salmon to postpone emigration (PFMC 1999). There may be other factors that contribute to a freshwater residency of longer than one year, such as late spawning, which can produce fish that are too small at the time of smolting to migrate to sea (Bell 2001).

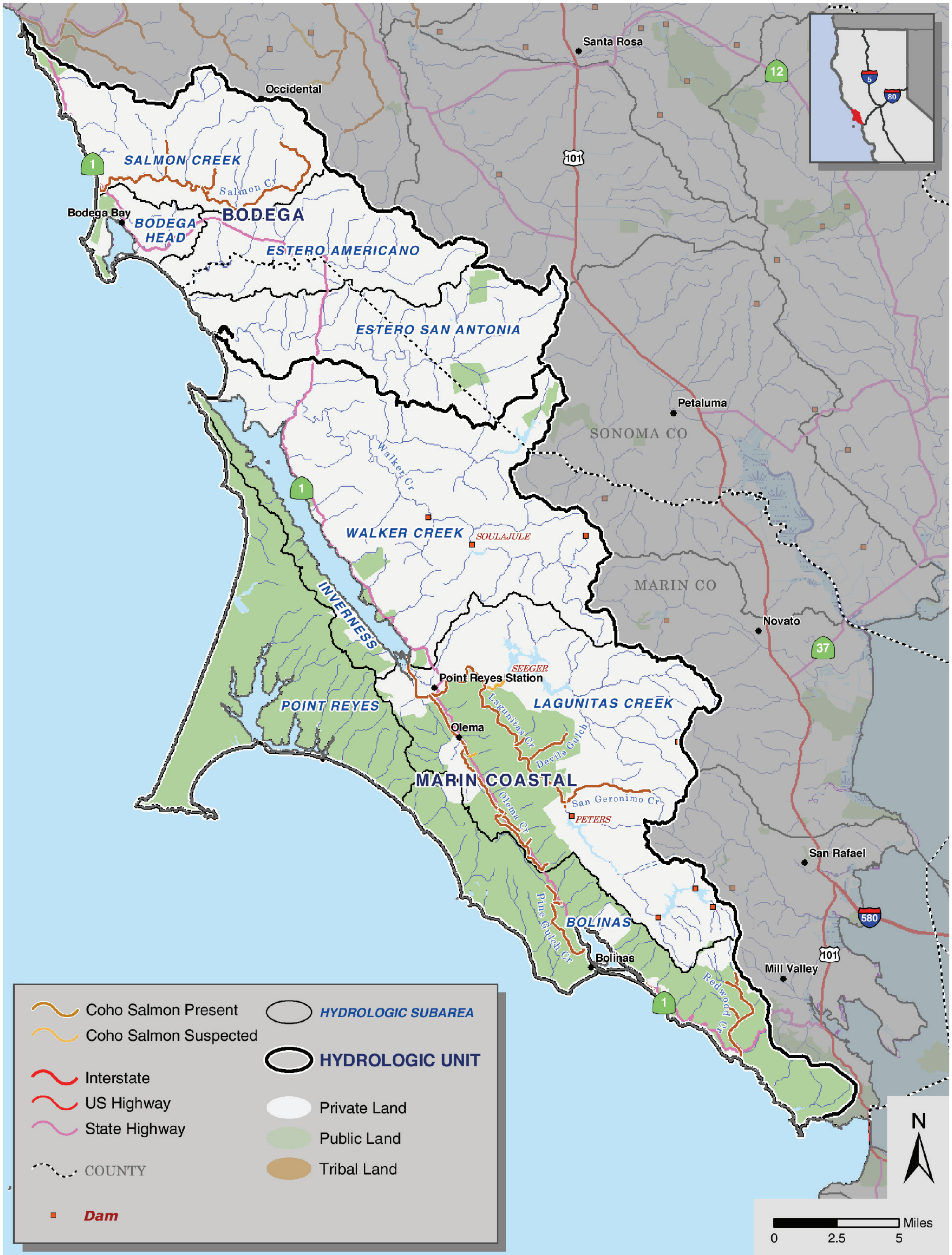
The amount of time coho salmon spend in estuarine environments is variable, and the time spent there is less in the southern portion of their range (PFMC 1999). Upon entry into the ocean, the immature salmon remain in inshore waters, congregating in schools as they move north along the continental shelf (Shapovalov and Taft 1954; Anderson 1995). Most remain in the ocean for two years; however, some return to spawn after the first year, and these are referred to as grilse or jacks (Laufle et al. 1986). Data on ocean distribution of California coho salmon are sparse, but it is believed that the coho salmon scatter and join schools from Oregon and possibly Washington (Anderson 1995).

2.5 POPULATION STRUCTURE AND VIABILITY

McElhany et al. (2000) define an independent fish population as a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. This definition of a population is the one used for purposes of this document and is much the same as Ricker's definition of stock (1972, as cited in McElhany et al. 2000). The term "coho salmon population" typically refers here to spawning adults.

The Department defines and manages runs of anadromous salmonids based on genetic distinctiveness, run-timing differences, juvenile emigration timing, and watershed distinction (CDFG 1998). In many cases, California coho salmon populations roughly correspond to distinct spawning runs within watersheds. However, there is not enough information to assess the

FIGURE 6-19: Bodega and Marin Coastal Hydrologic Units



6 RECOVERY UNITS AND WATERSHEDS

FIGURE 6-13: Cape Mendocino Hydrologic Unit

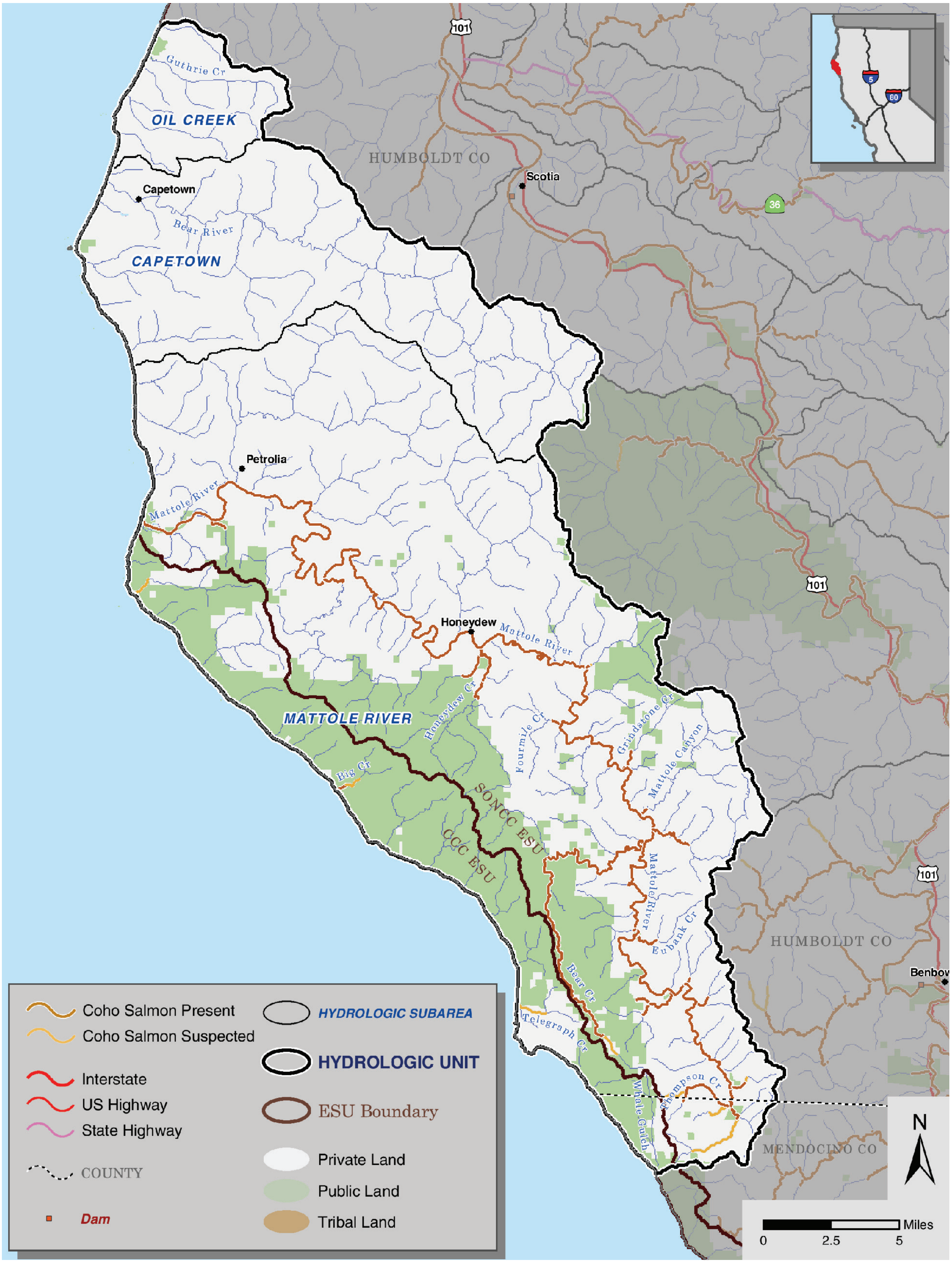


FIGURE 6-12: Eel River Hydrologic Unit

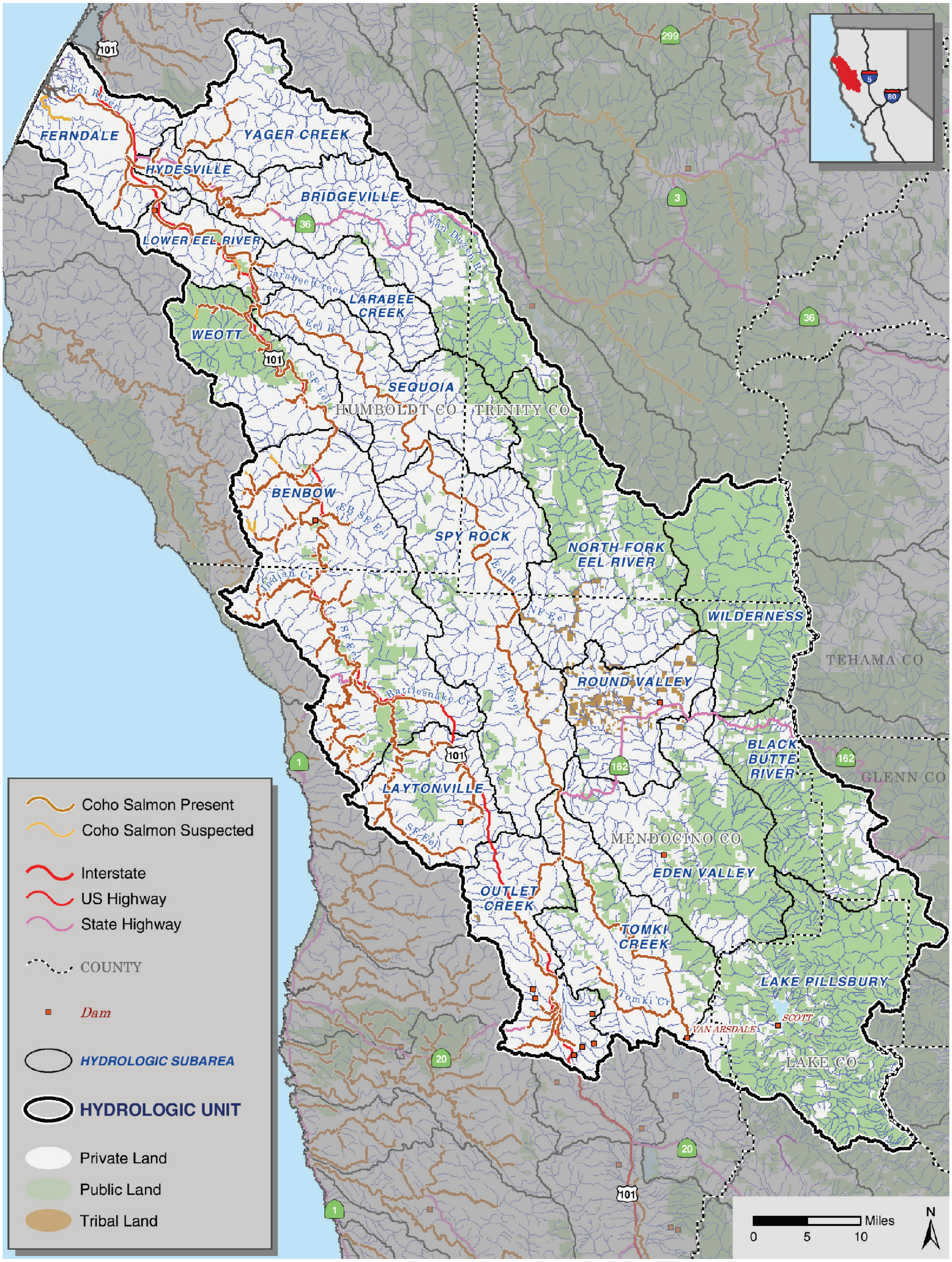


FIGURE 6-11: Eureka Plain Hydrologic Unit

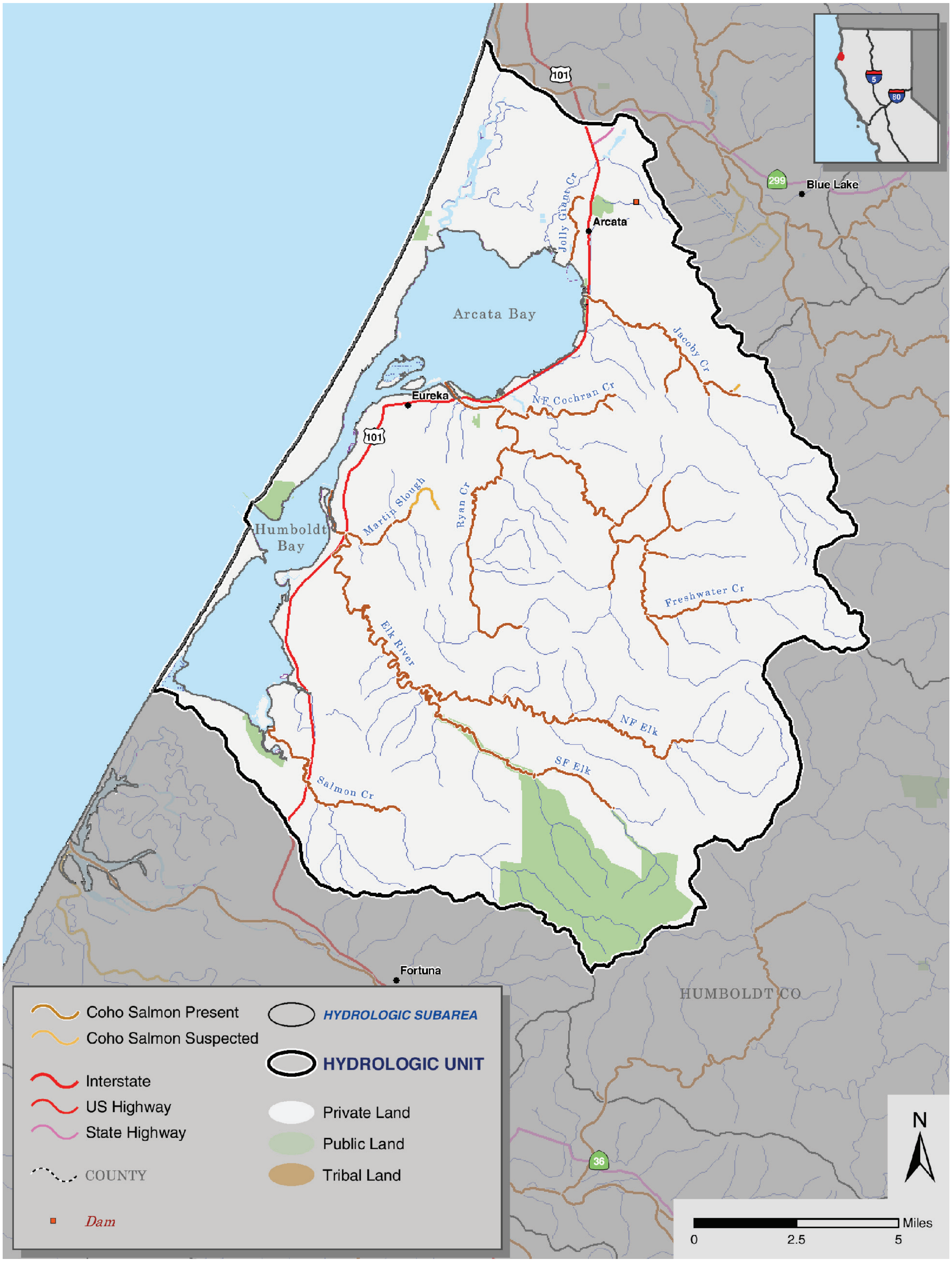


FIGURE 6-9: Mad River Hydrologic Unit

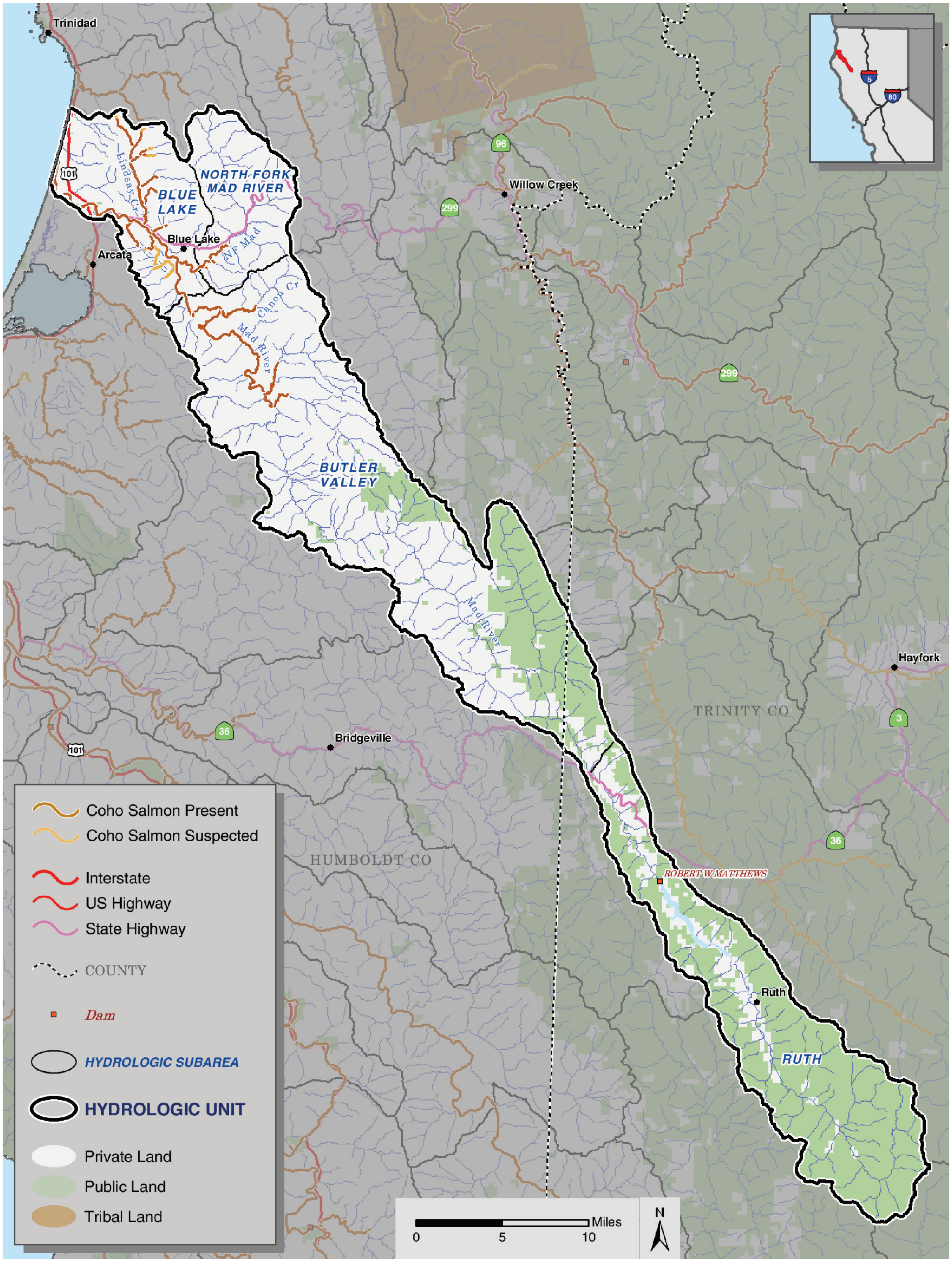


FIGURE 6-16: Mendocino Coast Hydrologic Unit (North)

FIGURE 6-17: Mendocino Coast Hydrologic Unit (South)

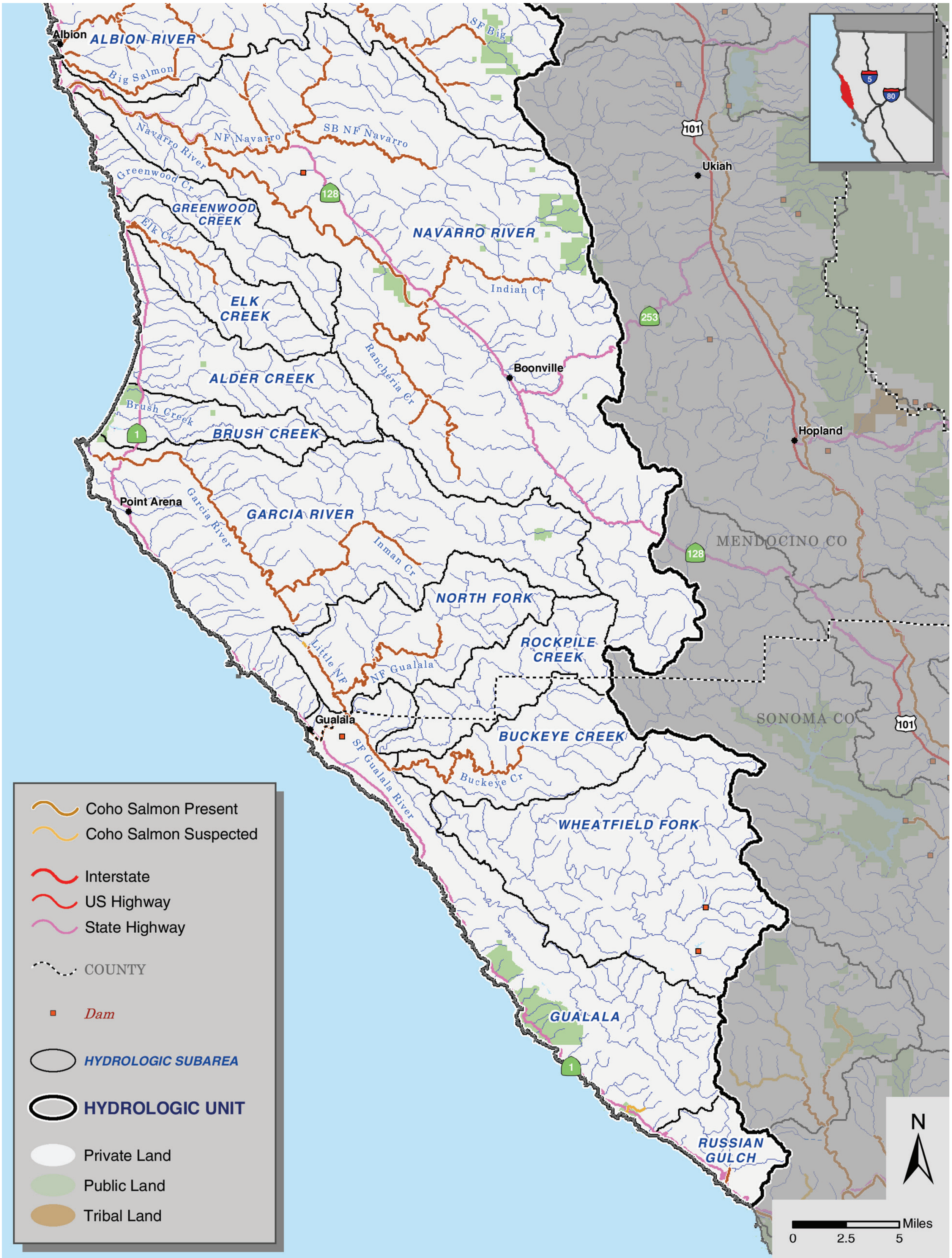


FIGURE 6-10: Redwood Creek and Trinidad Hydrologic Units

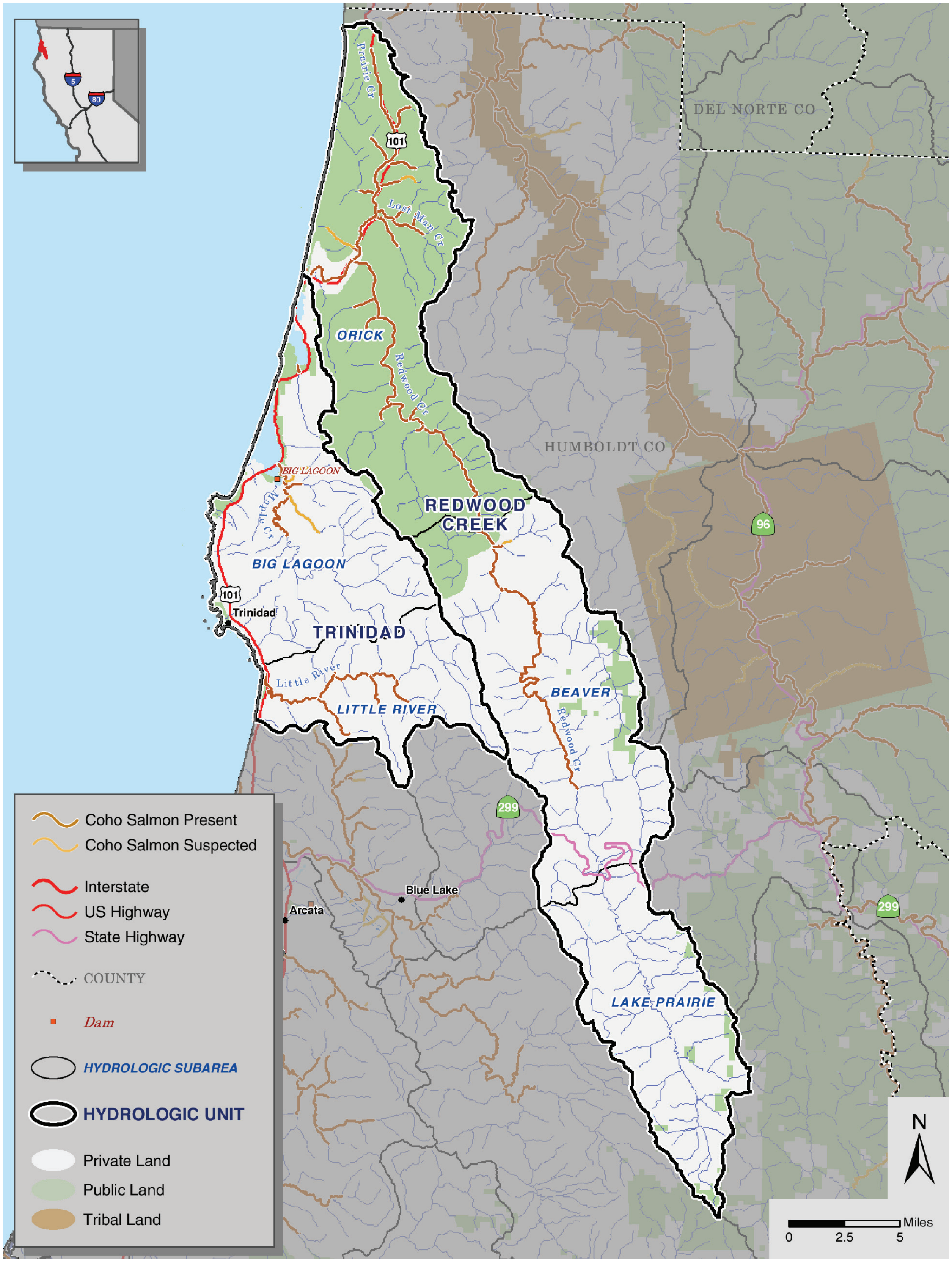


FIGURE 6-18: Russian River Hydrologic Unit

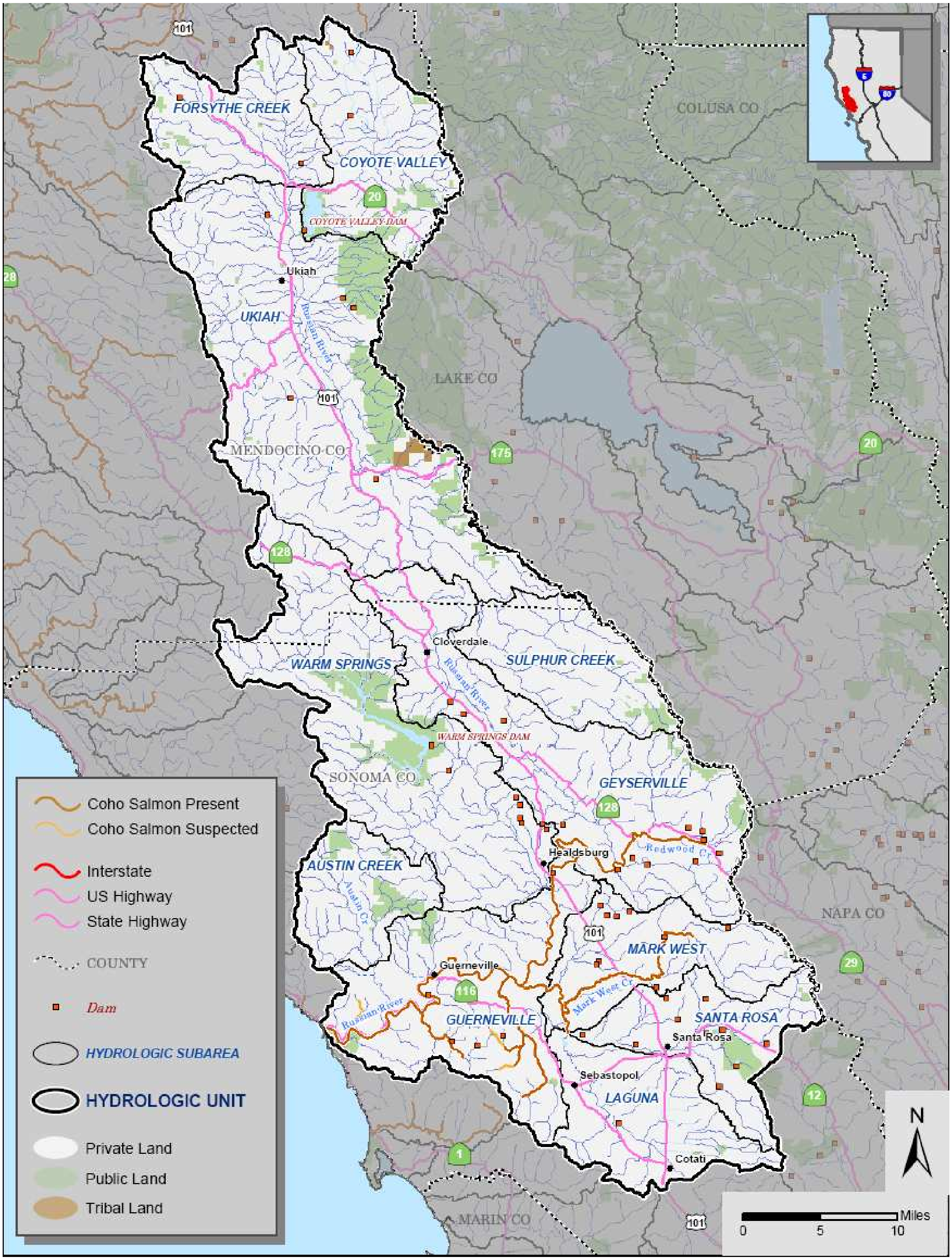


FIGURE 6-7: Scott River Hydrologic Area

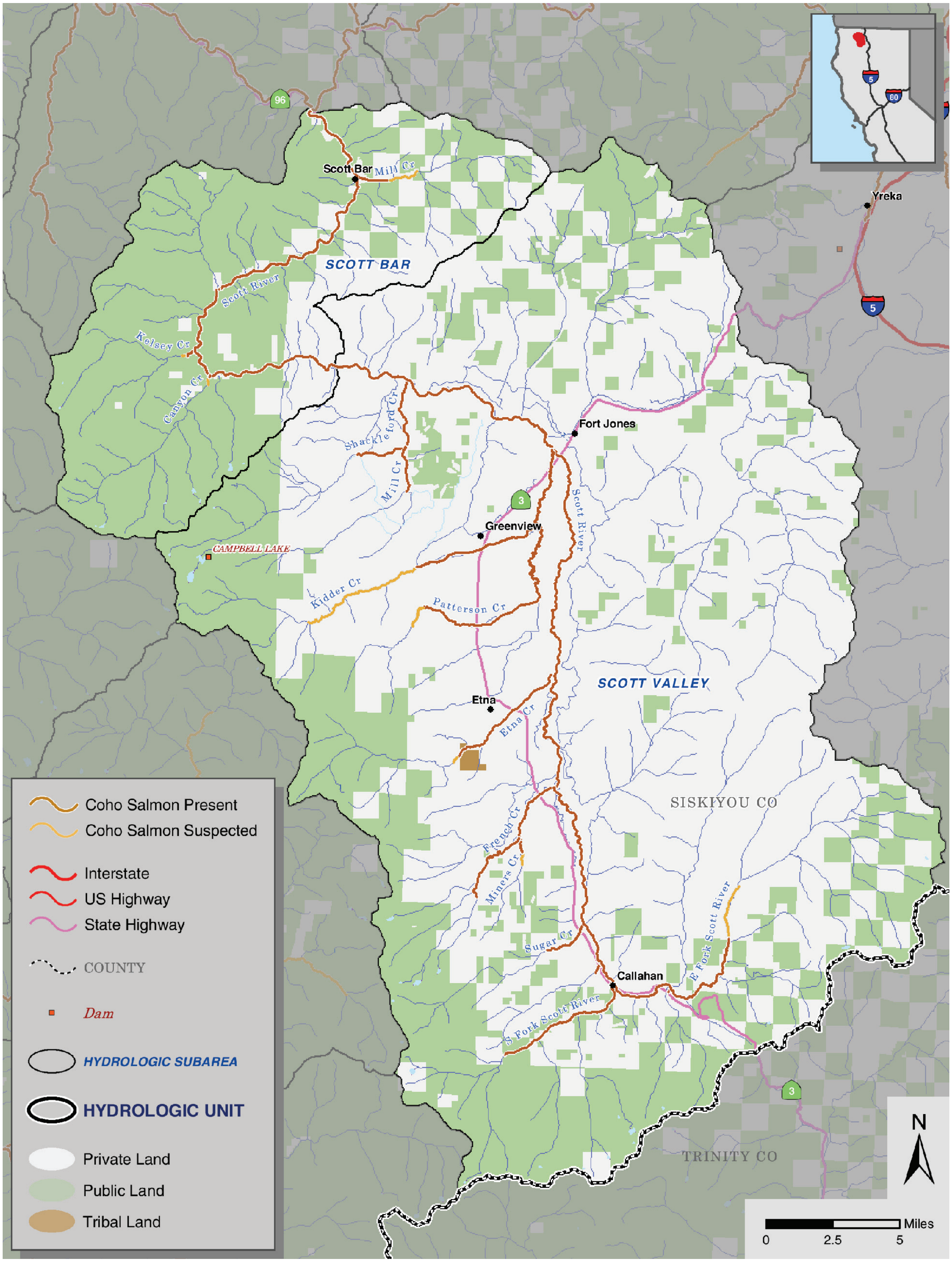


FIGURE 6-6: Shasta Valley Hydrologic Area

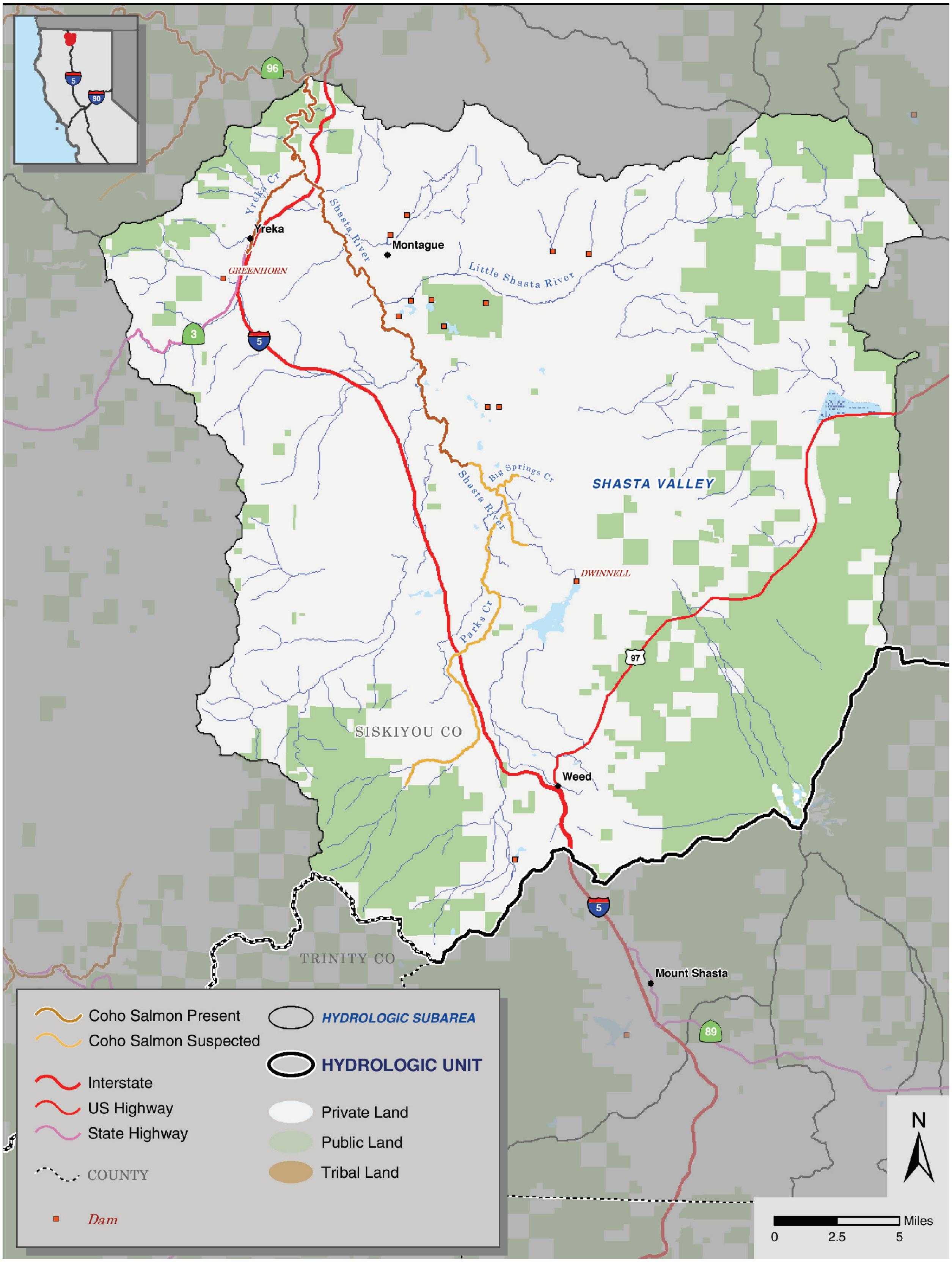


FIGURE 6-5: Salmon River Hydrologic Area

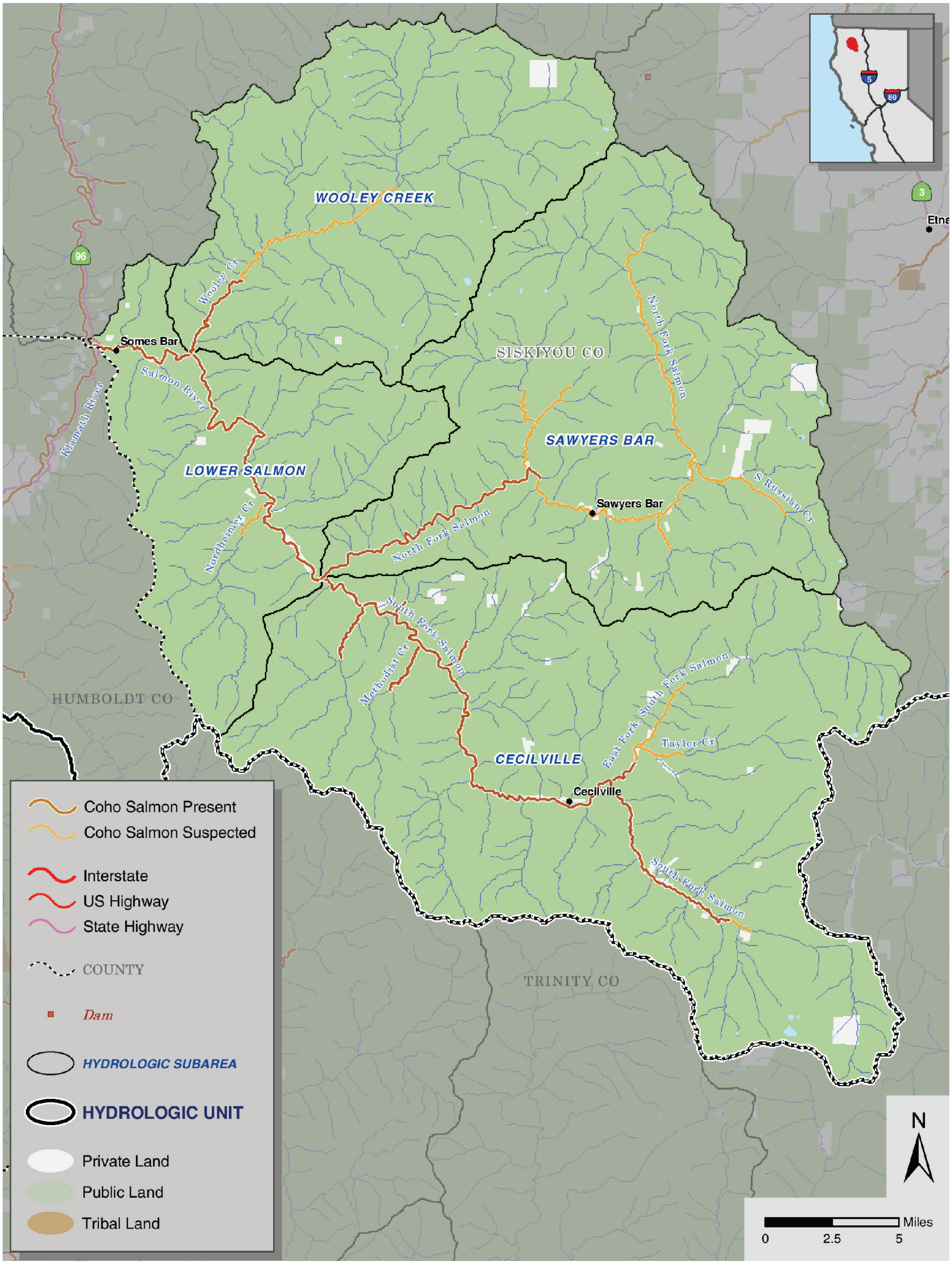


FIGURE 6-4: Winchuck River and Smith River Hydrologic Units

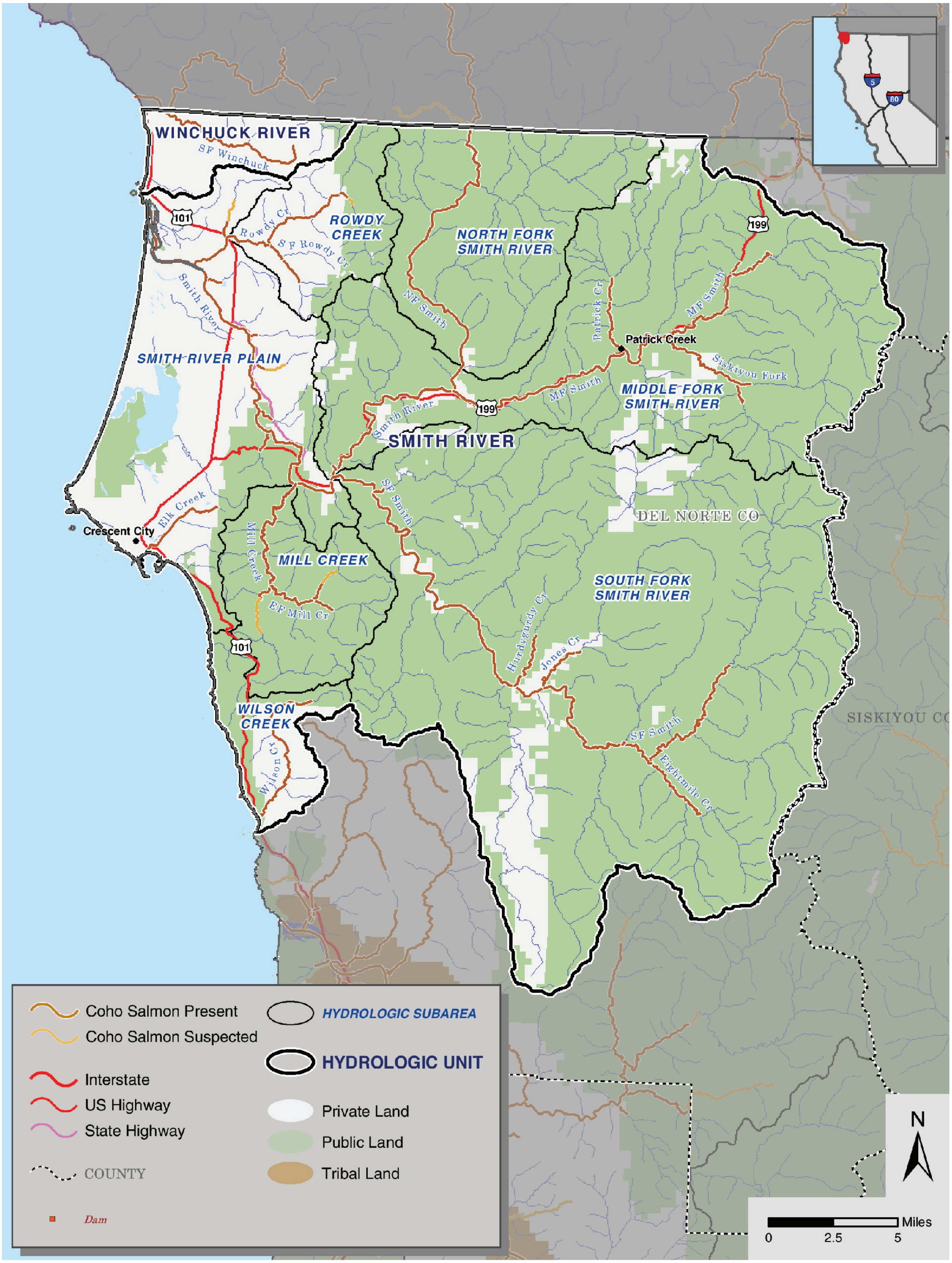


FIGURE 6-8: Trinity River Hydrologic Unit