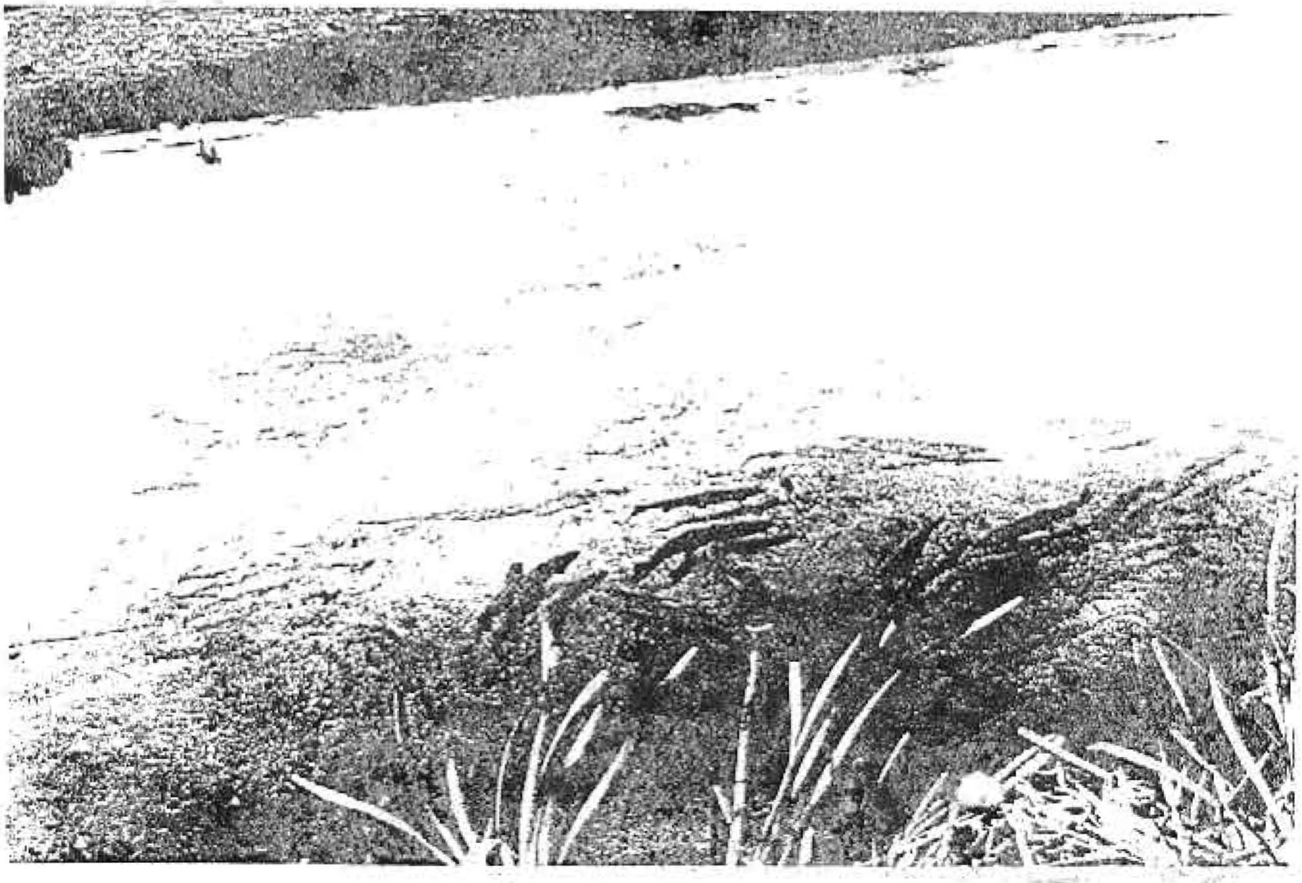
Ventura Watershed Analysis – Focused for Steelhead Restoration

Los Padres National Forest
Ojai Ranger District



Ventura River Steelhead, circa 1945

Prepared by

Sara Chubb, Forest Fishery Biologist

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I. INTRODUCTION

Southern California steelhead populations have decreased to less than 5% of their historical size and range and are in immediate danger of extinction (Nehlsen et al. 1991). The Ventura River once supported runs of several thousand anadromous steelhead (Clanton and Jarvis 1946) but numbers have dwindled to less than a few hundred, at best.

Steelhead are currently being reviewed by the National Marine Fisheries Service for listing under the Endangered Species Act. The USDA Forest Service (1995) is operating under interim National "PacFish" direction incorporated into the Forest Land and Resource Management Plan as part of a Riparian Conservation Strategy (USFS 1994). Los Padres National Forest is in the process of establishing "Riparian Habitat Conservation Areas" (special management zones), applying new standards to projects and ongoing activities, and managing to meet specified habitat objectives so as to lead to steelhead recovery. Watershed analyses are required in order to determine the most effective approach to managing for steelhead restoration. A coalition of various agencies have also initiated a Ventura River Steelhead Restoration and Recovery Plan with the goal of identifying and better coordinating actions which will restore steelhead while maintaining opportunities for ongoing and new public and private human activities. This report discusses results of a watershed analysis conducted with the primary goals of meeting PacFish direction and providing timely information and recommendations for the multi-agency Steelhead recovery planning effort.

II. THE SETTING

The Ventura River basin is situated along the southern California coastline less than 60 miles to the north of the Los Angeles metropolitan area (Figure 1). The city of Ventura is located near the Ventura River mouth and estuary.

The Ventura River basin encompasses a total of 577 km^2 (142,000 acres) and is composed roughly of half Forest Service lands (284 km^2) and half private lands. Private inholdings compose less than 7% of the area within the Forest boundaries. Over 95 km^2 (17%) are designated as Wilderness encompassing 89 miles of stream. Some 30 miles of the upper Main Fork Matilija and it's tributaries are designated as "Wild and Scenic Rivers". (Figure 2)

The mainstem of the Ventura River spans 31 miles from headwaters (upper Main Fork Matilija Creek) through the Main Fork Matilija and the Ventura River proper. Major subwatersheds with substantial Forest Service lands include in descending order of area: North Fork Matilija, Coyote, San Antonio, Upper North Fork, Gridley, Fall, and Murietta (Figure 3).

North Fork Matilija Creek runs parallel to Highway 33 through Wheeler Gorge in the lower reaches. Human use recreational and residential use is intense through this section. The upper reaches are less impacted, with denser stream shading and habitat diversity. Coyote Creek flows through a upper narrow bedrock and boulder lined cascade section, a mid lower gradient area of windthrow alder, and a lower moderate gradient and open reach before entering Casitas Reservoir. Only the headwaters of San Antonio Creek are on Forest Service lands. Gridley Creek flows through upper steep boulder cascade canyon reaches before entering private orchard lands and flowing into San Antonio Creek. Murietta Creek flows through dense alder thickets in the upper reaches, picks up flow from a side tributary in a more open middle section that has been impacted by past road related landslides, and may go subsurface in the lower less vegetated moderate gradient section before joining the mainstem Matilija Creek. Upper North Fork Matilija headwaters are boulder/bedrock cascades and step pools with good shading within a narrow canyon. The middle section is a more open lower gradient and wider section of shallow pools and riffles. Lower sections are steeper boulder/bedrock step runs and pools within a narrow canyon. The mainstem Matilija flows through upper steep narrow canyons into a middle section of moderate gradient bedrock dominated pool and riffle sequences. The lower sections of the mainstem are low gradient, wide, open, and shallow from the confluence of the Upper North Fork to Matilija Reservoir.

III. HISTORICAL CONDITIONS

Prehistoric conditions are difficult to determine. Analysis of sediment core samples from the Santa Barbara channel indicate that prior to 1500 C.E. Fire occurred less frequently but in greater intensity and to a wider extent than in the last century. Fire has likely always been a major formative factor of the watershed. Local geology also suggests that the landscape has undergone intense periods of uplift, channel incision, and landslides.

Historically, steelhead (*Oncorhynchus mykiss*) were a common inhabitant of California coastal streams as far south as Baja. The Ventura River supported a substantial steelhead run of at least 2,000 to 3,000 spawning fish (Clanton and Jarvis 1946). Historical accounts do not differentiate between steelhead and rainbow trout creating difficulty in determining the extent and magnitude of early anadromous runs. Newspaper articles of the late 1800's repeatedly mention the large angler catches from through out much of the length of the mainstem Ventura River (Appendix A). Flows were apparently adequate to support both resident and anadromous fish through out most mainstem reaches except during drought years. Sections of the mid to upper Matilija Creek are thought to have been the primary spawning habitat representing over half of the historically used habitat (Moore 1980). Approximately half of the river basin perennial and seasonal flowing streams may have once supported anadromous steelhead (Figure 4).

Other fish species native to the Santa Clara basin included Pacific lampreys, Santa Ana suckers (*Catostomus santaanae*), arroyo chub (*Gila orcutti*), and three-spine stickleback(*Gaasterosteus aculeatus aculeatus*). Pacific lamprey (*Lampetra tridentata*), were usually found in association with steelhead. Adult lampreys migrated upstream at the same time period and utilized the same spawning riffles as steelhead. Unlike steelhead, however, lamprey only spawn once and die in large numbers at the spawning grounds. Such die-offs must have been a seasonally significant food source for scavenging wildlife (including the grizzly bears that were once common in the area) and a important nutrient input to small tributary streams.

Santa Ana suckers and Santa Ana speckled dace, *Rhinichthys osculus*, historically inhabited the larger coastal streams throughout southern California (Swift et al. 1993). It is not clear that suckers and dace were native to the Ventura River basin, although they were inhabitants of the nearby Santa Clara River.

Arroyo chub, *Gila orcutti*, were historically endemic to the Los Angeles River basin (Swift et al. 1993) and may have been a early introduction throughout much of southern California. If present, chubs may have been a significant food source for migrating or held-over adult steelhead.

Three-spine stickleback, *Gasterosteus aculeatus*, were native to many of the streams of southern California (Swift et al. 1993). The unarmored three-spine stickleback was the native form in the nearby Santa Clara River. The partially armored variety was native further north. Intercrossed forms may have inhabited the Ventura River.

Several species of sculpin (staghorn sculpin *Leptocottus armatus*, prickly sculpin *Cottus asper*) and tidewater goby (*Eucyclogobius newberryi*) coexisted with steelhead and were native to the Ventura River lagoon and estuary. Sculpin may also have inhabited the mainstem but were not likely to have extended far into the upper basin and tributaries. Neither of these species interacted with steelhead to any great degree, except possibly as a food source for migrating adults.

Chumash Indians have inhabited the Ventura River basin for over 4,000 years. The Chumash likely had minimal impact on the landscape and resources. Several large villages were located in the lower coastal portion of the watershed. The primary use of the upper watershed was in dispersed hunting and fishing camps. Prior to the late 1700s Chumash were known to burn sage scrub and grasslands but not chaparral. It is thought that some of the prescribed fires would have escaped into chaparral however, perhaps altering vegetation patterns and fire intensities or intervals.

Grazing and vineyards were the most noticeable alterations associated with the Spanish missions in the 1700s and the Spanish rancheros in the early 1800s. Vineyards and intensive farming rapidly spread through out the Slower Ventura River Valley. During this period, grazing may have been heavy within portions of the watershed reducing grassland fuel loads. With the decline in the Chumash population, prescribed burning was no longer practiced. Historical accounts of 1793 describe chaparral stands as continuous, heavy, and decadent. It is not clear how fire patterns were affected during this period.

Homesteading began in earnest in the late 1800s, as did small hard rock mining operations and oil exploration. Grazing may have declined around the turn of the century and could have been a contributing factor to fuels build up and later major fires. During this period, ranches and small communities began to divert surface flows from the mainstem Ventura River. As the number and volume of these diversions increased, impacts on steelhead increased by reducing available instream water and habitat and by the high mortality of young fish diverted into unscreened water conveyance systems. Some of the structures associated with these diversions also may have at least partially blocked upstream steelhead migrations. The Foster Park Diversion in the lower mainstem Ventura River was completed in 1906. (Appendix B)

As populations increased, so did numerous non-native species. Carp (*Cyprinus carpio*) were introduced to local farm ponds and irrigation ditches in the late 1800s (Ventura Free Press, January 13, 1883). Brook trout (*Salvelinus fontinalis*) were brought in from the eastern United States by railroad and transported on horseback into many locations within the area (Ventura Free Press, January 4, 1882). Brook trout introductions may not have been successful, as there is no mention of brook trout being caught around the turn of the century. Brown trout were also introduced in the 1930's. Both brook and brown trout likely did not do well in this area since they are fall spawners that require cooler water temperatures, cleaner gravels, and more constant water flows. Experimental stocking of Atlantic salmon (Ventura Free Press, February 23, 1878) and "Lake Tahoe trout" (=kokanee salmon?) may also have taken place (Ventura Star Press, August 1, 1887), perhaps explaining the reports of what locals called "dog salmon" (Henke 1995). Stocking of non-native rainbow trout (usually domesticated varieties of more northerly and interior fish) began in the 1890s (Ventura Free Press, September 15, 1893) diluting native genes and the long term viability of native steelhead stocks. Stocking of non-native trout reached a peak around the turn of the century. In spite of continued stocking efforts well into the 1960's, angler catch rates and observed fish densities seemed to decline.

Steelhead transplants were also from those "rescued" from above newly built reservoirs both within and outside the Ventura River basin. Thousands of steelhead from the nearby Santa Ynez River were stocked into Matilija and Santa Ana Creeks between 1938 and 1944 (Titus et al 1994).

Beaver were introduced to the region sometime after 1917. It is not clear to what extent beaver may have inhabited and influenced the Ventura River. If beaver were present they may have altered habitat by removal of trees, widening of channels, and increasing of summer water temperatures. Beaver dams likely did not block upstream steelhead migrations as the dams would regularly washed out during winter storms. Regionally, beaver declined in the 1950s due to trapping and flooding.

As more people moved into the area and populations grew over utilization of the resource became a problem. Steelhead were likely taken as bycatch in commercial seining operations within the ocean and lagoon (Ventura Free Press 1876). Recreational and subsistence fishing also had a noticeable impact. Local newspapers bragged about the taking of hundreds of "trout" in a couple hours of fishing (Ventura Free Press, February 9, 1878). Matilija and other easily accessible drainages were the first to suffer the consequences of severe overfishing.

Fire suppression activities began in earnest as early as the 1920s. Thereafter, the first documented major fire occurred in 1932. The Matilija fire of 1983 burned 3,900 acres within the watershed and was noted as resulting in accelerated erosion that continued for at least a decade (USFS files). Woody debris washed downstream causing log jams that temporarily trapped sediment only to break loose and cause severe downcutting and lateral stream bank erosion with each successive storm. Fires altered riparian vegetation, often from mid or late seral alder and cottonwood to early seral alder or willow thickets. (Appendix B)

Inadequate flows appeared to be a noticeable problem in the 1940s. Increasing agricultural and municipal water demands expanded water diversions. Many water diversion structures were potentially impediments to upstream and downstream steelhead movements. Most water diversions were unscreened causing the loss of countless steelhead juveniles and smolts.

From what few accounts that are available, steelhead appeared to begin their most precipitous decline in the late 1950s. The Matilija Dam completed in 1948, and Robles Diversion Dam and Casitas Dam completed in 1958, effectively cut-off steelhead access to over 50% of their historical spawning habitat. These dams also captured much of the supply of sand and gravels and began a process which has drastically altered downstream channels and floodplains.

Road building, maintenance, and use, has also had an effect on steelhead and stream corridors. Many of the present day access roads were built around the turn of the century. Highway 33 (Maricopa Highway) was constructed in the 1930's. As continues to date, lengthy highway sections run parallel and impinge upon the North Fork River corridor greatly influencing riparian habitat, the floodplain, channel morphology, and water quality.

Comparisons of historical photos to present day conditions does not indicate a fundamental change in channel morphology although bedload and riparian vegetation has changed over time (Appendix C). Many of the historical photos were taken after humans had already altered the landscape. Other photos were taken shortly following a fire or flood and serve to illustrate that the only constant is change. Stream channels successively fill and scour, large boulders move downstream, logs are present either as massive debris jams or small clusters left on the floodplain, and riparian vegetation fluctuates from dense and continuous to sparse and discontinuous.

IV. CURRENT CONDITIONS

Steelhead and Rainbow Trout

The Ventura River anadromous steelhead population continues to be severely depressed. While it is likely that steelhead pass upstream without detection, it is certain that their numbers are low and well below the 200 fish threshold associated with a high risk of extinction (Franklin 1980). There have been no confirmed reports of anadromous adult steelhead in the Ventura River since 1993 and only a few scattered reports since the 1960s (Appendix A).

Southern steelhead and rainbow trout are of the same species and potentially intermixing populations. As has been observed in other steelhead populations (Shapovalov and Taft 1954) resident populations may coexist and geographically overlap with the anadromous form. Steelhead and rainbow trout eggs, fry, and juveniles can not easily be differentiated. They can conclusively be identified as "steelhead" when they go through the smoltification process which prepares their system for salt water and gives them the characteristic sleek silvery appearance. Smoltification probably occurs when fish achieve a length of 15 cm within the first or second year (Moore 1980). Smolts move downstream with receding storm flows in April through June (Shapovalov and Taft 1954).

Southern steelhead have adapted to their unpredictable climate by retaining the flexibility to remain landlocked through many years or generations before returning to the ocean when conditions allow (Titus et al. 1994). Such traits and behaviors appear to be inherited and there could very well be differences in the extent of anadromy between different river basins and even within a single drainage (Waples 1991). Research into the movements of inland trout has also shown that different populations have vastly differing degrees of mobility ranging from a few feet to 50 miles within a year (Schmal and Young 1994). Both anadromous and resident trout have likely adapted to periodic flood extremes and droughts through upstream movements. Success of restoration may be dependant on retaining the appropriate genetics for physiology and behaviors adaptive to local situations. Research is needed.

It is not clear to what extent overstocking with non-native rainbow trout may have caused introgression in the Ventura steelhead. Genetic analysis of what appeared to be resident rainbow trout from the upper Ventura/Matilija basin indicated that only 2 out of 31 of the sampled fish had clear native ancestry (Nielsen et al. 1997). It is possible, however, that some of the more isolated populations may retain a greater proportion of native steelhead genes. It is not known if the progeny of resident trout will ever be able to smolt and regain the anadromous life-style of their ancestors.

Resident rainbow trout are fairly well dispersed throughout the Ventura River basin, inhabiting much of the main Fork Matilija and upper North Fork, North Fork, Murietta, Coyote, Santa Ana, and Gridley subwatersheds (Figure 5). They extend upstream as far as there is good perennial water (Figure 6) and stream gradients are not too steep (generally less than 10%) (Figure 7). In drought years their distribution shrinks, and in high water years their distribution expands where falls, boulder cascades, or man-made barriers do not block their upstream migration. Only one instance of fish-less perennial water is known at this time (approximately 1 mile upstream of barrier falls on the Santa Ana drainage). Many of the highest densities of juvenile trout are found within seasonally intermittent reaches (upper Main Fork and upper North Fork for example) (Figure 8), suggesting that a lack of late summer holding water and periodic floods limit retention of older fish but enough survive to successfully reproduce and re-populate the area. The apparently high juvenile trout densities may be a function of less competition and predation from older fish and/or an inherent richness of habitat and productivity. It is likely not feasible to get steelhead up and over the multiple natural barriers and into these areas. And it may not be desirable, since many of these upper reaches may harbor other sensitive aquatic and riparian species, such as red-legged frogs that do better without fish competition and predation.

Ventura River waters support moderate ("good" according to Smith 1982) overall trout densities (0.3-0.6 fish per m^2), comparing favorably to more northerly small coastal streams (Burns 1971; Shapovalov and Taft 1954) and of similar densities to other south coast streams (Entrix 1994; USFS data files). Adult population densities are estimated at 800-1500/mi which is comparable to nearby Santa Paula Creekc but 25-50% lower than Sespe Creek. Juvenile densities ranged from 0.01-3.0 per m^2 with the average around 0.09, which is comparable to other southcoast resident trout densities but low when compared to known juvenile steelhead densities (0.18/m^2 in the lower and larger Santa Ynez River; Entrix 1994). In short, Ventura River fish production is largely what would be expected for resident fish and while resident production can be an indicator of potential steelhead production, steelhead productivity could be higher.

Projecting residential trout production out across historically accessible reaches within the Ventura basin, Forest lands could yield roughly 199,500 juvenile trout on the whole, or potentially enough smolts to support an adult steelhead run of approximately 2,800 (Table 1). A similar estimate of potential steelhead production (2,100 adult spawners) can be derived from the quantity and quality of spawning habitat which could be made accessible to spawning steelhead within the Forest Service System lands. These estimates are comparable to the historical projections of over 2,000 steelhead historically utilizing Matilija Creek (Clanton and Jarvis 1946).

There is an insufficient sample size to determine age-class size ranges, frequencies, and growth rates of upper Ventura River basin salmonids. Of the fish that were measured (n=50) in June of 1993, their sizes ranged from 82 to 242 mm and averaged 116 mm. Growth rates and population age classes are likely similar to those encountered on nearby Sespe Creek. Within the Sespe, at least four age classes of resident trout are identifiable: Juvenile trout typically range between 5 and 8 cm in their first growing season; First year fish are between 12 and 18 cm; Two year old fish are between 20 and 25 cm; Three year old fish may attain lengths over 28 cm. Smolts captured at the Vern Freeman Diversion on the Santa Clara River range between 20 and 30 cm and may include young-of-year fish. A similar pattern of rapid growth and early smoltification was observed in the lower Ventura River (Moore 1980). High growth rates of 0.9 to 2.8 cm per month were documented.

<u>Other Aquatic Species</u>

Pacific lamprey (*Lampetra tridentata*) share many of the same habitat requirements as steelhead and may spawn and rear within similar areas. Lamprey larvae are not easily detected, however, and although they were not observed in Forest Service surveys they may be there. Lamprey are also hampered in their upstream migrations by natural and artificial barriers, but possibly to a lesser extent than steelhead.

Arroyo chub (*Gila orcutti*) and three spine stickleback (*Gasterosteus aculleatus aculleatus*) are found in abundance (10-20 fish per 100 feet) throughout much of the mainstem Matilija and the lower North Fork (Figure 9). Optimal stickleback habitat includes small pools with constant flow and low water velocities (Baskin and Bell 1975). Chubs appear to be associated with low gradient riffles and runs (USFS 1995). Both species are known to coexist with steelhead and resident trout and may serve as a food source for migrating or held-over adult steelhead.

Speckled dace (*Rhinichthys osculus*) have not been observed in recent surveys. Dace are adapted to warm water (>28°C) and prefer cobble riffle habitats. It is unlikely that trout and dace would compete for the same food resources since dace are bottom feeders and trout generally feed up in the water column (Moyle 1976).

Exotic species that have been observed in the upper Ventura River basin include largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), and Pacific crayfish (*Procambarus clarki*). Highest densities of the exotics appear to be found in and downstream from Matilija Reservoir (Figure 9). Bass are notorious predators on other fish including trout and steelhead. Crayfish are scavengers that readily will feed upon eggs and fry in gravel spawning beds (Hobbs et al. 1989; Page 1985). Periodic floods likely limit upstream expansion of these species. Droughts may limit populations but can also increase the impacts of exotics on native species as there is increased competition for shrinking habitat.

Native species which may impact trout and steelhead include western pond turtles (*Plemmys marmorata pallida*) and two striped garter snakes (*Thamnophis hammondii*). Turtles prey upon fish but only if the fish are stranded, dead, or sluggish. Two-striped garter snakes are highly effective predators, taking juvenile salmonids of up to five inches in length (Chubb personal observation). Their impacts on local fish populations can be substantial during dry summers when fish are concentrated in limited habitat.

Other native aquatic species that appear not to negatively impact trout or steelhead include red-legged Frogs (*Rana aurora*), California treefrog (*Hyla cadaverina*), Pacific treefrog (*H. regila*), Western Toads (*Bufo boreas*), and California newt (*Taricha torosa*). All of these species except California newts overlap with trout in the use of stream channel types, reaches, and to some extent, instream habitat. California newts are generally only found in substantial numbers in perennial stream reaches where trout densities are low to non-existent.

Habitat Quality -- Migrations

Water flow is highly variable. In a "normal" water year (15-40 inches of rainfall) there are adequate peak flows to allow steelhead and trout to migrate upstream to their spawning grounds if there are not barriers. Usually, several successive winter storms would allow for multiple spawning migrations and assist with the movements of steelhead smolts downstream to the ocean.

An average of one out of five years is well below normal precipitation (less than 15 inches over the year) potentially severely limiting steelhead spawning migrations and trapping smolts. Fish passage at low to moderate flows is thought to be provided if depths are over 0.6 feet across at least 25% of the wetted channel (10% should be contiguous areas >0.6 feet deep) and velocities are less than 8 feet per second (Thompson 1972).

Low flow barriers become more significant during the dry years, not only for limiting upstream spawning steelhead, but also for limiting movements of steelhead juveniles and wild resident trout into late summer refugia habitats (see later section on summer habitat). Resident trout have been shown to also undergo seasonal migrations over great distances (>50 miles in some cases) (Schmal and Young 1994).

Migrating steelhead can generally navigate upstream against flows up to 6 feet per second and leap over 4-6 foot heights (Evans and Johnston 1972). Deep water (>half of the vertical jump) is necessary to gain the leaping momentum. Resting pools (>6") are necessary in long sections of high velocity flows.

During low flows, boulder cascades, bedrock slides, and low gradient riffles may become barriers to upstream fish movement. Steelhead may become stranded on their upstream migration if flows rapidly decline. The presence of good deep pools is essential during this period as fish may need to wait out the period between storms.

Swimming and jumping abilities are size dependant (Evans and Johnston 1972), so that fewer but larger individuals may be able to reach the upper reach spawning beds. The spawners that do make the effort would be compensated with less competition for available habitats, larger and more numerous fry, and healthier progeny.

Low flow barriers are likely found throughout many of the reaches of the upper Ventura River basin. Surveys were not of sufficient detail to describe all low flow barrier locations. The greatest numbers of complete barriers were noted within the North Fork and upper mainstem Matilija (Figure 8). Many of these barriers are formed by water plunges through boulders jammed against bedrock streambanks and canyon walls. Some of the barriers are waterfalls over bedrock ledges. Boulder barriers have the potential for shifting through natural processes of floods and earthquakes. There is also opportunity for human intervention to blast open a channel for fish passage. The rather immutable waterfalls, however, are often situated at the lower end of reaches with numerous boulder barriers, and thus the potential for opening up additional access for steelhead may be limitedt.

Artificial barriers to steelhead migrations include Casitas Dam on Coyote Creek, the Robles Diversion and Matilija Dam on the mainstem Matilija, and Wheeler Gorge Campground road crossing on the North Fork. Removal of these barriers provide opportunities to open up substantial additional areas (5, 2, 10, and 7 miles respectively) of steelhead habitat. Water diversions on Santa Ana and Gridley Creeks may be barriers for downstream migrating juvenile trout as they are not screened and remove a large proportion of the base flow.

Habitat Quality -- Spawning

As previously discussed, steelhead, and likely wild rainbow trout, will move into seasonally flowing reaches to spawn. They are not limited to only perennial waters and may utilize intermittent reaches to avoid crowding and potential predators (Carroll 1985; Everest 1973). Riffles provide the predominant spawning habitat, although small gravel pockets associated with pool tails may also be utilized by steelhead rainbow trout. Coyote, North Fork, Murietta, and Oldman Creeks have the highest proportions of riffle habitat. The mainstem Matilija Creek appears to have relatively low percentages of riffles except in reaches near the confluence of Old Man Creek.

Not all riffle habitat is good spawning habitat, however. Good spawning habitat should have a high percentage of gravels (>20%), no more than 15% fine sediments, and channel morphology (width/depth ~ 15) offering the good oxygen and silt carrying velocities. Given these parameters, the most suitable spawning areas would be predicted to be in Coyote, lower North Fork, and a short section of the Main Fork Matilija (Figures 10 and 11). Siltation in Murietta may be severe enough to limit spawning success and fry survival, although juvenile trout densities are moderate to high within these reaches (Figure 8). The lower sections of the mainstem Matilija do not offer good stable spawning conditions. Storm flows gain power as they sweep down through the canyon. Eggs and fry of the lower Matilija are susceptible to being washed downstream, smothered in silts and sands, or damaged in debris flows. The most useful spawning habitat resides in the mid sections of the side forks and tributaries.

Rearing Habitat

Soon after hatching steelhead and trout fry swim up through the gravel and disperse downstream into shallow slow water stream margins (Bisson et al. 1981). Low gradient riffles, runs, and glides provide the primary rearing habitat into the early summer. The quality of rearing habitat is largely determined by the continuation of water flow of moderate temperatures and the availability of cobble and small woody debris for use as cover from predators and protection from high water velocities.

The best rearing areas do not completely overlap with the localities of the best spawning reaches (Figure 12); There is overlap within Murietta and North Fork drainages but additional rearing habitat is to be found within Upper North Fork. Rearing habitat appears to be lacking within Coyote Creek. It would seem that there is a greater correspondence between observed juvenile trout densities and potential rearing habitat than with potential spawning habitat (not a unexpected result). The similarity between production estimates derived from spawning habitat availability and actual juvenile densities (i.e. reflecting limitations of both actual spawning and rearing success) suggests that spawning and rearing habitat suitability are similar and neither habitat factor is the key limitation on salmonid recruitment.

As mentioned above, cover structure such as that provided by woody debris is important as refuge from predators and high water velocities. Instream cover is in low abundance through out much of the upper Ventura River Basin (Figure 13), a situation common to most southern California coastal streams. Woody debris (>8"dbh) densities range from 0 to 220 pieces per mile with an average of 15. This compares favorably and may indicate slightly higher woody debris densities than nearby Sespe Creek (USFS 1997). Less than 5% of the surveyed reaches would retain enough wood to meet the National "PacFish" standard for at least 120 pieces of "large" (>12") woody debris. This standard is being modified to better apply to the southern California ecosystem. Smaller sized wood is of importance to rearing juvenile trout, although it is still a uncommon element in this region.

Woody debris is found in higher densities within very localized reaches in Coyote, Santa Ana, North Fork, Upper North Fork, Murietta, and Old Man Creek. These areas are all associated with mid to late seral alder stands (Figure 14) which are prone to windthrow particularly after fires.

Food Producing Habitats

Good spawning riffles and pool tails are usually also good food production zones. Highest productivity would be expected where substrate size is dominated by cobble, however. Woody debris contributes nutrients and substrate for primary and secondary production. Less than 15% fines and moderate sunlight but ample streamside vegetation (canopy 40-60%) would be ideal for aquatic insect production. Based upon limited aquatic invertebrate sampling, food availability is good throughout most of the upper Ventura River basin and may not be the key factor limiting trout recruitment.

Late Summer Habitat

As fish grow in late summer and fall they move into swifter and deeper water, inhabiting runs and pools (Chapman and Bjornn 1969). Runs are quite common and not limiting. Pools and coolwater refugia from the summer heat are likely the most restrictive bottleneck that reduces population size and limits growth and recruitment. During dry years, summer conditions of high temperatures and low dissolved oxygen are particularly severe reducing fish growth, survival, and health. By August particularly in drought years, only isolated deep pools retain fish, and complete or partial fish die-offs can occur. If there are barriers to upstream movements it is possible that tributaries may become fishless after extreme drought.

The southern variety of steelhead rainbow trout is thought to have evolved to be able to withstand higher temperatures (Higgens 1991) but they are not immune to lethal temperatures (>75 °F). High but sublethal water temperatures can also affect growth (Barnhardt 1986), smoltification, immunity to disease, and behavior (Reeves et al. 1987).

As shown in Figure 15, reaches with denser canopy cover are likely to maintain the coolest water temperatures into late summer. Likewise, cool water springs and seeps may be important. Much of the mainstem Matilija experiences high temperatures (>75°F) that likely limit trout survival and production. Hot springs in the North Fork and mainstem further increase surface water temperatures. The best refugia are to be found in mid Coyote, mid North Fork, upper Upper North Fork, a side tributary of Murietta, and the upper mainstem. Temperatures within these reaches usually stay below 65 °F. These areas appear to correspond with the areas of greatest trout densities (Figures 5 and 8).

Pool densities may also be related to trout abundance (Figure 16). Deep pools have been shown to retain cooler water near the bottom, offering thermal refugia to fish in late summer (Matthews 1996). Salmonids, and particularly steelhead require deep pools as resting areas and refuges from high flows and water temperatures (Dunn 1981). As juvenile steelhead grow they gradually shift from shallow to deeper water habitat, including pools (Bisson et al. 1981).

Generally, the best and most abundant pool habitat is situated within the mid to upper reaches of side drainages. The mainstem is pool poor which when coupled with higher solar influx with a less dense shade canopy and lack of cool water springs and lesser late summer flows equates to inhospitable summer habitat. The side forks are presently the most significant trout habitat and have the greatest potential for restoration of anadromous steelhead runs, if access can be restored.

Riparian Vegetation

Two general types of riparian communities are encountered in the Ventura River basin: southern alluvial woodlands and southern riparian woodlands. Southern alluvial woodlands consist of various combinations of Fremont cottonwood, western sycamore, willows and mulefat and are found in lower gradient reaches. The southern riparian woodland type is the dominant vegetation community throughout most of the upper Ventura River basin and includes a mixed assemblage of primarily alder, willow, and oak. Conifers are only an extremely minor component within the headwaters of the upper mainstem. (Figure 14)

Tamarisk is a early seral exotic colonist species of low value as fish and wildlife habitat (Cohan et al. 1978). It is found in mainstem reaches below Matilija Reservoir and needs continued vigilance to control. If it has a chance to develop into large monotypic stands as it has elsewhere in southern California, it can crowd out native vegetation, reduce available surface water, limit species and habitat diversity, and contribute to adverse water temperatures and chemistry. Tamarisk is of high concern for it's negative effects on wild trout and potential steelhead restoration efforts.

As mentioned elsewhere in this report, alder stands appear to contribute the most woody debris to channels. Alder is also highly effective in withstanding the erosive power of debris flows and floods. One of the reasons for this effectiveness is alder's propensity for forming dense root mats in and among boulders and bedrock. Alder rootmats are virtually indestructible unless there is disease, fire, drought, or other forms of extreme stress. In healthy alder stands, stream banks are well armored and stable. Alder roots may also span across the active channel protecting the channel bed from downcutting. Typical alder dominated reaches are composed of highly stable step pool sequences of habitat.

Water Quality

Detailed water quality sampling has not been conducted within the upper Ventura River basin. As observed in the nearby Sespe watershed, water quality is likely to be adequate for trout and other biota. PH, mineralization, and alkalinity may be high, especially within reaches with a large influx of groundwater springs and seeps. White crusty sodium chloride and sulfide deposits are common where evaporation is high near spring influxes. In some reaches (as noted in Upper North Fork) calcium carbonates will precipitate out forming a layer of cement across the stream bottom. Such cementing could lessen the quality of spawning beds although winter high flows appear to dissolve the minerals and break up much of the cement prior to the spawning period. Scattered small iron rich seeps may contribute to local precipitation of iron flocculent which can be damaging to fish eggs and gills (McKee and Wolf 1970). Many of springs are likely high in total dissolved solids, aluminum, copper, and iron.

The water chemistry suggests a moderately productive aquatic community, although nutrient levels have not been measured. Aquatic productivity may be limited at total dissolved solids over 400 ppm (Bell 1973) as may be encountered immediately downstream from high mineral hot springs.

Economics

Based upon the recreationl and tourism money ($106-$111/fish) (RPA 1990) that can be associated with steelhead trout (RPA, 1990), the Ventura watershed is potentially worth at least half a million dollars per year, probably more. Additional economic value can be derived from non-consumptive use of steelhead resources. Other values associated with the presence of a healthy steelhead run can not be assigned a monetary figure.

Disturbance Processes

Fire and post-fire floods and debris slides are the most significant disturbance processes in the upper Ventura River basin. Chaparral fires are expected to occur every 30-60 years (Davis et al. 1988) and seem to burn hot over large areas of the landscape (Figure 18). In normal water or wet years the incidence of fire is low, it burns only at low intensities, and rarely burns through moist riparian zones. The riparian network thus is protected from fire and may contain fires within smaller patches of the watershed. Such is also the case if nearby hillslopes have recently burned and lack the fuels to carry the fire. Many recent fires have originated in or near streams in areas of greatest concentration of fire causing human activity (campfires, vehicles, etc.).

Alders are a less fire resistant species than willows, sycamores, and oaks and appear to be slower to recover and regenerate after intense riparian fires (Davis et al. 1988). If fire ignition and fuel build up continue to lead to intense riparian corridor burns alders may decline in their distribution within the watershed. Such a decline would likely contribute to a reduction in late seral riparian communities resulting in less woody debris, reduced canopy cover leading to higher tributary water temperatures, more channel instability, decreased fish habitat complexity, and reduced availability of summer and winter refugia for salmonids. A comparison of fire frequencies (Figure 18) and the time since last burn (Figure 19) indicates that some areas of the upper Ventura River basin have not burned for a number of years and present a risk for intense and potentially damaging future fire. Key areas to consider are around Casitas Reservoir and portions of the San Antonio drainage. Fuels will also be building up to dangerous levels within most of the remainder of the upper basin within the next 10 years. There is an opportunity for pro-active fire and fuels management.

Precipitation and resulting stream flow is highly variable and cyclic (Figure 24). Stream flow as measured at the lower Ventura River indicates a typical 3-4 year drought cycle followed by one or more wet years. Recurrent cycles of drought (1895-1905, 1928-1937, 1945-1957, 1984-1990) almost always precede the most devastating periods of fires followed by floods (1917, 1932, 1986, 1991). An overlying 20 year cycle of high to low average flows may also be evident. Although it is unclear how patterns of global climatic change may affect local conditions, renewed cycles of drought and floods are inevitable.

On the average, major channel defining floods occur once every 5-7 years (Figure 24). Such flood flows replace gravels, flush out silts, transport and deposit woody debris and leaf litter, scour out pools, and facilitate regeneration of riparian vegetation (Yanosky 1982). Cottonwood, sycamore, and alder may only successfully regenerate during sustained flood years when the soil is continuously saturated for several weeks (Zimmermann 1964). Floods may be detrimental to fish by flushing them downstream away from their preferred habitat. Under normal circumstances rainbow trout quickly rebound within one or two years since they have an innate life cycle that drives them to move upstream in fall and winter. Research has shown that even "resident" populations of trout may move great distances (up to 50 mi) each year (Schmal and Young 1994). Therefore, trout recolonization could take approximately five to ten years if impassible barriers do not block upstream movements.

Floods after severe fires are much more destructive, ripping out riparian vegetation, flushing out woody debris, widening channels, reducing shade and increasing temperatures, smothering riffles with sands and silts, killing or displacing fish downstream, filling and reducing available fish habitat, and creating new fish barriers (logs or boulders). Davis et al. (1989) estimates that post-fire floods have contributed to up to 50% of the channel deposition that has occurred in our southern California rivers within the last 1000 years. Roughly 75% of the increased sediment yield occurs during the first winter after one such fire event (Rice 1994). Lower gradient channels fill up past bank full with sediment during the first major storm event and then return to base level over the course of several more moderate storms within the first or second winter (Davis et al. 1989).

Regeneration of riparian vegetation appears to take up to five years after major fires depending on hydrologic and climatic conditions. A post fire pulse in nutrients, plant, and algal growth continues over several years. Regenerated riparian corridors may be denser and more continuous than pre-fire conditions. Channel sedimentation is most devastating during the first year but may continue for several additional years. Secondary effects of channel downcutting, streambank erosion, sheet and rill erosion, and mass wasting may continue for a decade or more. The time to recover is also dependant on the size of the drainage, the steepness of the channel, and it's position within the watershed (Keller et al. 1988). The lower gradient third and fourth order reaches which are of primary importance for steelhead spawning and rearing are typically the slowest to recover to pre-fire conditions.

Windthrow generated pulses of woody debris may also be tied to fires. Windthrow frequently occurs in older alder stands after fire. The effects can continue for ten years or more. Deciduous logs last up to 5 years prior to decomposition (Armantrout 1991) and may greatly contribute to instream habitat and productivity during this period. Wood does not stay in place for long. At the next flood most of the wood ends up either high and dry within small pockets on floodplain terraces or 50 miles downstream on Pacific coast beaches. While dead wood may play a less significant role than in more northerly streams, it does greatly contribute to the erosion potential of floods and may increase the risk of destructive riparian fires.

Minor landslides appear to be an occasional disturbance (once every 20 years). Major landslides are associated with earthquakes and occur once every 100-1000 years (Davis et al. 1988). In the short-term (1-5 years), landslides can be quite destructive, denuding the riparian zones, smothering downstream channels with sand and silts, killing or displacing fish downstream, filling and reducing available fish habitat, and acting as fish barriers. Landslides may cause a complete or partial blockage until additional flows cut through and restore the channel grade. Within 5-10 years, high flows will transport and distribute gravels and boulders to downstream reaches greatly enhancing instream habitat. Murietta, North Fork, and upper San Antonio drainages appear to be prone to landslides (Figure 17).

While there is ample evidence of historical slope instability, it is unclear to what extent human activities have affected these patterns of disturbance. It is clear, however, that changes in patterns of fire and associated erosion during floods have accelerated landslide activity. Many of the chronic slides are associated with present or past roads, trails, or mining activities. Human activities such as construction of roads, trails, channel clearing, channelization, and development have contributed to changes in the timing of peak flows. With increased runoff, floodwaters may rapidly rise and descend, subjecting stream channels to greater erosive force with less water infiltrating into the ground, the health of riparian vegetation may decline. Increased sediment input can result in increased channel width and loss of continuous vegetation (Grant 1988). Over 40% of the upper Ventura River basin contains highly erosive soils which are subject to gullying and sheet erosion (Figure 20). Within the Forest boundaries of the upper watershed there are approximately 15 miles of roads requiring maintenance grading, 20 miles of road associated with stream crossings, 25 miles of foot trails, 8 miles of off-highway vehicle trails, 4 acres of dispersed recreational camps, and a five acre developed campground (Wheeler Gorge). (Figure 21)

People have also directly disturbed the Ventura River watershed and the riparian corridors. Historical channelization and bank revetment work has straightened and constricted mainstem channels to the detriment of fish and other aquatic life. After fires, large amounts of woody debris have been removed from the upper basin channels. This was the case in the Wheeler Fire of 1985 when approximately 50 miles of channels in the North Fork and Main Fork Matilija, Murietta, Gridley, Senior, and Santa Ana drainages were cleared of woody debris. Channel clearing for purposes of flood control continues within the lower River basin.

People have introduced a number of exotic plants and animals that out-compete native species and alter riparian habitat. Tamarisk and arundo continue to be a problem that will need ongoing inter-agency efforts at control.

Stocking of non-native rainbow trout may be detrimental to native trout through direct predation, competition, or transmission of disease (Carline et al. 1991; Moyle 1986). There are continued concerns with the risks of introgression and dilution or compromise of native genetic variation in southern steelhead. According to genetic analysis results, most of the resident trout in the upper Ventura River basin have already been intercrossed to some extent (Carpanzano 1996). It is not entirely clear how stocking would effect the restoration of anadromous steelhead. Filmore Hatchery rainbow trout are stocked in the North Fork Matilija Creek near Wheeler Gorge Campground and in the Matilija Reservoir. Fingerling stocking is usually avoided where there is potential for overlap with anadromous fish. The potential impacts of continued stocking of catchable non-native rainbow trout would need to be examined if steelhead gain access into the Wheeler Gorge area. Tributaries have been stocked in the past but have not been stocked for the last ten years.

Until recently, the regular five fish limit without gear restrictions was applied throughout the Ventura River basin. Since 1993, only catch and release fishing with barbless artificial flies is allowed from May through December below Robles Diversion in order to protect anadromous steelhead trout. The five fish limit continues in upstream reaches. Most angling activity is concentrated in North Fork Matilija near Wheeler Gorge, lower sections of Upper North Fork, and sections of the main Fork in and around the reservoir. The extent that angling has impacted wild trout populations is not clear. Steelhead populations have been shown to be highly susceptible to angling in the northwest (Pollard and Bjornn 1973). Even catch and release angling can be stressful during periods of warm water temperatures and reduced flows (Wright 1992).

Angling as well as other recreational activity may affect trout and their habitat. Recreationists concentrate their activity along fragile streambanks and may wade in the prime shallow water spawning areas. Research has indicated that a single wading across salmonid spawning redds can kill 40% of the eggs. Mortality increases to over 90% with multiple wadings (Roberts and White 1992). Recreationists build flimsy small boulder and cobble dams for ponding water for summer soaking. At lower flows these small dams act as barriers to fish movements and create additional pool habitats that may favor exotic species such as bass, mosquitofish, sunfish, and bullfrogs to the detriment of native species and trout. Recreationists potentially have the greatest impacts on stream fish and biota from May through August with the highest potential impacts on steelhead and resident trout during April and May when the eggs and fry are sensitive to damage or habitat loss.

There are three small grazing allotments totalling about 100 acres within the upper Ventura River Basin (Figure 22). One in Coyote Creek, one along the lower mainstem of Matilija Creek, and one in the headwaters of the San Antonio watershed. All allotments are stocked at low densities and with active management to minimize riparian and channel disturbance. If steelhead are listed and restored to these drainages, Biological Assessments will be conducted to assess if grazing activities are in need of further changes in management in order to meet the Endangered Species Act.

A number of water developments are also scattered throughout the upper Ventura River basin (Figure 23). Most are livestock tanks, drinking spigots, or emergency fire water tanks tapping springs or collecting rainwater in upland areas. Seven surface water diversions are permitted on Forest Service lands. A unknown number of direct surface water diversions may be operating on the private inholdings. Subsurface flows are likely also tapped through shallow wells. A more detailed review of existing water rights and Forest Special Use Permits would be conducted to ensure there are not conflicts with restoration of steelhead trout.

The Robles water diversion is downstream from Forest Service lands but effectively blocks all upstream fish movements. Modification of the Robles Diversion so as to allow fish passage would open 2 miles of fair to excellent spawning and rearing habitat with the potential for producing 11,000 smolts (200 equivalent adults). If the boulder barriers and road crossings in the lower North Fork can be modified to allow for fish passage, an additional 5 miles of fair to good habitat would be available potentially producing 43,000 smolts (860 adults). Restoration of fish passage above Matilija Reservoir would open an additional 8 miles of fair, 5 miles of good, and 6 miles of excellent spawning and rearing habitat potentially producing 40,000 smolts or 1,100 equivalent adults. If all of the above measures are taken, an additional 26 total miles of spawning and rearing habitat could be utilized to produce nearly a million steelhead smolts or the equivalent of 2,160 steelhead adults. If steelhead access is restored above Casitas reservoir, an added mile of excellent and 2 miles of good spawning and rearing habitat would be available representing 50-200 equivalent adults. The range in figures for the Coyote drainage reflects a discrepancy between predicted numbers based upon available spawning habitat and actual trout production, perhaps indicating that rearing habitat is the limiting factor.

V. SUMMARY AND CONCLUSIONS

Different disturbances occur at differing rates and frequencies which may coincide with additional human impacts on the Ventura River basin. Low intensity flooding, as is beneficial for steelhead reproduction and survival, occurs every year except drought years that appear to come in clusters every 10-20 years. Low intensity flooding may benefit steelhead survival for 3 years thereafter. High intensity floods occur every 4 years and depending on the season and timing may negatively affect steelhead for up to 3 years (Noland and Marron 1985). Moderate fires associated with moderate floods occur every 10 years and have effects lasting for over 5 years. Extreme and catastrophic fires associated with major floods occur every 20 years and may reduce steelhead survival for 10 years thereafter. Minor landslides occur every 5-10 years and negatively affect steelhead for 1-2 years and positively affect steelhead for up to 10 years; Major landslides occur every 100 years and may continue to negatively affect steelhead for several decades.

Ventura River steelhead face many challenges. At the currently suspected low population size (<200 spawning adults) even minor disturbances could be devastating. The Ventura watershed should be managed for a diversity of steelhead habitat areas so as to minimize the risks of simultaneous catastrophic disturbance. Overall steelhead population viability can best be maintained by restoring multiple (ideally at least three) spawning subpopulations within the Ventura watershed and managing these populations to allow for, but not encourage, intermixing. Based upon the estimates of steelhead smolt production and habitat capabilities, restoring fish passage up through the Robles Diversion is essential. The potential for habitat and production gains are relatively balanced between upper North Fork or Main Fork. An analysis of costs and engineering feasibility would help determine whether additional effort should be expended on ensuring access further up North Fork or up and over Matilija Dam, or both. Other factors such as the presence of exotic species, land ownership complications, and recreational use should also be considered. The opportunities for long term and unimpeded recovery and restoration of steelhead may be greater in the less heavily used and readily accessed upper Main Fork. The Main Fork also has the advantages of multiple side tributaries which could also support spawning and rearing steelhead and thus serve to distribute the population into additional subpopulations which may be able to better withstand disturbances such as floods, drought, and fire. Of course, the ideal situation would be restoration of steelhead to their entire historic range in the North Fork, Main Fork, Coyote Creek, and San Antonio drainages.

Steelhead live at most 8 years; Five years without successful reproduction is the likely limit beyond which the population would be at extreme risk of extinction. The ability of steelhead to survive the challenges of the last 40 years attests to their resiliency. However, each reduction in steelhead numbers places the population (and by extension the overall southern California steelhead stock) at further risk.

Linkages Beyond the Sespe Watershed

Peak flows are usually associated with El Nino weather patterns which may bring higher nearshore productivity. Ocean productivity may thus be synchronous with peak steelhead spawning activity. An underlying 40 year cycle of ocean productivity has also been identified (Ware and Thompson 1991). Applying this cycle to southern California suggests that ocean productivity was low in the 1980s but should peak around the turn of the century. Ocean conditions are thus likely to be a positive benefit for the recovery of Ventura River steelhead.

The key factors for steelhead restoration will be ensuring access to a diversity of quality spawning and rearing habitats both within and outside the Ventura River basin. The risk of watershed wide catastrophic events must be moderated to the extent possible. The risks of widespread fire and cumulative watershed effects can be mitigated through modified management. The risk of human caused barriers to migration can be addressed. Steelhead restoration should include actions to ensure there is at least one other viable subpopulation of steelhead within the nearby Santa Clara River Basin and at least one other river basin (Santa Ynez?) that can support steelhead in southern California.

VI. RECOMMENDATIONS

From a strictly fisheries perspective, the most important actions that need to be taken are those that will allow steelhead to access their prime spawning grounds in the upper Ventura River basin. The Forest Service can contribute to this effort by providing the best available information on the consequences of various alternatives and by addressing opportunities to restore steelhead to Forest lands. The Forest Service will need to analyze the Wheeler Gorge road crossing for fish passage modifications if steelhead can gain access past Robles Diversion.

Protective measures to decrease migratory mortality will also require multi-agency involvement since most of the potential problem areas are in the mainstem Matilija and Ventura Rivers downstream of Forest Service lands. As steelhead are able to return to their historical spawning grounds, restoration and/or enhancement of these areas becomes important. Measures to reduce streambank instability and control run-off of silts may be indicated. A more detailed analysis of overall watershed conditions would be necessary to identify, prioritize, and plan projects. Although there are some localized areas which could be treated to reduce erosion, efforts to return the watershed to a more natural or desirable cycle of fire return may be the most significant contribution to restoration of steelhead habitat. Not only would siltation be lessened, but watershed hydrology could be improved to lessen the effects of drought and scouring floods and thus enhance habitat. Development of a fire management plan may also be warranted.

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Ventura Watershed Historical Habitat Analysis
Last Update May 31, 1997 by Nicolas Romero

Ventura Watershed Historical Habitat Analysis

Year	Source	Location	Event	Comments
00/00/1832	21	Ventura River	Flood	Discharge info not available
00/00/1862	21	Ventura River	Flood	Discharge info not available
00/00/1867	21	Ventura River	Flood	Discharge info not available
00/00/1884	21	Ventura River	Flood	Discharge info not available
00/00/1900	2	Ventura River		Foster Park Diversion completed
00/00/1911	21	Ventura River	Flood	Discharge info not available
00/00/1914	21	Ventura River	Flood	Discharge info not available
00/00/1932	1	Coyote Cr	Fire	10 ft fish barrier filled by sediment deposition
00/00/1933	1	Coyote Cr.		7 miles surveyed. Riparian, substrate, spawning and physical info.
00/00/1934	1	Coyote Cr	Flood	Debris and sediments from 1932 fire flushed
00/00/1938	21	Ventura River	Flood	Peak flow measured at 38,200 cfs
00/00/1943	21	Ventura River	Flood	Peak flow measured at 35,000 cfs
10/30/1947	2	Ventura River		Stream dry at Hwy 150
00/00/1948	19	Matilija Cr.		Matilija Dam completed
00/00/1948	19	Ventura River		Army Corp of Engineers constructs levee to potect San Buena Ventura
01/15/1949	3	Matilija Cr.	Fire	Fire denuded north side of canyon at Sopers Ranch. Nice pools, gravel, Sycamore, Alder, and
01/15/1949	3	Matilija Cr.		Rocky gravel susbstrate, aquatic plant growth common, semi-open Alder margin with deep pools 0.5 mi Surveyed from NF Matilija junction to Matilija Reservoir (temp, flow, and physical measure info)
01/15/1949	4	Ventura River		Notes 2 diversions at Foster Park. First upstream barrier to Steelhead
03/21/1949	5	North Fork Matilija	Fire	Turbid water. Heavy siltation. Entire upper drainage denuded by fire. (Temp, flow, width and depth info)
03/21/1949	6	Matilija Cr.		Creek surveyed 1/2 mile above reservoir at bridge crossing. Cobble bottom, semi-open Alder margin with slight gradient. Area to be inundated by reservoir (Temp, flow, width and depth info)
03/28/1950	7	Matilija Cr.		Heavy algae growth. Tules near lake inlet potentially blocking any spawning run. 2.2 miles surveyed (above dam) Below dam heavy growth of aquatic vegetation. Pools, heavy siltation and clear water near Hwy. 0.7 mi surveyed (Flow and Temp info)
03/29/1950	8	North Fork Matilija	Fire	Surveyed from Sopers Store to Wheeler Gorge campground. Abundant shade, pools, and food Minimal shade above campground due to fire. (Temp and flow info)
07/1?/1951	9	Matilija Cr.		Stream in good condition with pools and shade at Hwy 399 Junction (Temp and flow info)
04/14/1952	10	Matilija Cr.		No pools, white water forms some cover (Above dam). Matilija full and spilling. 3 mi. surveyed (flow and temp info)
04/14/1952	11	North Fork Matilija		Good pools and cover. Section of stream planted. 3 mi. surveyed. (Temp and flow info)
04/06/1956	13	NF/Ventura River		Physical dimensions of sampled pools
08/01/1956	13	Matilija Cr.		Road constructed from USFS gate (below NF Matilija) to upper end of claims. Crosses stream 2x
00/00/1958	19	Ventura River		Robles Diversion Dam completed
00/00/1958	19	Coyote Cr.		Casitas Dam completed
00/00/1960	18	Ventura River		So. Pacific Milling Company begins strip mining 152 acre site, extracting up to 250,000 cubic yards of rock annualy
01/18/1969	20	Ventura River	Flood	16,600 cfs. River reaches critical saturation level (precipitation and discharge info)
01/23/1969	20	Ventura River	Flood	62,900 cfs. Greatest flood flows in recorded history (precipitation and discharge info)
02/22/1969	20	Ventura River	Flood	40,000 cfs. Severe flood damage. Jan and Feb storms reduce Matilija Reservoir storage capacity 3500 AF to 1400 AF. Additionally, extensive channel sedimentation, bank erosion and landslides occured.
1976-1978	19	Ventura River	Drought	Moore sites confluence of San Antonio Cr with Ventura River to Foster Park to hold the most important Steelhead rearing habitat
00/00/1978	21	Ventura River	Flood	63,600 cfs peak flow
00/00/1980	21	Ventura River	Flood	37,900 cfs peak flow
01/21/1983	16	Ventura River	Flood	27,000 cfs peak flow. El Nino driven (precipitation and discharge info)
09/18/1985	15	Matilija Cr	Fire	Wheeler Fire reduces midstory cover of White Alder and Black Cottonwood. Influx of sediment expected
00/00/1985	15	North Fork Matilija	Fire	Wheeler Fire reduces midstory of White Alder, Cottonwood and Big Leaf Maple. Willows accout for 50% cover. Abundances of pools. High sediment influx expected
00/00/1985	15	Murietta Cr.	Fire	Impacted by Wheeler Fire. Large nursery pools. Perennial up to 3/4 mi. above confluence. Alders Sycamores and Willows.
08/25/88	17	Ventura River		Ca Supreme Court upholds Appellate Court decision prohibiting diversions during low flow periods
02/00/92	21	Ventura River	Flood	46, 700 cfs peak flow. River overflowed primarychannel and reoccupied old distributory channel
10/00/92	21	Estuary		19% Estuarine, 2% Riverine, 37% Palustrine, 17% Upland, 20% Ruderal, 5% other. Vegetated flood plain between Main St. and ocean reduced from 127 acres in 1855 to 82 acres in 1993
00/00/1993	13	Ventura River		So. Pacific Milling Company operation closed
09/09/1994	14	Upper NF Matilija		Riparian, aquatic, hydrological, biological and physical information

Historical Distribution and Abundance of Fish in the Ventura Watershed

Year	Source	Location	Comments
10/23/1875	25	Arroyo Los Coyotes Cr.	Surveyors kill 25" RBT
02/23/1878	26	Ventura County	New Hampshire RBT and Maine salmon to be stocked in county streams
04/29/1882	27	Ventura River	Ventura man catches 1,835 RBT in 8 days
05/27/1882	28	Ventura River	1,000 RBT taken every Sunday
02/16/1884	29	Ventura River	River teeming with young RBT after great flood
05/31/1884	30	Matilija Cr.	312 RBT caught by two men in two days
08/11/1887	31	Matilija Cr.	Depleted of trout; to be stocked
04/10/1891	32	Ventura River	Four men catch 438 RBT in 1 day
05/01/1891	33	Matilija Cr.	One man catches 1,000 RBT in 1 week
05/15/1891	34	Matilija Cr.	Two men catch 753 RBT in 1 day. Largest being 28.75"
04/23/1892	35	North Fork Matilija Cr.	Fish ladder constructed
06/17/1892	36	North Fork Matilija Cr.	RBT observed 2 1/2 miles above falls where fish ladder installed
08/26/1892	37	Ventura Pier	RBT caught off pier
03/16/1894	38	Ventura River	20,000 Eastern Brook Trout planted in headwaters
09/21/1894	39	Ventura County	10,000 RBT and 15,000 Tahoe Trout to be planted in county streams (streams not specified)
05/31/1895	40	Ventura County	62,500 RBT planted (streams not specified)
04/03/1896	41	Ventura County	Free Press maintains wild fish doomed if strict conservation measures not taken
03/24/1899	42	Ventura River	Steelhead weighing 14 lbs. caught at mouth
09/27/1938	1	Ventura River	10,000 RBT planted in 12 mi. length of stream
10/22/1939	2	Ventura River	5,000 RBT planted in 12 mi. length of stream
02/11/1942	3	Murietta Cr.	1,200 RBT planted above confluence with Matilija Cr. Hot Cr. egg source from Filmore
07/05/1944	4	North Fork Matilija Cr.	1,000 fingerlings transplanted from San Antonio Cr.
07/06/1944	5	Santa Ana Cr.	525 fingerlings rescued from Gridley Cr. and planted in Santa Ana Cr.
07/26/1944	6	Matilija Cr.	53,000 fingerlings rescued from SYR and planted in Matilija Cr.
02/26/1945	7	Senor Canyon Cr.	10,000 fingerlings planted. Mt. Whitney strain from Filmore Hatchery
00/00/1945	20	Coyote Cr./Santa Ana Cr.	2,500 Steelhead adults used creeks. 3,000 adults in normal years.
01/03/1946	8	Ventura River	Final year Brown Trout stocked. King Salmon recorded
03/27/1947	9	Ventura River	Steelhead oberved in every hole. Low flow conditions28
06/21/1948	10	Upper North Fork Matilija C.	4,800 RBT planted. Mt. Shasta egg source from Filmore Hatchery
00/00/1948	43	Matilija Cr.	Historical estimates place Steelhead run @ 2,000-6,000 prior to construction of Matilija Dam.
01/15/1949	11	Matilija Cr.	Stickleback common. One 10" RBT observed
03/06/1950	12	Ventura River	Bar at mouth breached and Steelhead observed
03/28/1950	13	Matilija Cr.	Three spined stickleback common
11/18/1950	14	Ventura River	Engineers report large schools of Steelhead observed at mouth
07/12/1951	15	Matilija Cr.	Abundant Stickleback (Temp and Flow info)
00/00/1953	16	North Fork Matilija Cr.	3,762 catchables planted
00/00/1956	17	North Fork Matilija Cr.	5,000 catchables planted
00/00/1956	17	Matilija Cr.	NF Matilija Cr. to Matilija Reservoir utilized as YOY nursery. Well stocked w/ 3" RBT
00/00/1956	17	Upper Matilija Cr.	Sustains native RBT population
08/20/1958	18	Ventura River	120 Stickleback and 15 Gila caught in 1.25 mi. seined
08/20/1958	18	Coyote Cr.	500+ Stickleback, 50 LMB, 35 Gila and 4 G's found in 2 units near Foster Park
08/20/1958	18	San Antonio Cr.	280 Stickleback, 75 Gila and 2 LMB in 2 surveyed units
08/20/1958	18	Ventura River	Biologists states future of Steelhead to be "mighty bleak" one Casitas Reservoir flooded and Robles Diversion completed (survey info)
09/18/1961	19	Deep Cat/Coyote Cr.	Liquid retonone released to kill exotic fish (see results)
00/00/1976	24	Ventura River	9,000 fingerlings planted. Mad River strain from Filmore Hatchery
00/00/1977	24	Ventura River	11,000 fingerlings planted. Mad River strain from Filmore Hatchery
00/00/1978	24	Ventura River	20,000 fingerlings planted. Mad River strain from Filmore Hatchery
09/18/1985	21	North Fork Matilija Cr.	High RBT productivity level
09/18/1985	21	Murietta Cr.	Good RBT productivity level
05/05/1991	22	Ventura Estuary	14-25 adult O. mykiss ranging between 350-650 mm in upper estuary
01/04/1993	23\	Ventura River	2 RBT approximately 20" length and 5-6 lbs. at Shell Bridge

HABITAT CAPABILITY AND PRODUCTION ESTIMATES FOR VENTURA STEELHEAD
Prepared by S.Chubb for U.S.Forest Service
May 1997

DRAINAGE	Reach	Chan Type	(1) Flow Type	Miles	average Width (m)	%Rifl	%Gravl	%Fine	Barrier Type	(2) Spawning Habitat (m²)	YOY Trout Densities (#/100m)	(3) Total #YOY from Habitat	(4) Total #YOY from Densities
Coyote	1	B3	P	2.0	3.0	20	30	15		386	30	7,720	1,920
	2	A2	P	3.0	4.0	10	15	0	bldr	113	30	2,260	2,680
Gridley	1	C7	S	1.0	2.5	-	-	-	silt	?	?		
	2	B3	PI	1.0	1.5	20	20	30	bldr	97	10	970	80
	3	A2	P	1.0	1.5	20	15	0	falls	72	0		
Santa Ana	1	C7	SI	2.0	3.0	-	-	-		?	?		
	2	B3	P	1.0	2.5	20	20	5		161	15	6,440	400
	3	A3	ST	2.0	1.5	30	20	0	flow		0		
Matilija (N.Fork)	1	B3	P	3.0	3.0	40	15	8	xing	869	200	34,760	19,300
	2	B2	P	4.0	2.0	25	15	5	" "	483	500	19,320	64,360
	3	A3	P	3.0	1.0	15	20	5	bldr	145	150	5,800	14,480
	4	A+	I	2.0	1.0	10	5	5	falls	16	0	640	
Bear	1	D1?											
	2	B6											
	3	A3											
Matilija (M.Fork)	00		P	2.0	9.0	20	10	0			10		
	0		P	8.0							50?		
	1	C3?	P	1.5	4.0	25	10	10		241	50	4,820	2,400
	2	B3?	P	2.5	4.0	15	15	5	slides	362	200	14,480	16,080
	3	A3	P	2.0	4.0	15	15	5	falls	290	500	11,600	32,180
Cannon	1	?	P	1.0	3.0	10	20	5		97	10	3,880	320
Old Man	1	B2	P	3.0	1.5	25	10	5		81	400	3,240	25,740
	2	A2a	P	1.0	2.5	10	10	10		40	30	800	960
Matilija UpperNF	1	B3	P	2.0	2.0	10	20	10		129	30	2,580	1,920
	2	B2	P	1.5	2.0	15	10	10		72	45	1,440	2,160
	3	C3b	P	3.5	2.0	20	15	5	bldr	338	40	13,523	4,500
	4	B2	P	1.0	2.0	15	10	5	" "	48	200	1,920	6,440
	5	B2a	P	1.0	3.0	25	10	5	" "	121	300	4,840	9,660
	6	A2	P	1.0	2.0	40	5	5	slides	64	200	2,560	6,440
	7	Aa+	I	1.0	2.5	50	5	5	falls	100	0	4,000	
Murietta	1	C3b	S	0.8	2.5	30	20	10	flow	193	90	3,860	2,300
	2	B2a	PI	1.2	2.5	30	20	10	slides	290	210	5,800	3,060
	3	A2	PI	3.0	3.0	20	20	5	bldr	579		23,160	

(1) P-perennial, S=seasonal, I- intermittent

(2) Spawning Habitat Available = reach lengthxwidth x %riffles x %gravels

(3) Estimated potential salmonid smolts derived from available spawning habitat multiplied by 0.20 redds/m² (Reiser and White 1981), 2000 eggs/redd (Bulkley 1967) and 0.50 egg survival (Bley and Moring 1988) and 0.10-0.40 fry survival depending on %fines in gravels.

(4) Estimated current salmonid young-of-year production derived from observed salmonid fry densities projected over total reach length and multiplied by 0.20 for fry to YOY (or smolt) survival.

Ventura Watershed Historical Habitat Analysis References

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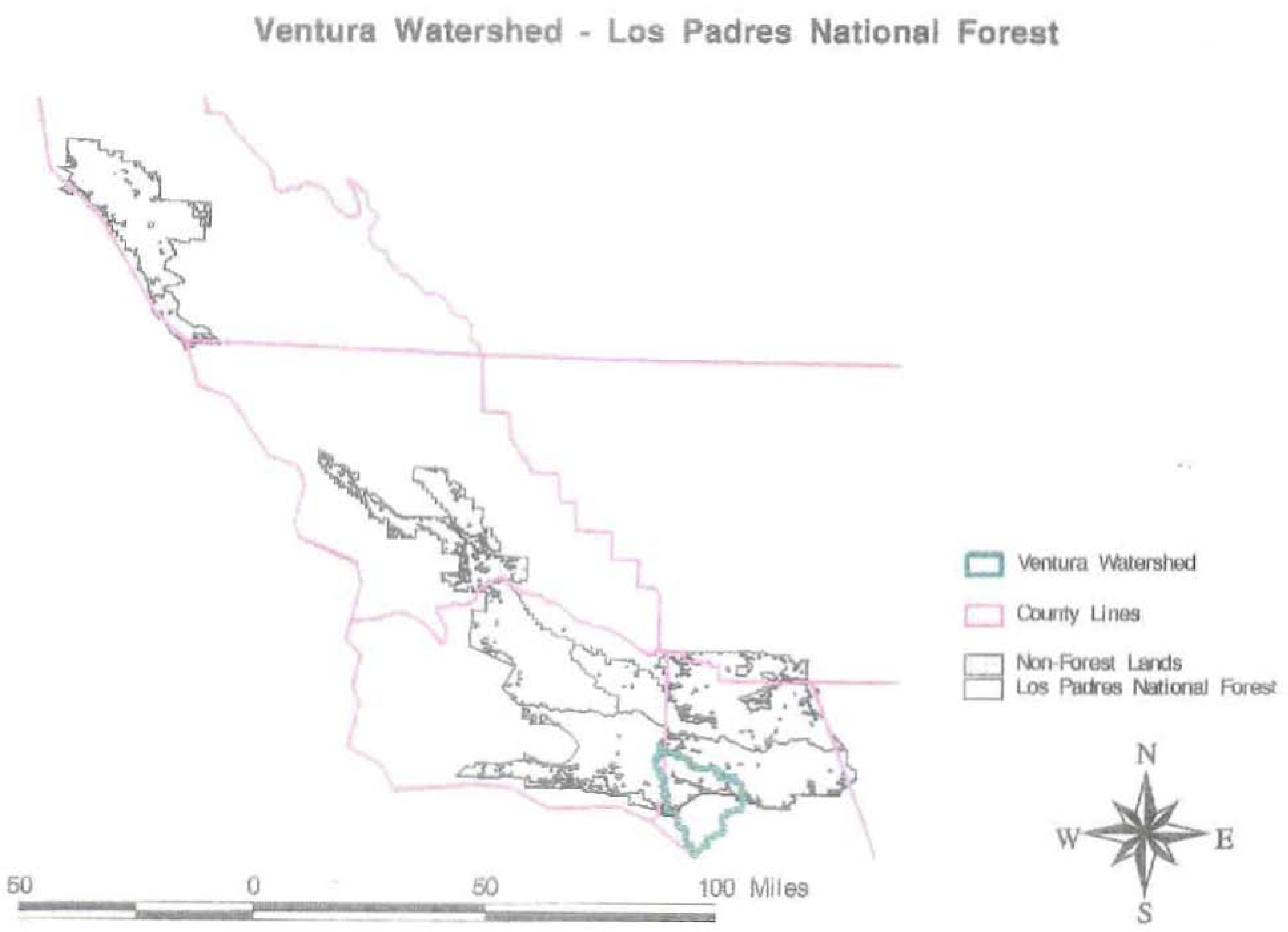


Figure 1. Map of the Southern California coastline showing the location of the Ventura River basin within the Los Padres National Forest.

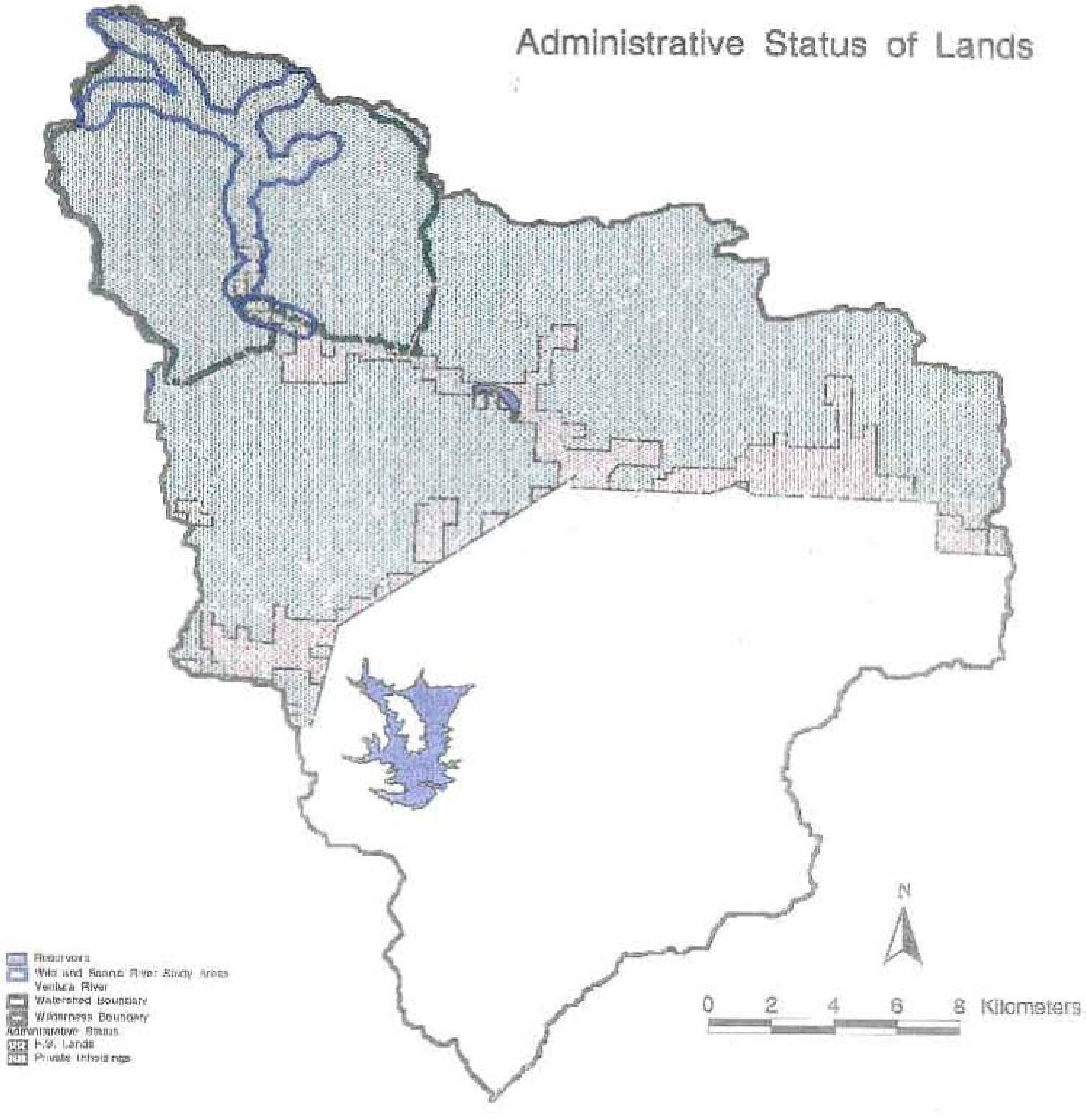


Figure 2. Map showing administrative status of lands within the Ventura Watershed.

Figure 3. Subwatersheds of the Ventura River Basin.

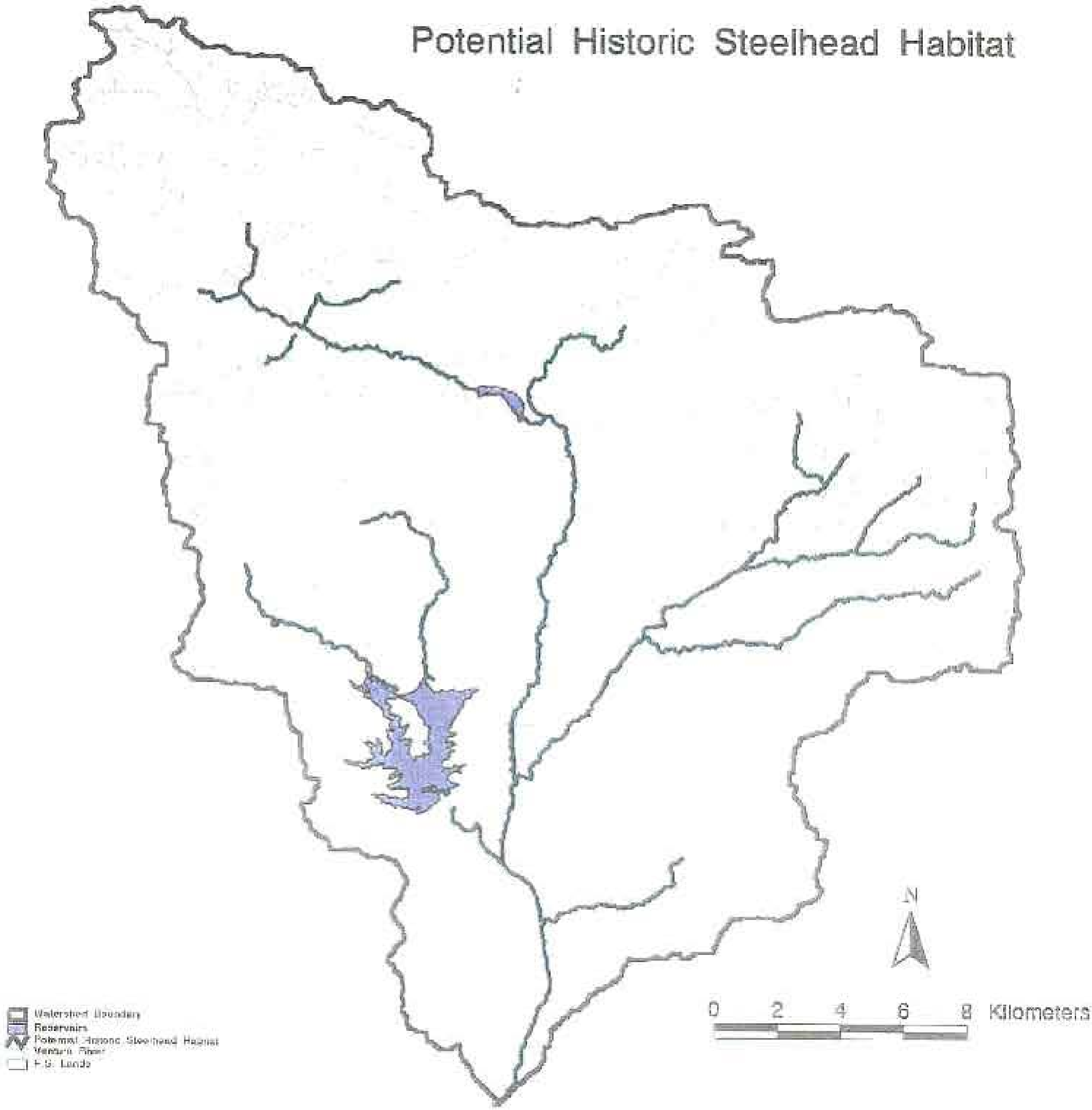


Figure 4. Potential habitat for restoration of anadromous steelhead in the Ventura Watershed based upon the location of historical barriers and various accounts.

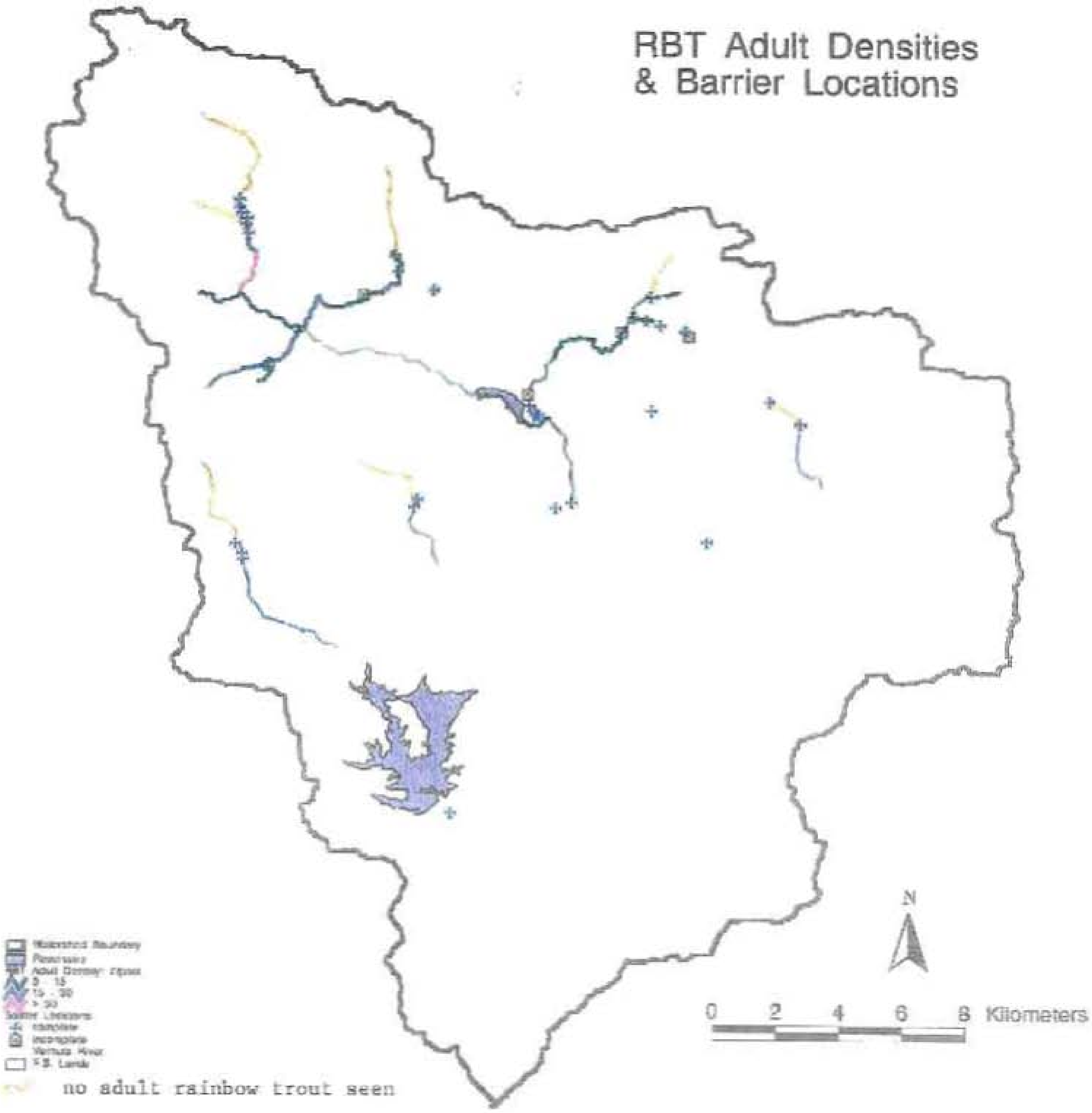


Figure 5. Densities of adult rainbow trout and locations of potential fish barriers within the Ventura River basin.

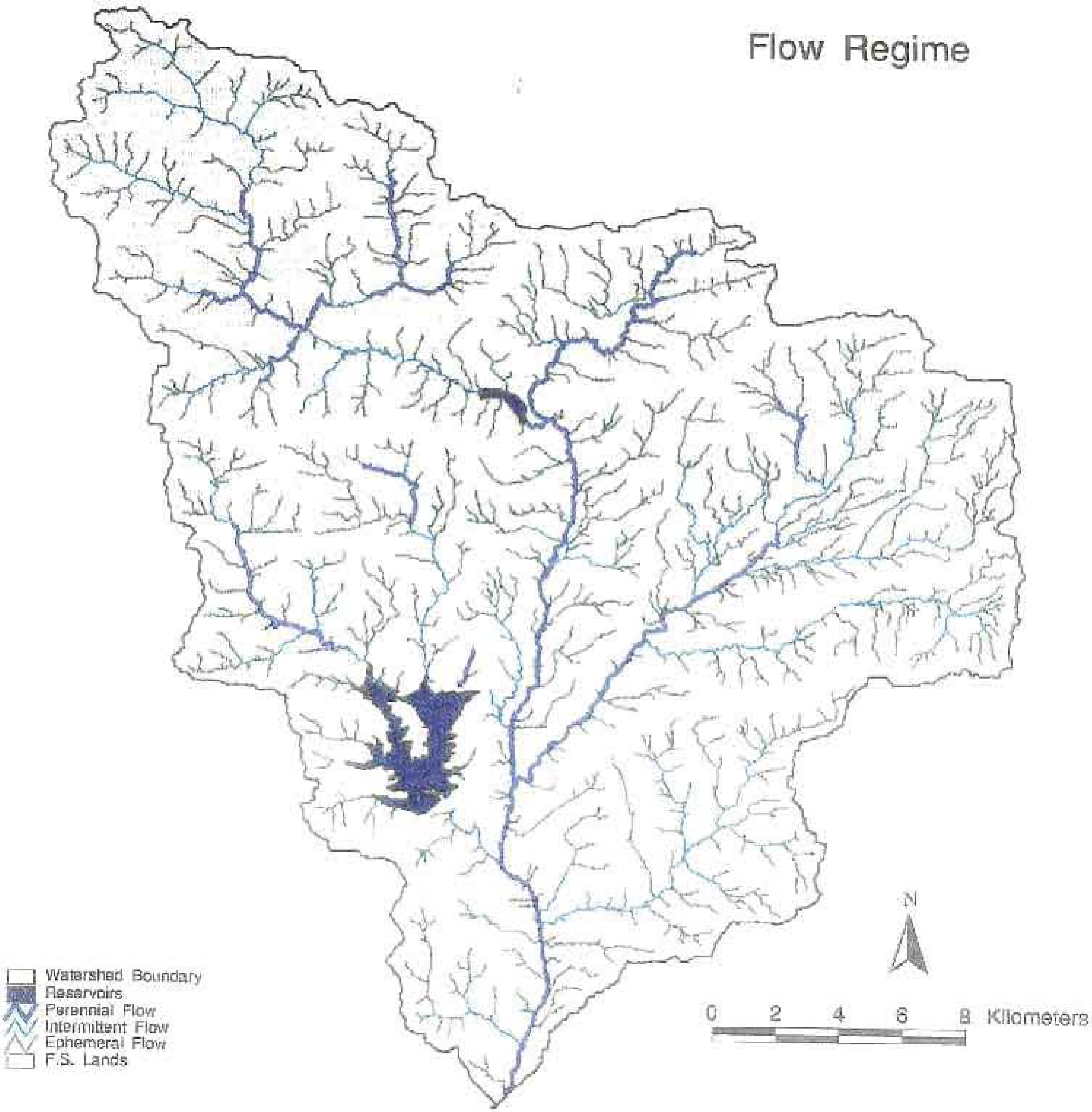


Figure 6. Flow regimes of the stream network of the Ventura watershed.

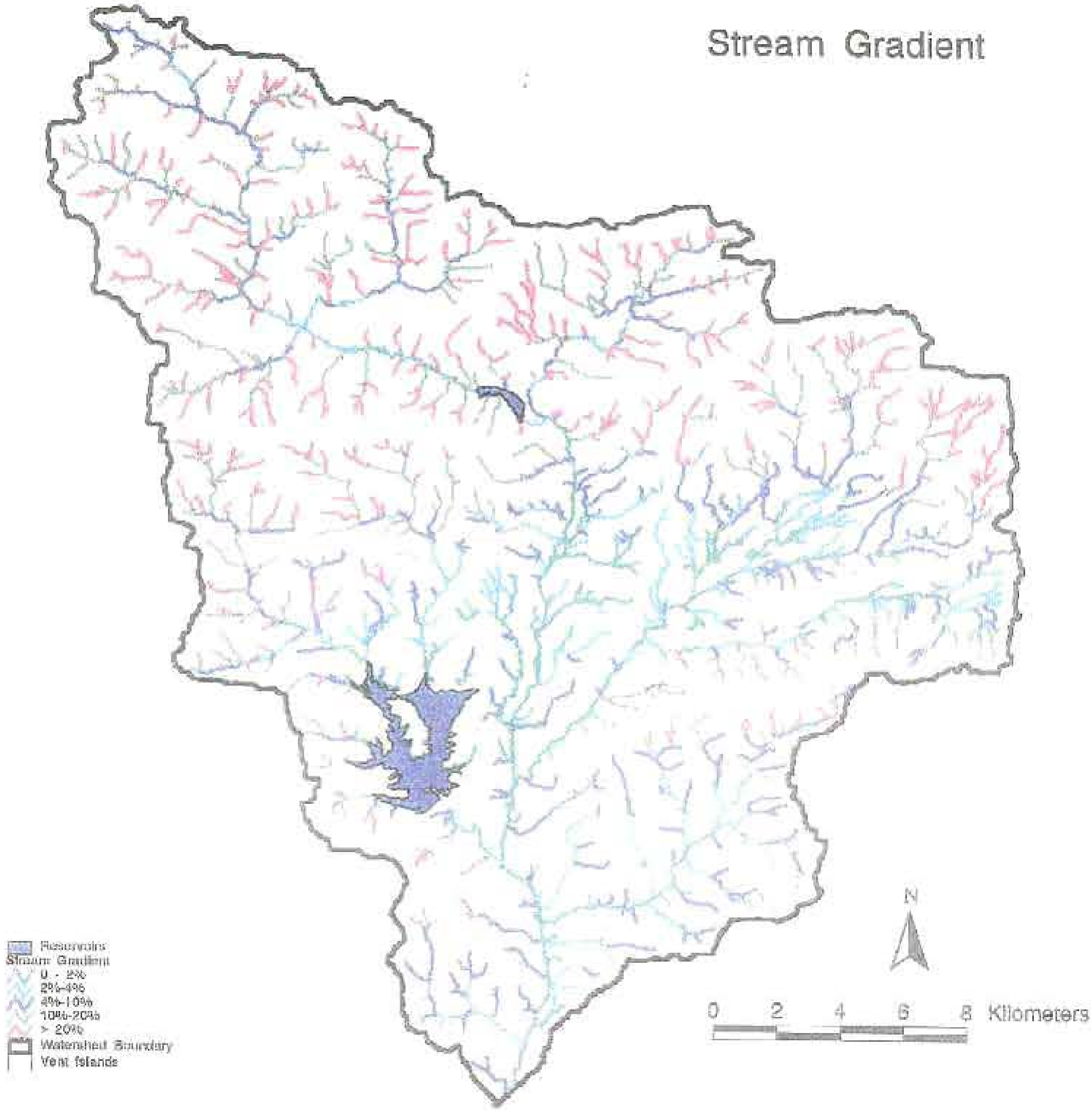


Figure 7. Stream gradients of the Ventura Watershed.

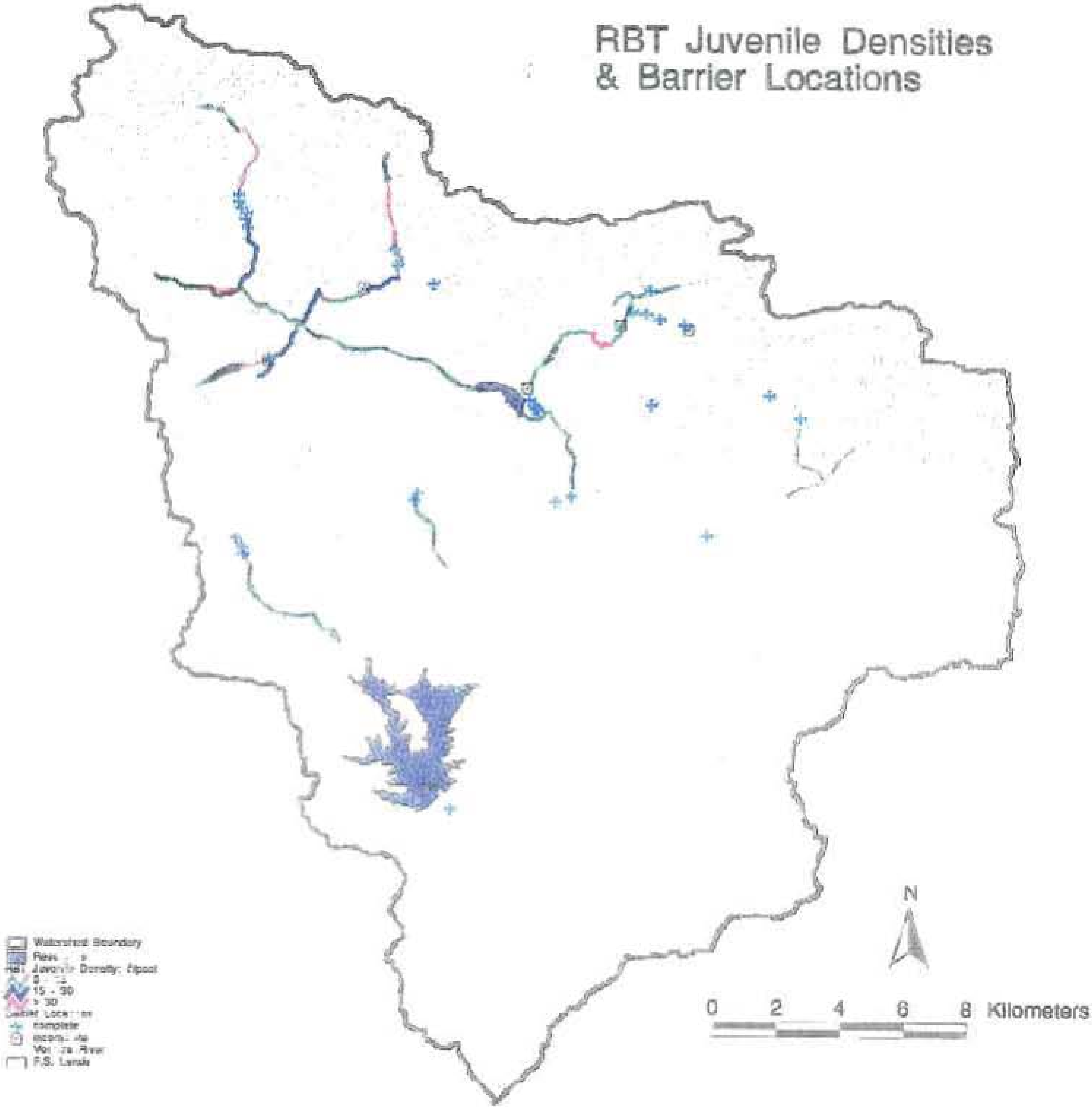


Figure 8. Densities of juvenile rainbow trout and locations of potential fish barriers within the Ventura River Basin.

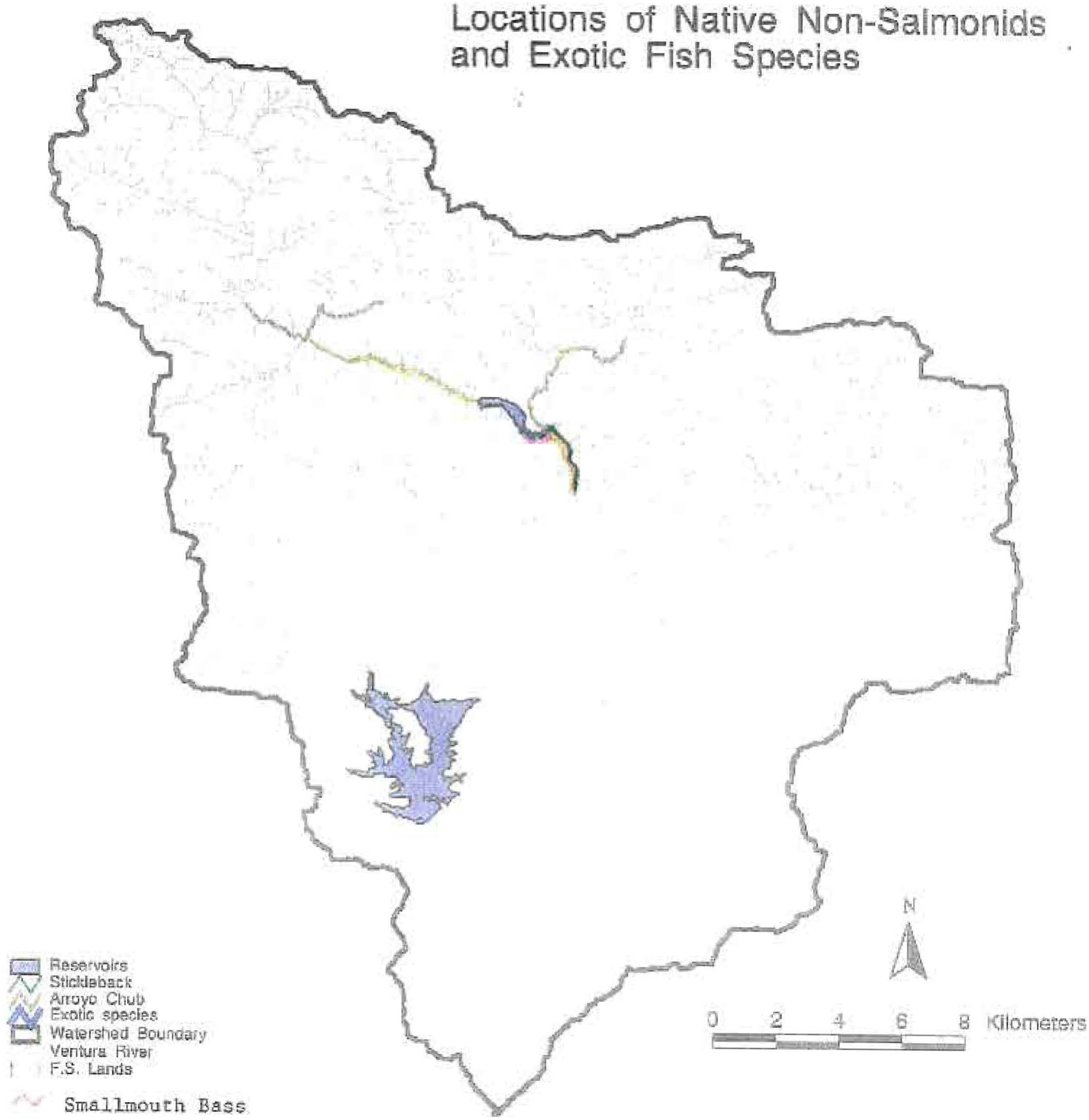


Figure 9. Locations of various fish species within the Ventura River Basin.

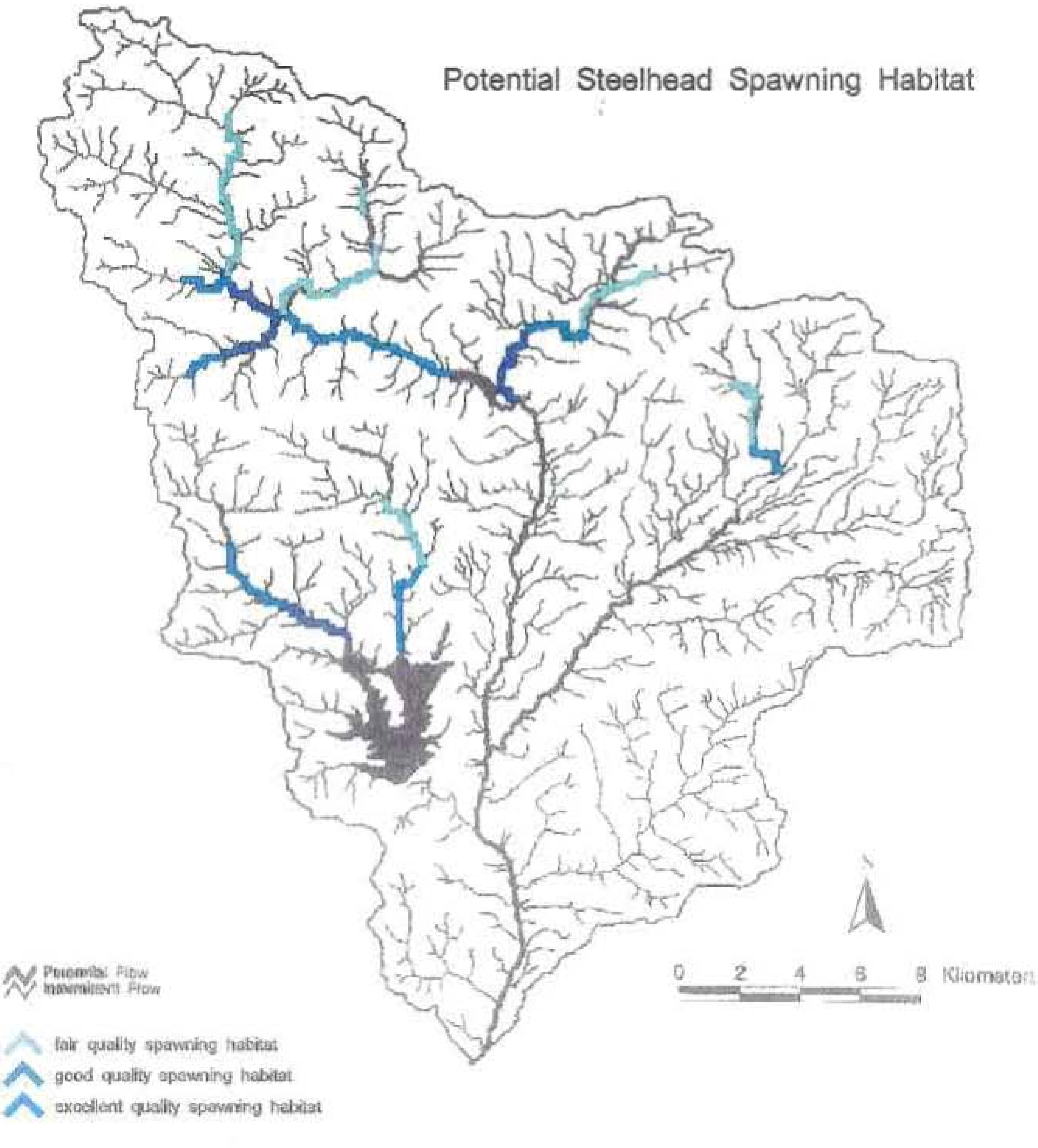


Figure 10. Potential steelhead spawning habitat within the Ventura Watershed as determined by the availability of riffle habitats and gravel substrates (1980-1995 USFS data).
gravels (1980-1995 USFS data).

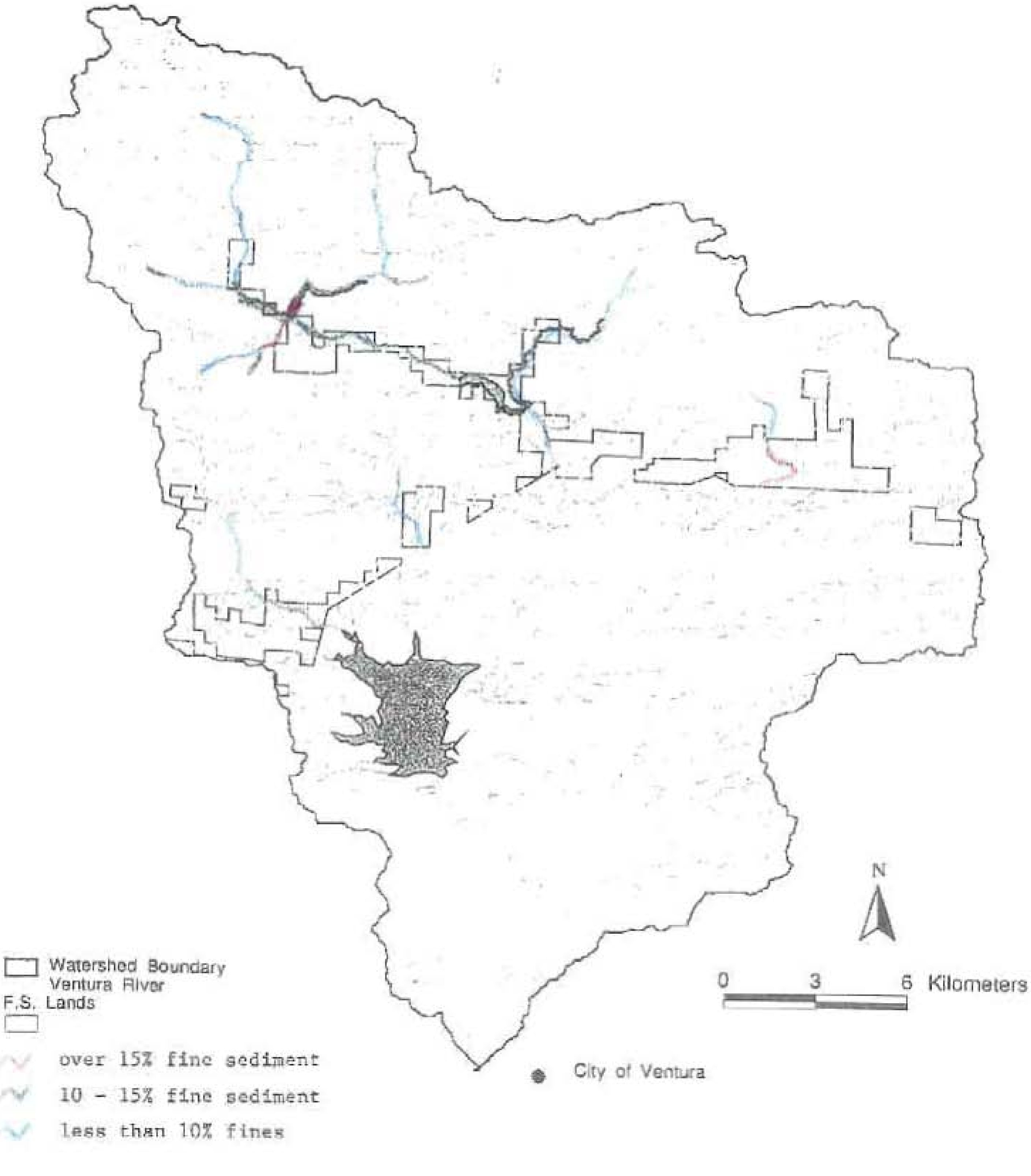


Figure 11. Distribution of fine sediments within the Ventura River basin.

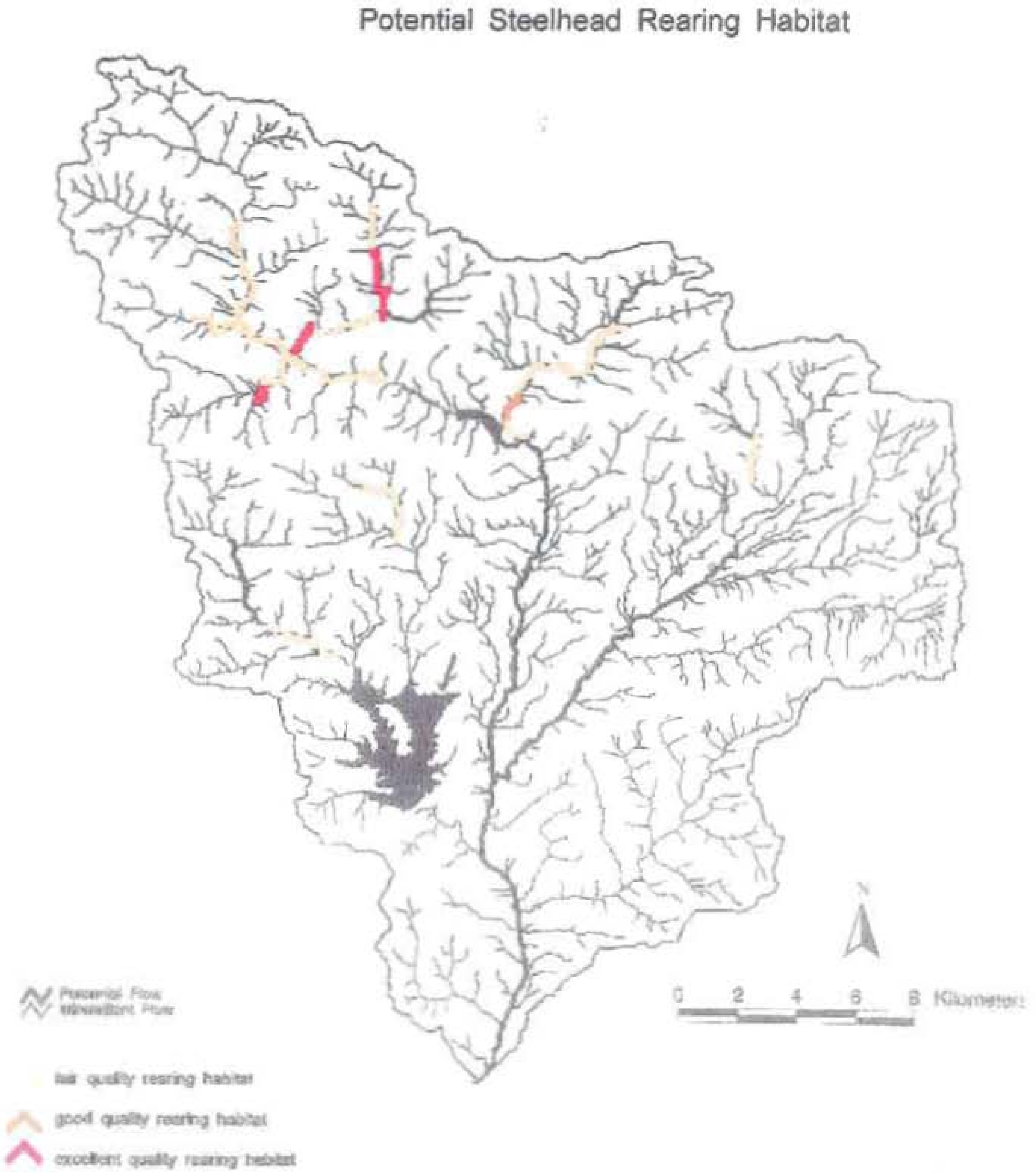


Figure 12. Potential steelhead rearing habitat within the Ventura Watershed as determined by the availability of flow, run and pool habitats, and cover components (1980-1995 USFS data).

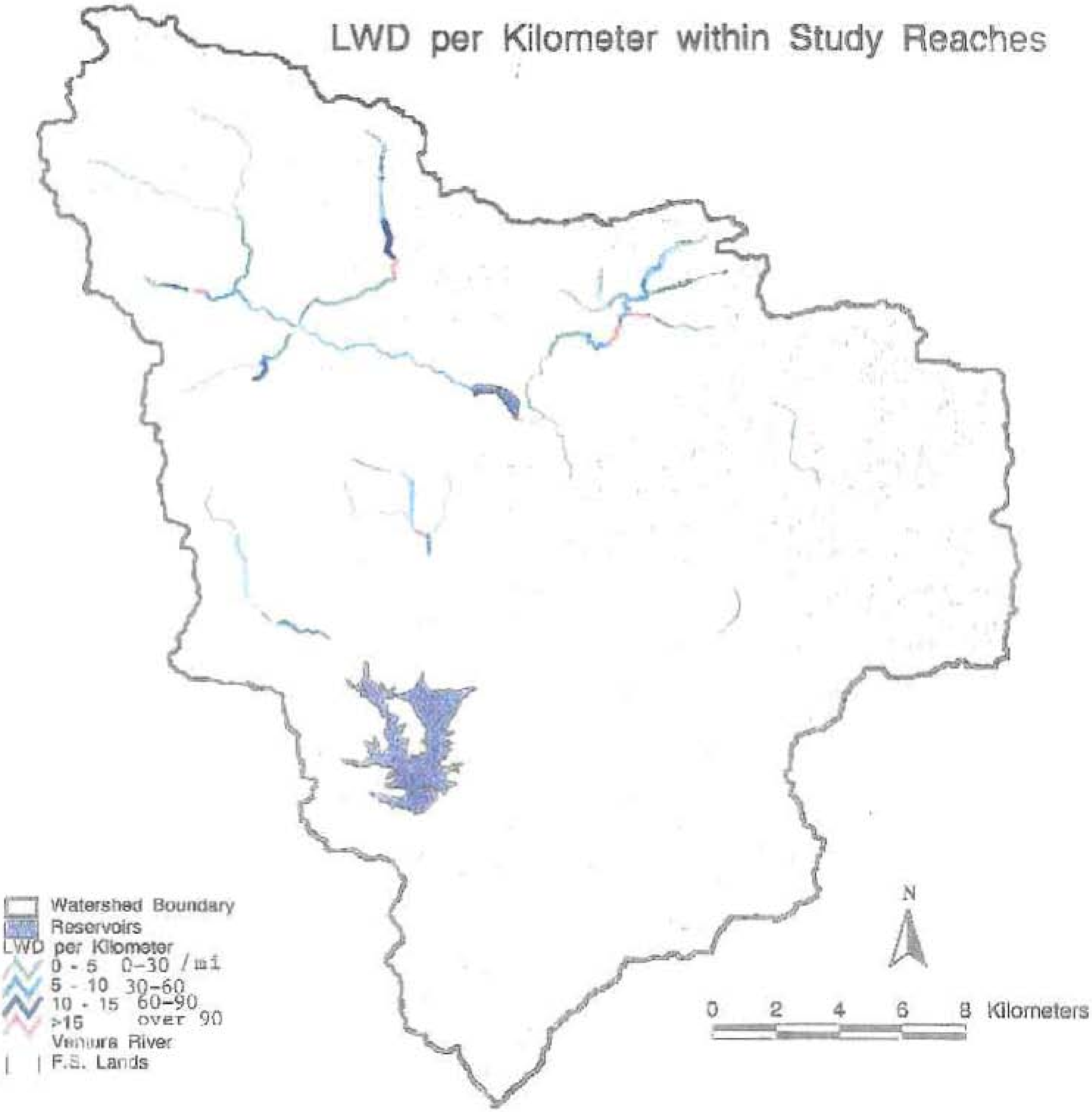


Figure 13. Ventura River basin densities of large and small (over 8 inch diameter) woody debris.

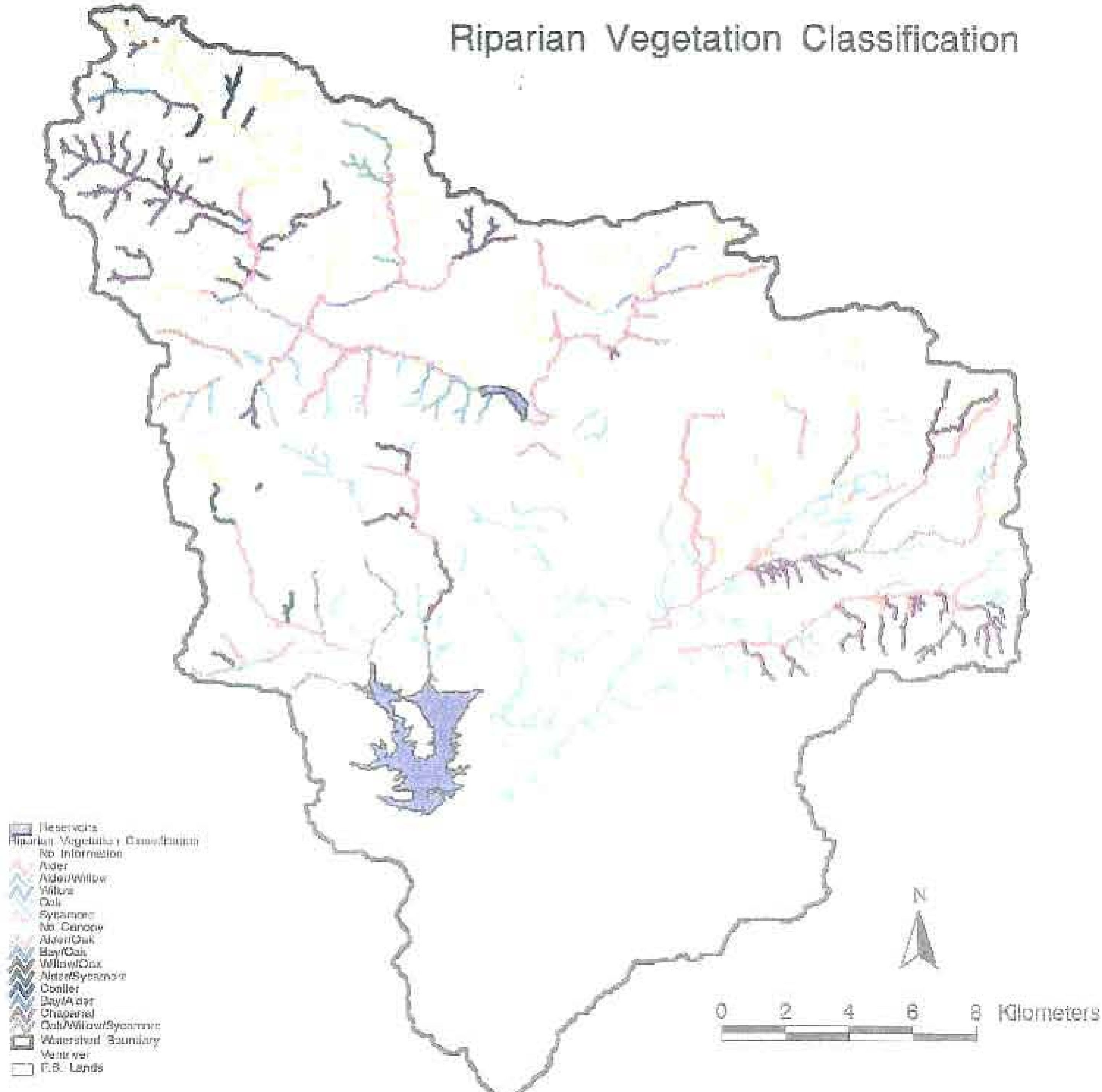
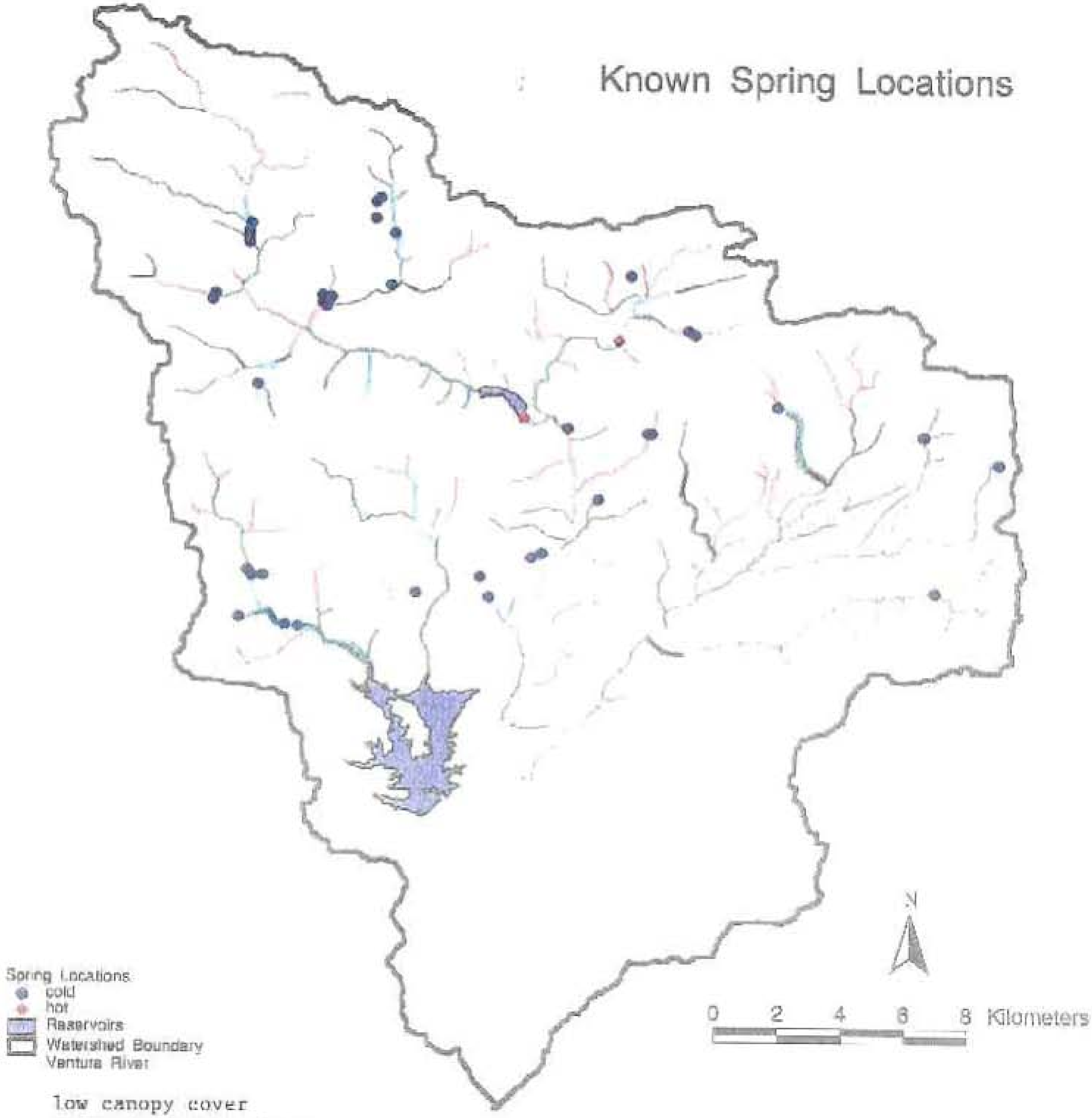


Figure 14. Riparian vegetation of the Ventura Watershed.



low canopy cover
moderate canopy cover
dense canopy cover

Figure 15. Location of springs and stream shade of Ventura River basin.

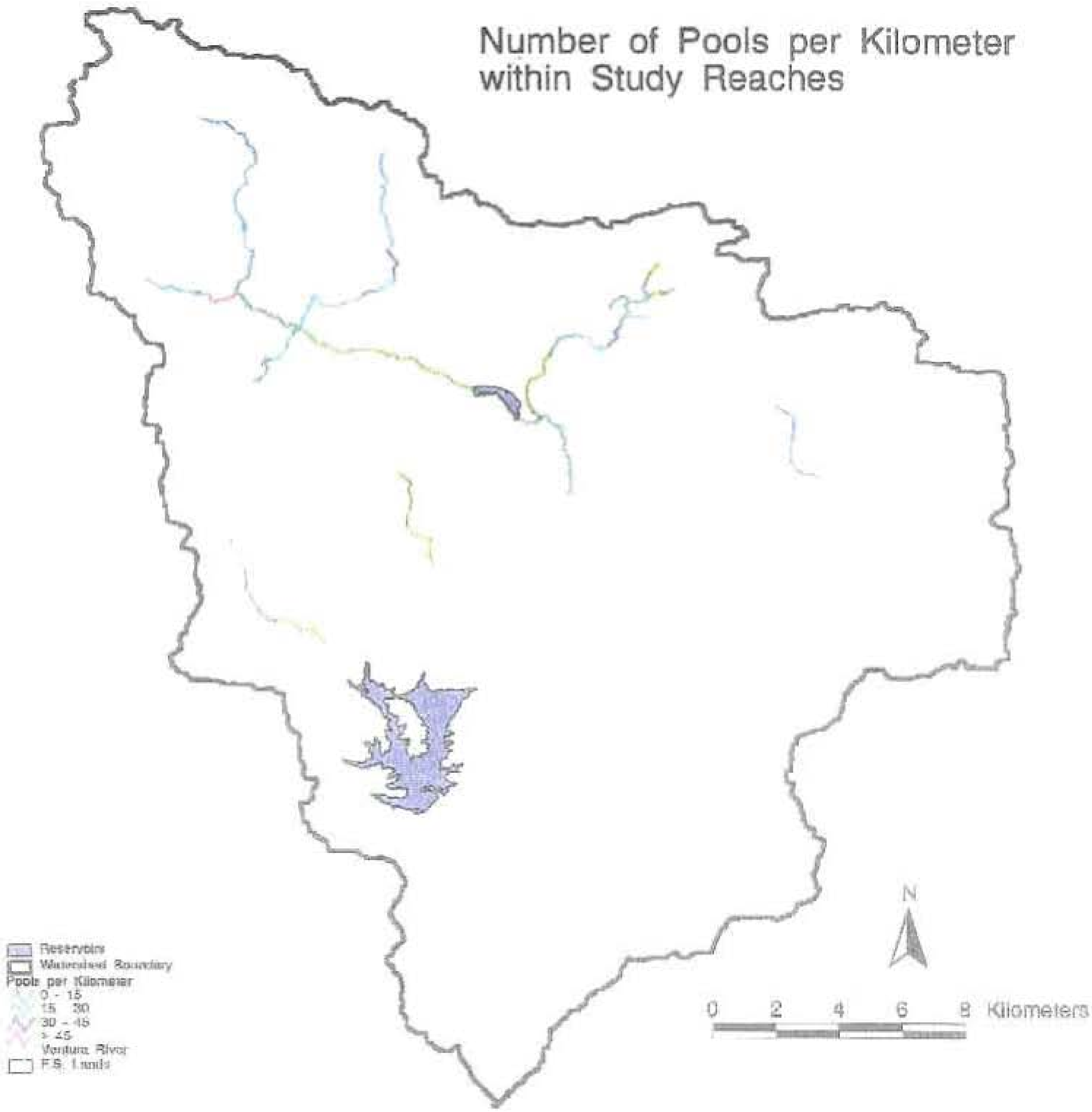


Figure 16. Pool densities within the Ventura River Basin.

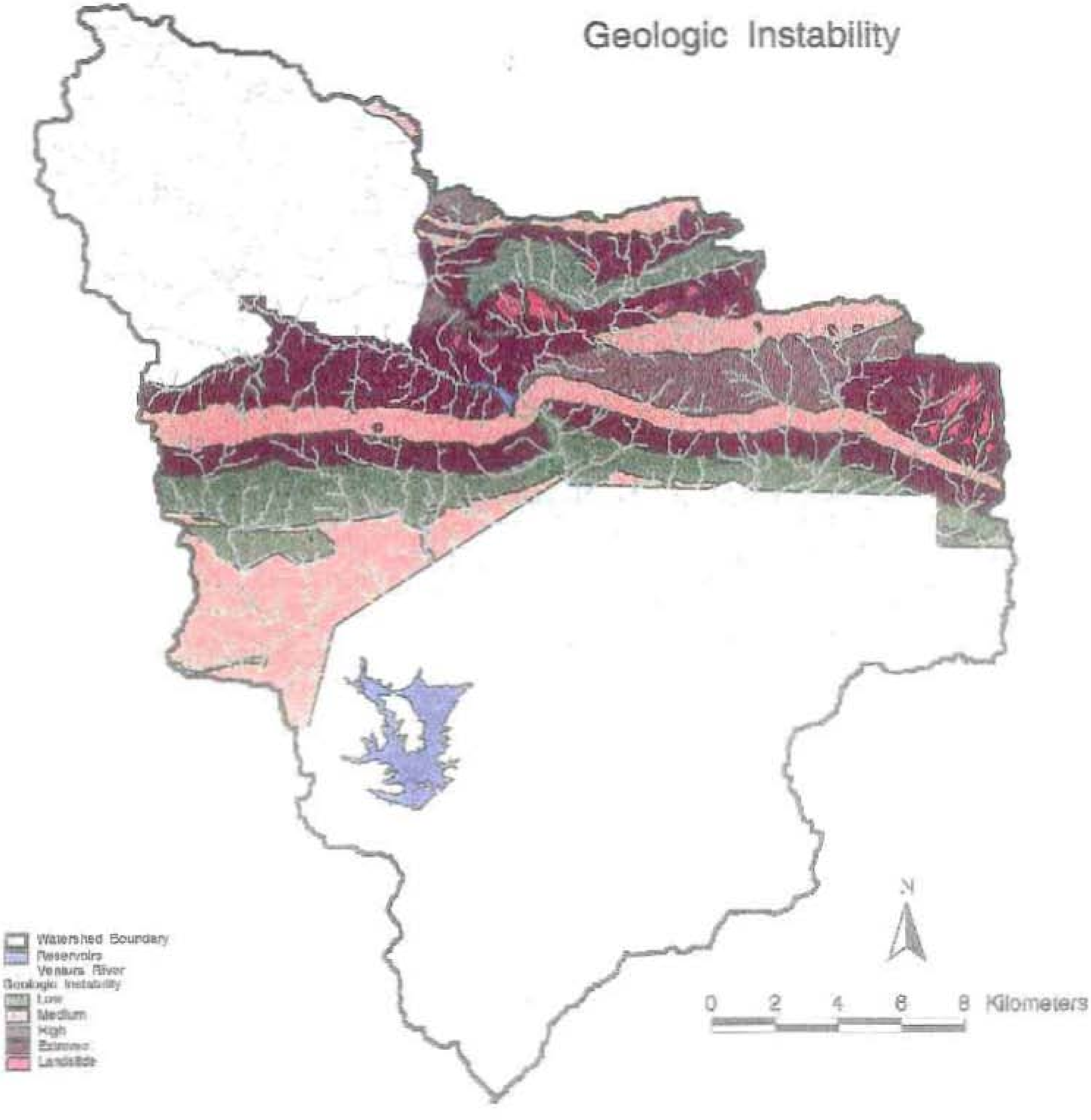


Figure 17. Geologic instability of Ventura Watershed.

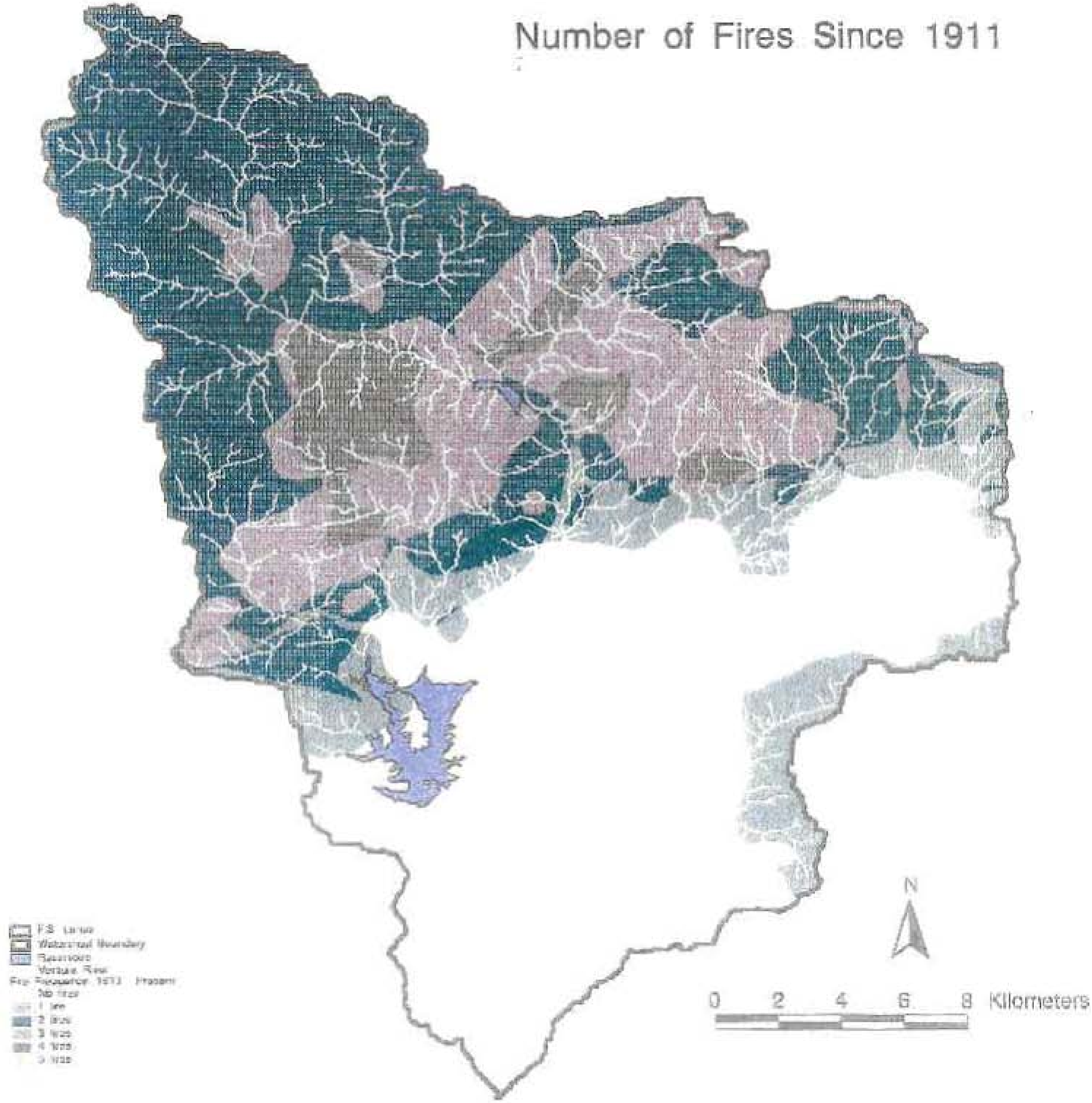


Figure 18. Fire frequencies of the upper Ventura Watershed.

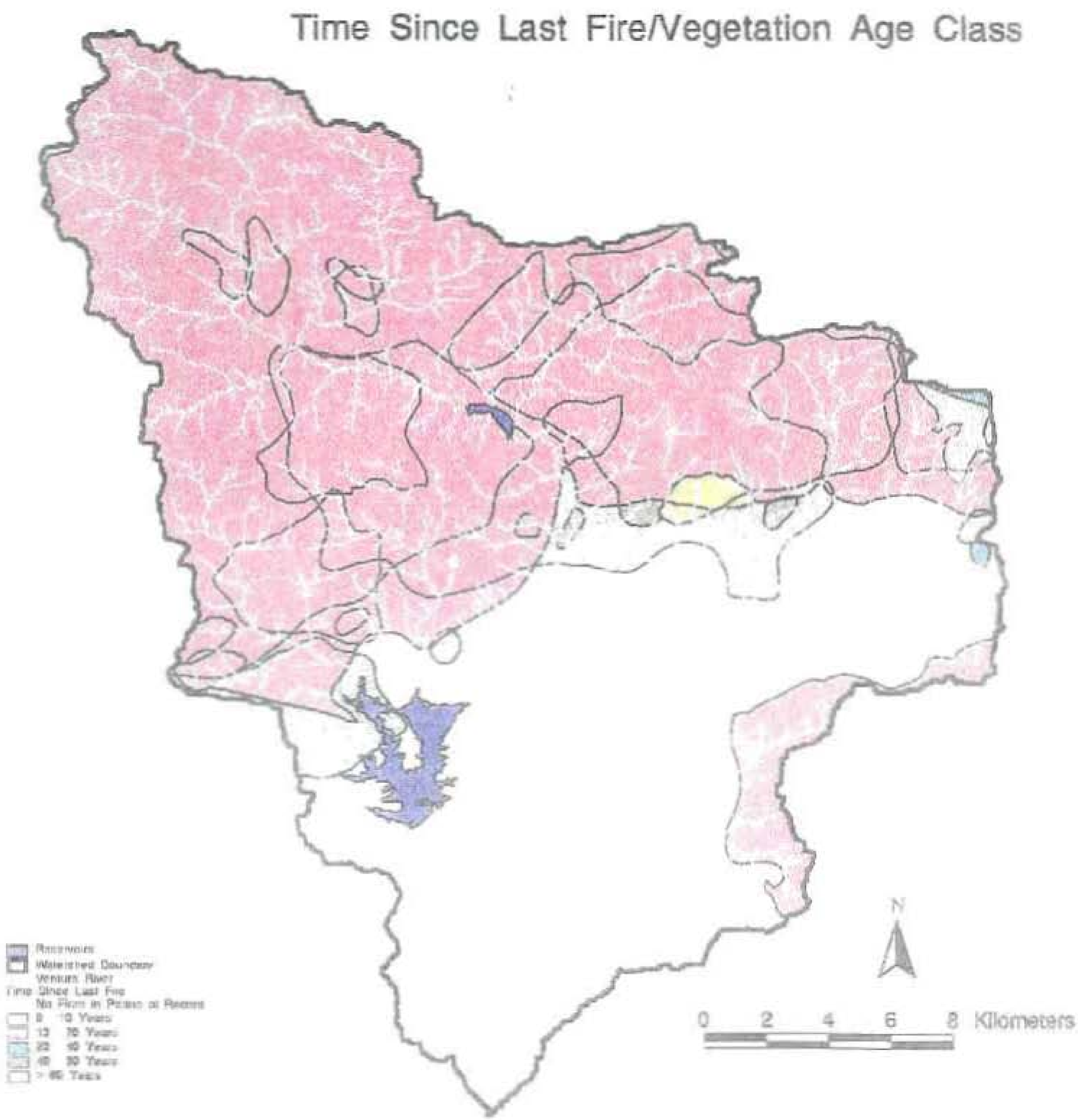


Figure 19. Time since last fire in the upper Ventura Watershed.

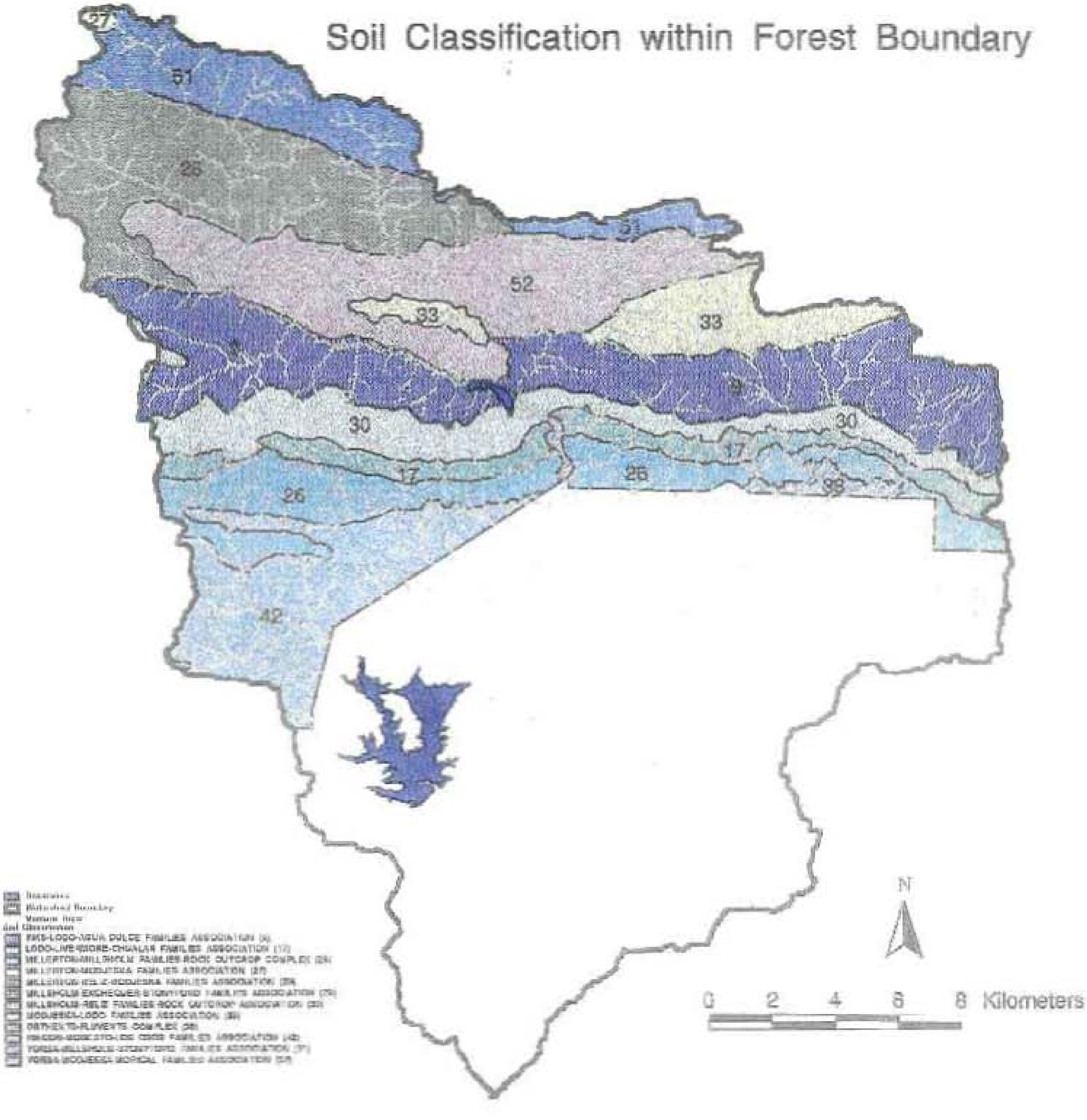


Figure 20. Soil classification within the Forest Boundary of the Ventura Watershed.

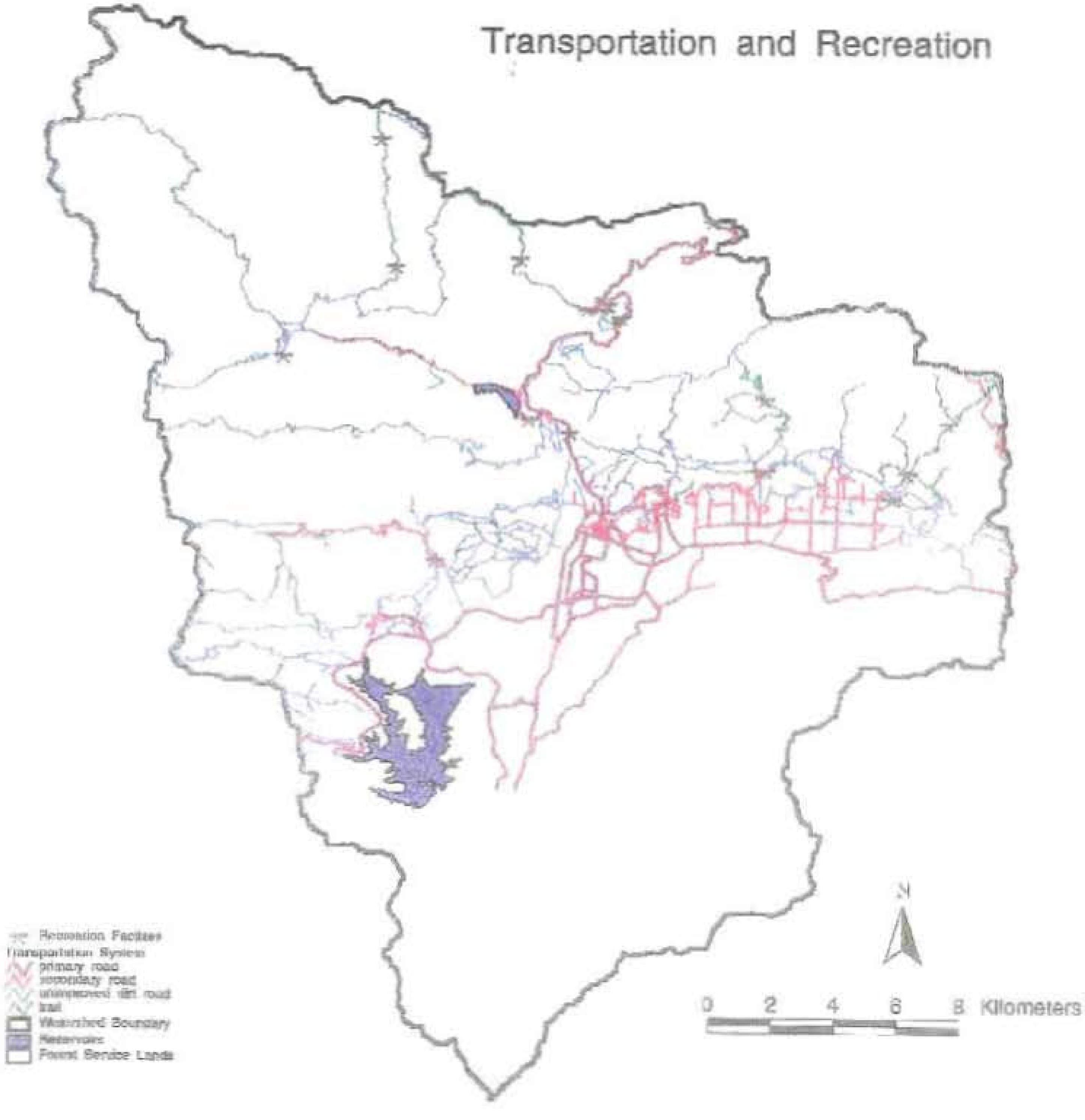


Figure 21. Transportation and recreation facilities within the Ventura Watershed.

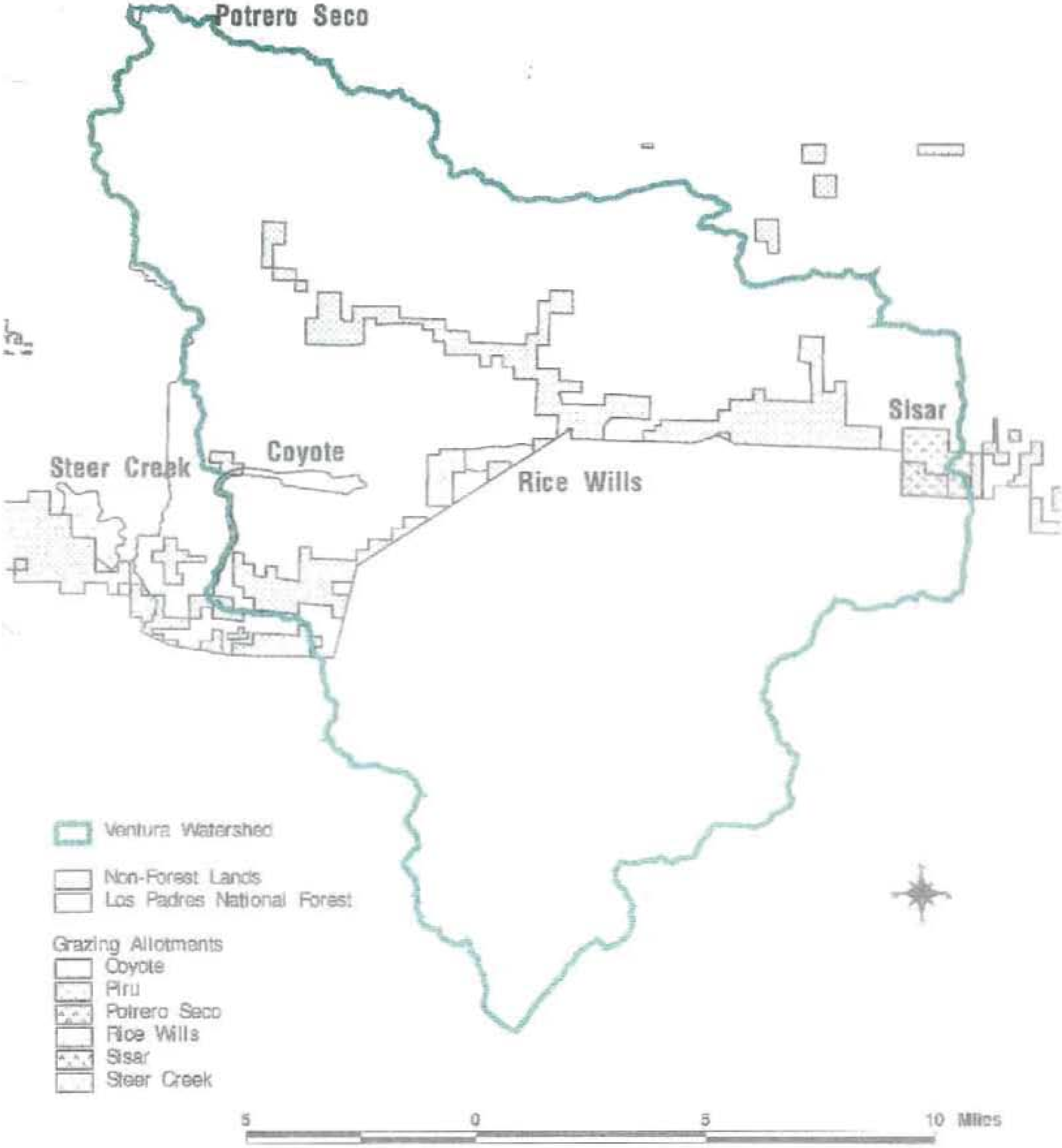


Figure 22. Grazing allotments within the Los Padres National Forest and Ventura Watershed.

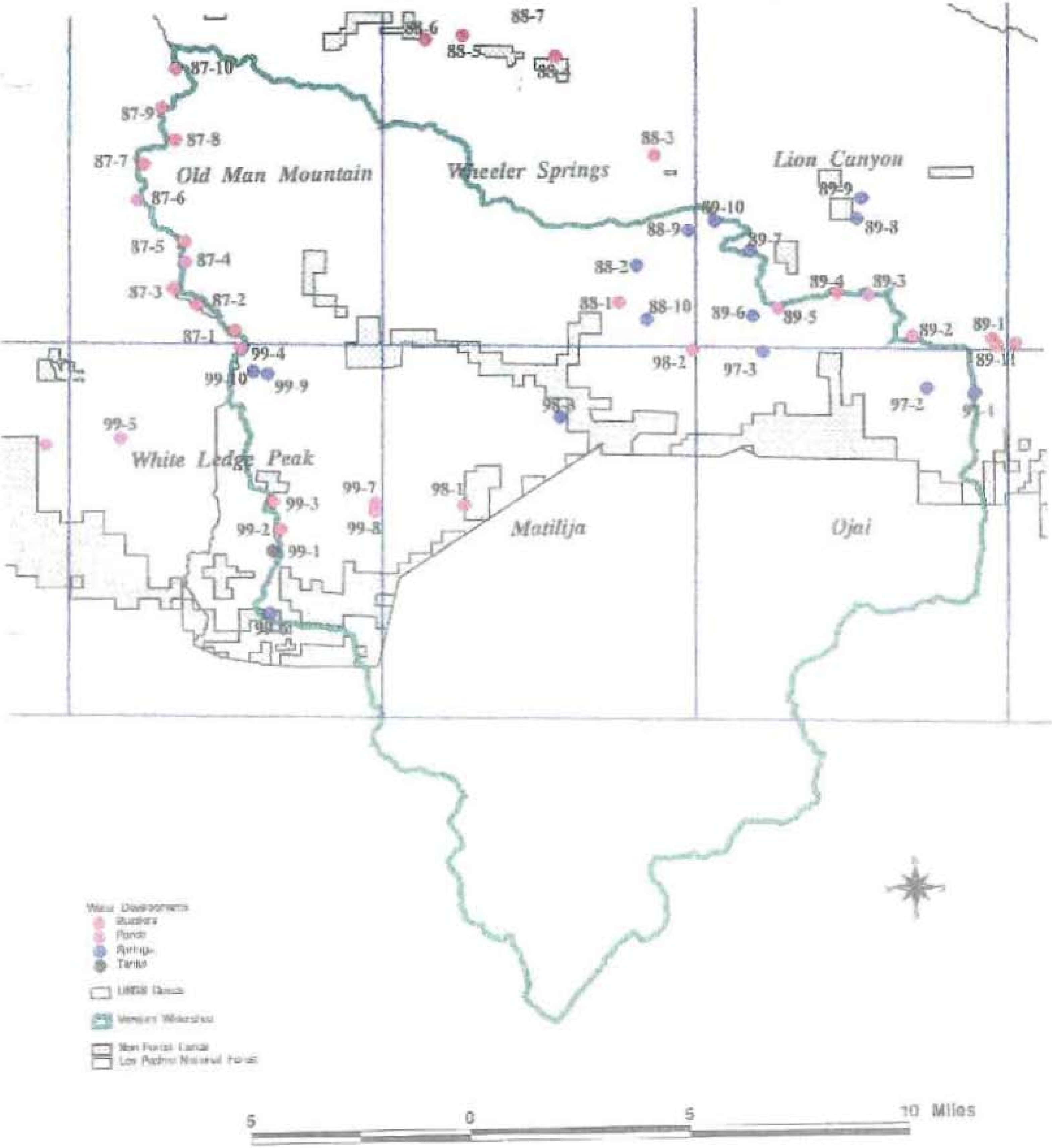


Figure 23. Water developments within Los Padres National Forest and Ventura Watershed.

Lower Ventura River

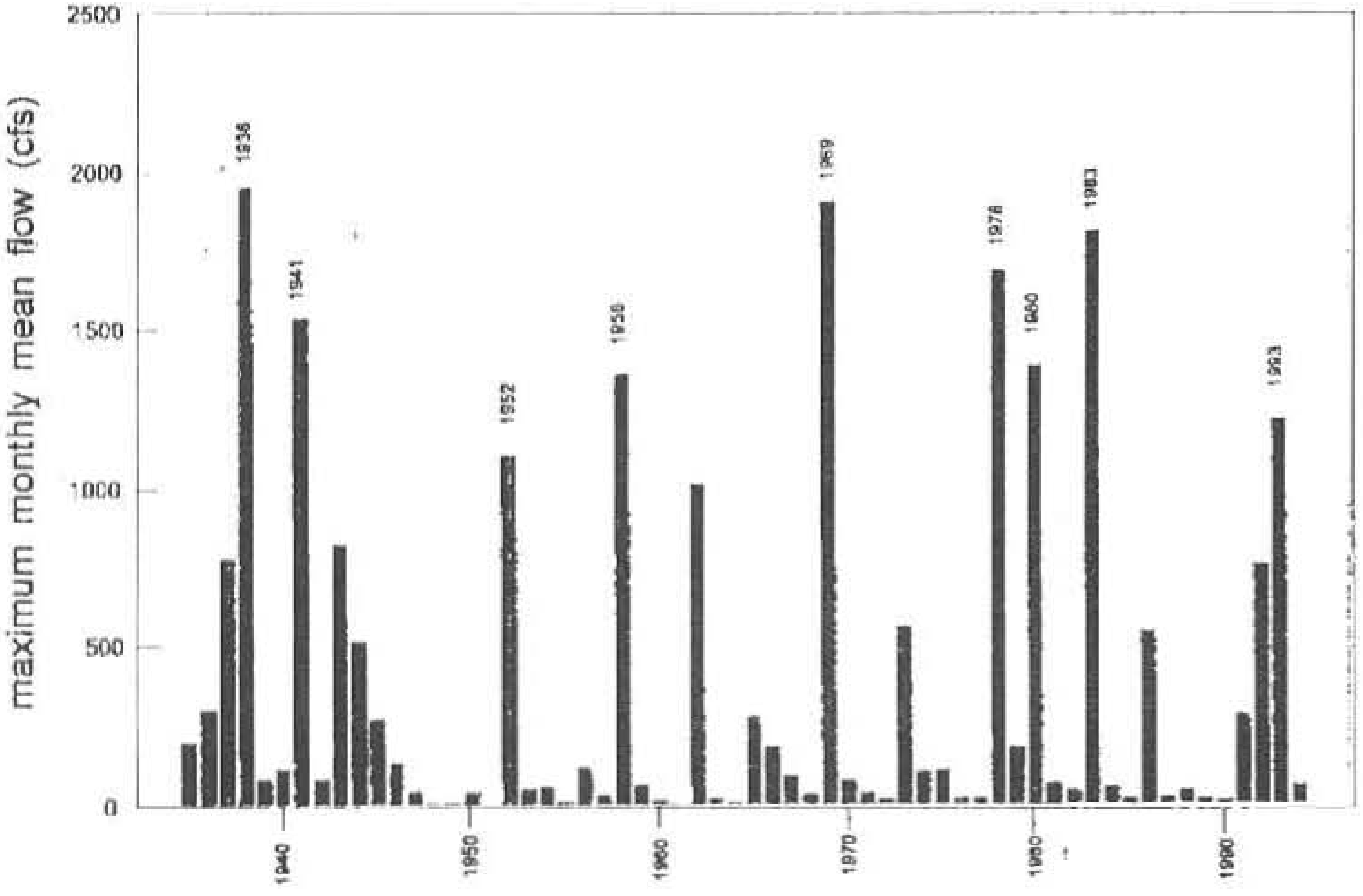


Figure 24. Comparison of average seasonal high flows from 1935 to 1995 in the lower Ventura River (USGS data).