

**Historical Distribution and Current Status of Steelhead/Rainbow Trout (*Oncorhynchus mykiss*)
in Streams of the San Francisco Estuary, California**

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Center for Ecosystem Management and Restoration

MARIN COUNTY

Coyote Creek Watershed

Coyote Creek originates on the eastern face of the Marin Peninsula range and flows generally east to enter the San Francisco Estuary in Richardson Bay. The Coyote Creek watershed consists of about 3.6 square miles. Oakwood Valley Creek joins Coyote Creek from the south in the lower Tamalpais Valley.

Coyote Creek

According to local residents, Coyote Creek supported steelhead prior to the construction of a U.S. Army Corps flood project in 1965 (L. Lewis pers. comm.). One location on a branch of Coyote Creek at the GGNRA trailhead along Tennessee Valley Road was sampled in September 1981 as part of a fish distribution study. No salmonids were found (Leidy 1984). Leidy sampled Coyote Creek near the terminus of Northern Avenue in October 1993 and did not find any fish (Leidy 2002). Marin County PWA staff indicates that salmonids do not presently use Coyote Creek (L. Lewis pers. comm.).

Assessment: Coyote Creek likely supported steelhead historically. However, flood control projects and other watershed factors appear to have made the creek unusable by *O. mykiss* populations.

Arroyo Corte Madera Del Presidio Watershed

Arroyo Corte Madera del Presidio drains the east side of Mount Tamalpais and areas including and around the town of Mill Valley. The creek drains a watershed of about six square miles and its tributaries include Old Mill Creek, Reed Creek, Widow Reed Creek and Warner Creek. A fish passage assessment performed in 2002-2003 notes that several culverted portions of the arroyo impede fish passage and should be modified (Ross Taylor and Assoc. 2003). The reach immediately upstream from the Old Mill Creek confluence was ranked as a high priority passage improvement project.

Arroyo Corte Madera del Presidio

In January 1946, DFG visually surveyed several sites on Arroyo Corte Madera del Presidio. *Oncorhynchus mykiss* in good condition were identified at Montford Avenue and at Sunnyside Avenue. Two dead *O. mykiss* (100-125 mm) were found at the Park Avenue bridge (Shapovalov 1946a).

In July 1963, DFG visually surveyed the entire length of Arroyo Corte Madera del Presidio and its tributaries. Small numbers of fingerling and YOY steelhead were observed (10 per 30 meters) ranging in size from 50-150 mm, but predominantly 50 mm in length (Brackett 1963). The survey report noted that 3.5 miles of Corte Madera del Presidio are utilized for spawning and rearing purposes, and cited the creek as an important spawning and nursery area for steelhead and possibly salmon (Brackett 1963).

In August 1965, DFG visually surveyed Arroyo Corte Madera del Presidio, finding many “excellent” spawning areas and frequent, well-shaded pools. *Oncorhynchus mykiss* averaged approximately 75 per 30 meters of channel, and a sample of 20 fish ranged

in size from 46-71 mm (Culley and Fox 1965). The creek was said to be a good spawning and nursery area for steelhead trout (Culley and Fox 1965).

In 1981, Arroyo Corte Madera del Presidio was sampled by dipnet at Locust Road. Eleven *O. mykiss* (52-109 mm FL) were collected (Leidy 1984).

As part of a restoration feasibility study, several Arroyo Corte Madera sites were sampled by electrofishing in October and November 1994. *Oncorhynchus mykiss* was collected near downtown Mill Valley and in Miller Grove Park, while downstream sites did not produce salmonids (Rich 1995). Population density at the two sites with *O. mykiss* were 0.7 per square meter and less than 0.1 per square meter, respectively. At the downtown Mill Valley site, *O. mykiss* found ranged from 40-90 mm in length, with one individual at 140-150 mm. The Miller Grove Park site had *O. mykiss* between 40 and 160 mm, with three fish between 170 and 200 mm. Three or four age classes were represented in the sample (Rich 1995).

In July 1997, Leidy electrofished Arroyo Corte Madera del Presidio at four locations and found at least four age classes of *O. mykiss* present (Leidy 2002). At La Gama Street he caught two *O. mykiss* (135, 150 mm FL) in a 30-meter reach. Immediately downstream of Park Avenue in Mill Valley, he caught 15 *O. mykiss* (100-307 mm) at an estimated density of 25 per 30 meters of stream. A 20-meter reach just downstream from Presidio Road yielded four *O. mykiss* (59-173 mm). Additionally, Leidy caught 12 *O. mykiss* (47-195 mm) in a 30-meter reach centered at West Blithedale Road (Leidy 2002).

Willow Reed Creek (Widow Creek)

Willow Reed Creek drains Homestead Valley and enters Arroyo Corte Madera del Presidio from the west. According to records of the Mill Valley Historical Society, Blithedale Dam was constructed on Widow Creek in the 1870s. The dam was equipped with a fish ladder known to pass anadromous salmonids (Rich 1995).

During observations in the summer of 2004, staff from Marin County noted YOY and age 1+ *O. mykiss* in Willow Reed Creek (L. Lewis pers. comm.). Successful *O. mykiss* reproduction is assumed to be occurring in the creek.

Warner Creek

Warner Creek originates near the Mill Valley Golf Club on the slopes north of Mill Valley. The creek drains an area of about 5.2 square miles.

In July 1963, DFG visually surveyed the entire length of Arroyo Corte Madera del Presidio Creek and its tributaries, including Warner Creek. Small numbers of fingerling and YOY steelhead were observed (10 per 30 meters) ranging in size from 50-150 mm, but predominantly 50 mm in length (Brackett 1963).

Leidy electrofished Warner Creek at Boyle Park off East Blithedale and Elm Boulevard in 1997. No *O. mykiss* were found (Leidy 2002). During observations in the summer of 2004, staff from Marin County noted YOY *O. mykiss* in Warner Creek (L. Lewis pers. comm.). Successful *O. mykiss* reproduction is assumed to be occurring in the creek.

Old Mill Creek

Old Mill Creek drains the southeastern slopes of Mt. Tamalpais and joins Arroyo Corte Madera del Presidio in the town of Mill Valley. A fish passage evaluation performed in 2002-2003 noted that the culverted reach of Old Mill Creek beneath the post office in Mill Valley is a severe barrier to migration of all life stages of steelhead (Ross Taylor and Assoc. 2003). According to records of the Mill Valley Historical Society, Cascade Dam, located on Old Mill Creek above the confluence with Cascade Creek, was constructed in the 1870s (Rich 1995). The dam constitutes a complete barrier to upstream fish passage.

A January 1946 DFG survey reported natural propagation of *O. mykiss* in Old Mill Creek as “fair” in the lower reach to “good” in the middle reach (Shapovalov 1946b). According to the survey report, steelhead were hampered in their ascent by an inclined concrete apron at the Cascade Drive bridge in Old Mill Park (Shapovalov 1946b). The Cascade Reservoir dam was identified as a complete barrier to migration (Shapovalov 1946b).

In July 1963, DFG visually surveyed Arroyo Corte Madera del Presidio Creek and its tributaries, including Old Mill Creek. Small numbers of fingerling and yearling steelhead were observed throughout the Arroyo Corte Madera del Presidio system (10 per 30 m), ranging in size from 50-150 mm, with most fish measuring approximately 50 mm (Brackett 1963).

In September 1981, a dip-net survey of three sites on Old Mill Creek found 15 *O. mykiss* approximately 0.5 miles above the junction of Cascade Drive and Lowell Avenue (Leidy 1984). Fish ranged in size from 62-116 mm, with one individual 174 mm in length recorded. At the Cascade Drive crossing near Josephine St., seven *O. mykiss* ranged in size from 50-71 mm. At Locust Road, 11 *O. mykiss* ranged from 52-109 mm (Leidy 1984).

As part of a restoration feasibility study, several Old Mill Creek sites were sampled by electrofishing in October and November 1994. *Oncorhynchus mykiss* was collected at multiple sites, with mostly YOY represented in the sample (Rich 1995). These *O. mykiss* were predominantly between 40 and 200 mm in length, with one individual between 250 and 260 mm. Three or four age classes were represented in the Old Mill Creek population (Rich 1995).

In July 1997, Leidy electrofished Old Mill Creek approximately 0.5 miles below Cascade Dam. He found 11 *O. mykiss* (47-69 mm FL) at an estimated density of 15 per 30 meters of stream (Leidy 2002). Steelhead YOY were found in Old Mill Creek during observations between 1998 and 2001 (Jones 2001).

Cascade Creek

Cascade Creek joins Old Mill Creek from the north approximately 0.4 mile below Cascade Dam. In July 1963, DFG visually surveyed the entire length of Arroyo Corte Madera del Presidio Creek and its tributaries, including Cascade Creek. Small numbers of fingerling and yearling steelhead were observed throughout the Arroyo Corte Madera del Presidio system (10 per 30 meters). Fish ranged in size from 50-150 mm, but were predominantly 50 mm in length (Brackett 1963).

In September 1981, two sites were dip-netted on Cascade Creek, but no *O. mykiss* were found (Leidy 1984). Leidy sampled Cascade Creek at the Old Mill Creek confluence in October 1993. No fish of any kind were found.

As part of a restoration feasibility study, Cascade Creek was sampled in October and November 1994. One *O. mykiss* was collected above the culvert at the entrance to the Cascade Falls trail (Rich 1995). In July 1997, Leidy electrofished a 20 meter reach of Cascade Creek upstream of the Old Mill Creek confluence and found five *O. mykiss* (50-75 mm FL) at an estimated density of 10 per 30 meters (Leidy 2002).

Assessment: Arroyo Corte Madera del Presidio and its tributaries historically supported both *O. mykiss*. Steelhead continue to enter the system and reproduce successfully.

Oncorhynchus mykiss abundance in the watershed appears to be limited by lack of water (Rich 1995). According to a restoration feasibility study for the Arroyo Corte Madera del Presidio drainage, Old Mill Creek provides the best remaining salmonid habitat in the watershed (Rich 1995).

Corte Madera Creek Watershed

The Corte Madera Creek watershed is 28 square miles and includes unincorporated portions of Marin County, the city of Larkspur, and the towns of Corte Madera, Ross, San Anselmo and Fairfax. Main stem Corte Madera Creek is formed by the union of San Anselmo and Sleepy Hollow Creeks, and flows generally southeast to enter the Bay at a point about nine miles north of the Golden Gate Bridge, just south of Point San Quentin.

Between 1967 and 1971, the Corps channelized a two-mile portion of Corte Madera Creek from Kentfield near its mouth to its inception at the confluence of San Anselmo and Sleepy Hollow Creeks. The concrete channel extends up the lower portions of all direct tributaries to Corte Madera Creek in this reach, including Ross, Sleepy Hollow, San Anselmo, and Fairfax creeks. The upper portion of this channel blocks migration to all spawning areas in the watershed, according to a 2002-2003 fish passage evaluation (Ross Taylor and Assoc. 2003).

Corte Madera Creek

In January 1960, DFG visually surveyed Corte Madera Creek from its mouth to the confluence with San Anselmo Creek. Although no fish were observed during the survey, residents estimated a run of 500-1,000 steelhead each year (Allen 1960a). According to DFG, the upper half of Corte Madera Creek is used by steelhead for both spawning and as a nursery area (Allen 1960a). The DFG report also speculated that the proposed channelization would cause destruction of the nursery area and eliminate the steelhead run (Allen 1960a).

Unsigned reports of minnow-seine surveys dating from 1963 to 1974 indicate that sampling regularly recorded *O. mykiss* in Corte Madera Creek (DFG 1963-1974). Sampling results are listed in Table VII-1.

Table VII-1. Corte Madera Creek minnow-seine sampling results, 1963-1974

Date	Location	<i>Oncorhynchus mykiss</i>	
		No.	Size Range
November 1963	Lagunitas Rd. bridge	29	Fry
November 1963	~2 mi. downstream from Lagunitas Rd. bridge	0	--
May 1965	Ross/San Anselmo border and also Ross near bridge at fire station	36	--
October 1967	Ross near bridge	3	81-98
October 1968	Ross upstream from bridge	8	47-80
October 1968	Ross downstream from bridge	27	44-133
October 1969	Ross near bridge at fire station	3	64-81
September 1971	Lagunitas Rd. bridge	72	38-83
September 1972	Ross near bridge at fire station	19	50-85
September 1973	Ross near bridge at fire station	10	--
October 1974	Ross near bridge at fire station	5	64-95

(Source: DFG 1963-1974)

In July 1968, DFG visually surveyed Corte Madera Creek from its mouth to the San Anselmo confluence. *Oncorhynchus mykiss* were observed at a density of 75 per 30 meters of channel, ranging in size from 50-100 mm TL (Michaels and Thomson 1968). The survey reported that the limiting factors to the fishery included low stream flows and development. In addition, the survey recommended that the creek be managed as a steelhead spawning and nursery stream (Michaels and Thomson 1968).

In September 1969, DFG estimated population densities and sizes of *O. mykiss*, and evaluated habitat in Corte Madera Creek and its tributaries. In February 1976, DFG visually surveyed Corte Madera Creek between the Lagunitas Road Bridge and the denil fishway to determine the extent of salmonid migration and spawning during a drought year. No salmonids were seen. However, the local game warden reported seeing several salmonids successfully negotiating the fishway below Lagunitas Road (Scoppettone 1976).

In September 1980, DFG visually surveyed Corte Madera Creek from the concrete-lined channel in Ross upstream to its confluence with San Anselmo Creek. Forty diversions were counted, all for private homes. A few YOY steelhead were observed, but their location was not specified (Eimoto and Walkup 1980). The survey report noted that the Corte Madera Creek drainage sustained a steelhead resource, although diversions along the creek were believed to have contributed to portions of the creek going dry that historically had perennial flow (Eimoto and Walkup 1980).

In September 1981, a pole-seine survey found two *O. mykiss* (58, 72 mm FL) downstream of Madrone Drive (Leidy 1984). Corte Madera Creek was surveyed by RWQCB in July 1992. Seine netting and visual observation identified 11 *O. mykiss*, all in deep shaded pools toward the lower end of the creek (Marshall et al. 1994).

In July 1993, Leidy electrofished Corte Madera Creek immediately upstream from the fish ladder opposite the post office in Ross. He caught one *O. mykiss* (110 mm FL). At the Sylvan Road crossing, opposite the Ross fire department, he caught four *O. mykiss* (75-107 mm) and observed an additional ten in the same size range. Leidy estimated density at 25 per 30 meters of stream. In August, Leidy also electrofished Corte Madera Creek at Creek Park downstream from the pedestrian bridge and also immediately downstream of Winship Road. He found no *O. mykiss* at these sites (Leidy 2002).

In August 1997, Leidy again electrofished Corte Madera Creek at a site opposite the Ross postal office. A 30-meter reach yielded four *O. mykiss* (62-300 mm) at an estimated density of five per 30 meters (Leidy 2002).

Friends of Corte Madera Creek funded an electrofishing survey of Corte Madera Creek that occurred in August 1999. A total of 15 *O. mykiss* (68-110 mm FL) were found at four of 11 sites totaling 164 meters of stream sampled (Rich 1999).

Larkspur Creek

Larkspur Creek is tributary to Corte Madera Creek, and drains the area between the towns of Kentfield and Greenbrae. It enters Corte Madera Creek from the north near the uppermost extent of that creek's tidal portion.

In September 1981, Larkspur Creek was sampled by dip net at the terminus of Water Way off Madrone Avenue. Two *O. mykiss* (51-121 mm FL) were collected (Leidy 1984).

Tamalpais Creek

Tamalpais Creek flows west to east along Woodland Road and joins Corte Madera Creek southeast of the College of Marin in Kentfield. Staff from DFG electrofished Tamalpais Creek in August 1969 upstream of the Evergreen Street Bridge. A total of 21 *O. mykiss* (60-90 mm) were collected in a 30-meter reach (Jones 1969). The DFG report stated the area extending from Ridge View Road downstream to a Corps flood control project as containing nursery habitat, and estimated the steelhead population in the stream to be 552 based on a density of 21 per 30 meters (Jones 1969).

In July 1998, Leidy sampled a 30-meter reach of Tamalpais Creek centered on the lowermost Woodland Road crossing. He collected two *O. mykiss* (65, 87 mm FL) (Leidy 2002). Steelhead YOY were found in Tamalpais Creek during observations in 2000 and in 2001 (Jones 2001). In April 2002, Leidy and Lewis observed a single juvenile *O. mykiss* (estimated 75-100 mm TL) off Woodland Road near Laurel Way (Leidy and Lewis 2002).

Murphy Creek

Murphy Creek joins Corte Madera Creek northwest of the College of Marin in Kentfield. In April 2002, Leidy observed Murphy Creek at three locations near Hillside Avenue, at Bridge Road, and at Redwood Road. No *O. mykiss* were found (Leidy and Lewis 2002).

Ross Creek

Ross Creek is formed by the confluence of Phoenix and Bill Williams Creeks on the northeastern slopes of Mt. Tamalpais and enters Corte Madera Creek in the town of Ross. Phoenix Reservoir is an impassable barrier to upstream fish migration.

In January 1960, DFG visually surveyed Ross Creek from its confluence with Corte Madera Creek upstream to Phoenix Reservoir. No fish were observed at the time of the survey. However, residents reported that steelhead runs still occurred in some years (Allen 1960c). The survey report noted that prior to the construction of Phoenix Reservoir, Ross Creek was an important spawning and nursery tributary of Corte Madera Creek. Since construction of the reservoir, the stream dried out below the reservoir by mid-summer (Allen 1960c).

In August 1969, DFG electrofished a 30 meter reach near Ross Creek Park. A total of 109 *O. mykiss* (36-76 mm) were collected, yielding a density estimate of 113 per 30 meters (Jones 1969). The DFG report stated that a steelhead nursery area was available downstream from Phoenix Lake Dam extending to near the Glenwood Road Bridge, and that almost 3,000 juvenile steelhead were estimated to inhabit this reach (Jones 1969).

In July 1997, Leidy electrofished a 12 meter reach downstream from the Phoenix Park parking lot and found seven *O. mykiss* (67-180 mm FL) (Leidy 2002). Friends of Corte Madera Creek funded an electrofishing survey of Ross Creek in November 1999. Seven *O. mykiss* (82-164 mm FL) were found at one of two sites totaling 19 meters of stream sampled (Rich 1999). Steelhead YOY were also observed in Ross Creek in 2000 (Jones 2001).

In April 2002, Leidy and Lewis observed *Oncorhynchus* spp. to be common (25-200 individuals) at the entrance to Natalie Coffin Greene Park (Leidy and Lewis 2002). Two size classes of juveniles were present (~10-15 mm TL and ~25-30 mm TL). The smaller size class was identified as *O. mykiss*.

Sleepy Hollow Creek

Sleepy Hollow Creek drains Sleepy Hollow along Butterfield Road and joins with San Anselmo Creek to form Corte Madera Creek in the town of San Anselmo. As noted in a 2002-2003 passage evaluation, a box culvert at Deer Hollow Road seriously impedes upstream migration (Ross Taylor and Assoc. 2003). Modifying the culvert and removing Raven Dam, located about one mile upstream, would increase access to suitable habitat upstream substantially (Ross Taylor and Assoc. 2003).

In January 1960, DFG visually surveyed Sleepy Hollow Creek from the mouth to the headwaters and found it to be an excellent steelhead spawning and nursery area (Allen 1960e). No fish were noted during the survey, and residents reported that no steelhead run occurred in the winter immediately prior to the survey (Allen 1960e). Typically, moderate use by steelhead for spawning and rearing was expected (Allen 1960e).

A September 1969 DFG memorandum reported 1.5 miles of juvenile *O. mykiss* rearing area in Sleepy Hollow Creek with a population density of 39 per 30 meters (Jones 1969). Juvenile steelhead were reported 100 yards immediately upstream from San Anselmo Creek and from Arroyo Road Bridge upstream to a point about 200 yards upstream from Butterfield Road bridge (Jones 1969). Electrofishing caught 36 *O. mykiss* (31: 50-110 mm; 5: 115-190 mm) in a 30-meter reach. The stream was estimated to contain over 3,000 *O. mykiss* (Jones 1969).

In September 1981, a pole-seine survey was conducted upstream of the Butterfield Drive bridge. Seven *O. mykiss* (58-97 mm FL) were collected (Leidy 1984).

In October and November 1999, Friends of Corte Madera Creek funded an electrofishing survey of Sleepy Hollow Creek. A total of 23 *O. mykiss* (65-308 mm FL) were found at 11 of 39 sites that represented 378 meters of stream sampled (Rich 1999). Steelhead YOY also were observed in Sleepy Hollow Creek in 2000 (Jones 2001).

San Anselmo Creek

San Anselmo Creek is fed by several tributaries near the town of Fairfax. It joins Sleepy Hollow Creek in the town of San Anselmo and forms Corte Madera Creek. The Saunders Avenue crossing was noted as a migration impediment of high priority for modification in a 2002-2003 fish passage evaluation (Ross Taylor and Assoc. 2003). Both an existing fish ladder and the concrete channel reach immediately downstream appear to impede migration.

Oncorhynchus mykiss were collected from San Anselmo Creek in the town of San Anselmo in 1936. At this location, the stream was described as well shaded with no period of excessive dryness (Fry 1936).

Staff from DFG surveyed San Anselmo Creek in January 1960 between the mouth and 0.25 miles above the Cascade Creek confluence. No fish were observed, but the survey report noted local residents' accounts that moderate steelhead runs occurred approximately every other year (Allen 1960d). At least 90 percent of the nursery area was reported to be located in the lower half of the stream (Allen 1960d).

San Anselmo Creek was electrofished by DFG in August 1969 at the Pastori Avenue Bridge. A total of 183 *O. mykiss* (175: 41-110 mm; 8: 115-140 mm) were collected in a 30-meter reach, resulting in a population density estimate of 219 per 30 meters (Jones 1969). Steelhead juveniles were said to inhabit the two miles of the creek between the confluence with Fairfax Creek and the Winship Avenue Bridge (on Corte Madera Creek just upstream from its confluence with Ross Creek). The steelhead population in San Anselmo Creek was estimated to be more than 23,000 individuals (Jones 1969).

In July 1997, Leidy electrofished a ten-meter reach of San Anselmo Creek at a diversion dam near the end of Pacheco Avenue. He found four *O. mykiss* ranging in size from 73-140 mm FL (Leidy 2002).

Friends of Corte Madera Creek funded an electrofishing survey of San Anselmo Creek that occurred in September and October 1999. A total of 97 *O. mykiss* (43-198 mm FL) were found at 12 of 24 sites that represented 216 meters of stream sampled. Sixty-seven of the *O. mykiss* were found in the headwaters at three sites (a combined 18.3 meters of sampled reach) above the confluence with Cascade Creek (Rich 1999). Five juvenile *O. mykiss* (75-90 mm FL) were observed in a shallow isolated pool just upstream from the bridge on Meadow Way in July 2003 (Harvey 2003).

Fairfax Creek

Fairfax Creek is a tributary to San Anselmo Creek that flows generally south to enter San Anselmo Creek in the town of Fairfax. It consists of about 2.5 miles of channel. A 2002-2003 fish passage assessment noted a 458-foot box culvert immediately upstream

from the confluence with San Anselmo Creek at Bolinas Avenue. Although a serious impediment to fish passage, the culvert was listed as a lower priority modification project than others in the watershed due to high cost (Ross Taylor and Assoc. 2003).

In January 1960, DFG visually surveyed Fairfax Creek from the mouth to the headwaters. No fish were observed during the survey. The DFG report noted that the creek was a steelhead spawning and nursery tributary that had largely been destroyed by lowering of the water table through heavy groundwater pumping (Allen 1960b).

A 1969 DFG survey of steelhead in Corte Madera Creek and its tributaries concluded that the culvert at the mouth of Fairfax Creek was a passage barrier that precluded use by steelhead. No direct observations were made on the creek (Jones 1969).

In July 1997, Leidy electrofished a site immediately downstream of the Fairfax Park footbridge and found no *O. mykiss* (Leidy 2002). In 2002, Marin County staff noted *O. mykiss* in Fairfax Creek believed to be resident (L. Lewis pers. comm.).

Cascade Creek (Corte Madera Creek watershed)

Cascade Creek is the uppermost headwater tributary to San Anselmo Creek. It drains the south face of White Hill and enters San Anselmo Creek from the north. Cascade Falls is a natural barrier that limits use by steelhead to the lower 0.4 mile of Cascade Creek.

In September 1969, DFG visually estimated the density of *O. mykiss* in Cascade Creek at 98 per 30 meters (Jones 1969). Steelhead were said to occur from the Cascade Creek falls downstream to the confluence with San Anselmo Creek (Jones 1969). The estimated number of *O. mykiss* in Cascade Creek was almost 1,300 (Jones 1969).

Friends of Corte Madera Creek funded an electrofishing survey of Cascade Creek that occurred in September 1999. A total of 26 *O. mykiss* (39-152 mm FL) were found at the three sites sampled that represented a combined length of 19 meters (Rich 1999).

Assessment: The Corte Madera Creek watershed historically supported steelhead runs and continues to support *O. mykiss* populations in its main stem and in various tributaries. The most important Corte Madera Creek tributary in terms of salmonid production appears to be San Anselmo Creek. In 1960, DFG determined that San Anselmo Creek contained much of the spawning and rearing habitat in the Corte Madera Creek watershed (Allen 1960d). Abundance estimates reported by DFG in 1969 suggested that San Anselmo Creek supported about 75 percent of the juvenile *O. mykiss* believed to occur in the drainage (Jones 1969). Other tributaries with steelhead populations are Ross, Sleepy Hollow and Cascade Creeks.

Sampling within the last ten years consistently indicates multiple *O. mykiss* age classes in the Corte Madera Creek watershed, suggesting good natural propagation. This drainage appears to have considerable ecological importance to Marin County and to the San Francisco Estuary in general for its ability to contribute regionally to steelhead numbers. Efforts to improve fish passage in the Corte Madera Creek channel would allow in-migration to suitable spawning and rearing habitat in Corte Madera Creek tributaries.

Miller Creek Watershed

Miller Creek drains an area of 12 square miles with headwaters above the Gallinas Valley and proceeds through the town of Marinwood, entering San Pablo Bay at John F. McInnis County Park.

Miller Creek

In September 1981, four sites on Miller Creek were electrofished as part of a fish distribution study. At a site upstream from the junction of Lucas Valley Road and Sequeira Road, more than 50 *O. mykiss* (38-86 mm FL) were caught. Seven *O. mykiss* (48-162 mm FL) with silver coloration were found at Las Gallinas Avenue (Leidy 1984).

In July 1993, Leidy electrofished Miller Creek and found *O. mykiss* at four out of five locations (Leidy 2002). He found one *O. mykiss* (179 mm FL) in a pool upstream from Las Gallinas Avenue. Downstream of the Miller Creek Road crossing in Marinwood Park he caught three *O. mykiss* (126, 129, 150 mm) in a 16-meter reach and estimated density at five per 30 meters of stream. Upstream of the lowest Lucas Valley Road crossing, a 30-meter reach yielded four *O. mykiss* (63-254 mm). Downstream from the Upper Lucas Valley Road crossing, a 46-meter reach produced 13 *O. mykiss* (69-157 mm). Leidy found no *O. mykiss* when he electrofished immediately upstream from Hwy. 101 (Leidy 2002). At least four *O. mykiss* age classes were identified in Miller Creek.

In June 1997, Leidy again electrofished Miller Creek upstream from Highway 101. He found two *O. mykiss* (170, 225 mm FL), and estimated their population density at five per 30 meters (Leidy 2002). Leidy also caught 15 *O. mykiss* (50-80 mm) downstream from Mt. Shasta Drive, where he estimated density at 20 per 30 meters of stream. In October 2001, NMFS electrofished Miller Creek downstream of the Mt. Lassen Drive Bridge. A total of 87 *O. mykiss* were recorded with a size range of 55-201 mm FL (Fish et al. 2001).

Assessment: The Miller Creek drainage suffers from a shortage of survey information, although *O. mykiss* clearly inhabited the watershed historically and populations have been found in recent sampling. Multiple age classes occur in Miller Creek, and *O. mykiss* production from the system is likely to constitute a relatively small but important part of regional production. The habitat function of this creek system should be protected to ensure continued contribution to the regional fishery.

Pacheco Creek Watershed

Pacheco Creek originates on the eastern end of Big Rock Ridge and flows east to Highway 101, where it turns north, entering Novato Creek at Pacheco Pond in the town of Ignacio. The Pacheco Creek watershed is about 2.1 square miles.

Pacheco Creek

In September 1981, Miller Creek was electrofished as part of a fish distribution study at Alameda del Prado immediately upstream from Highway 101. No *O. mykiss* were found (Leidy 1984). According to Marin County PWA staff, salmonids presently do not use Pacheco Creek (L. Lewis pers. comm.).

Assessment: Pacheco Creek is not is not used presently by salmonids.

Arroyo San Jose Watershed

Arroyo San Jose is formed by two streams draining the northeastern slopes of Big Rock Ridge, south of the town of Novato. The arroyo's watershed is about 5.7 square miles. It enters a lagoon known as Bel Marin Keys in the town of Ignacio, which is connected to San Pablo Bay by the historic Novato Creek channel and a series of canals within Hamilton Airforce Base. A 2002-2003 fish passage evaluation noted two areas of concrete flood control channel and weirs, both near Ignacio Boulevard, as creating "impassable condition for all species and life stages" (Ross Taylor and Assoc. 2003).

Arroyo San Jose

In September 1981, two sites on Arroyo San Jose were electrofished as part of a fish distribution survey. Three *O. mykiss* (61, 149, 161 mm FL) were found at Enfrente Boulevard, while no fish of any kind were found at Indian Way. (Leidy 1984).

In June 1997, Leidy electrofished Arroyo San Jose opposite the Novato Business Park, at the end of Digital Drive. No *O. mykiss* were found. However, adult steelhead were observed in Arroyo San Jose in 2000 and 2001 (Jones 2001).

Assessment: This relatively small watershed has been found to support multiple age classes of *O. mykiss* in the past and recent observations of adult spawners suggest current use, although successful hatching and rearing of juveniles has not been verified. Further investigation is recommended to inform management of the drainage as salmonid spawning and rearing habitat.

Novato Creek Watershed

This is the northernmost Marin County watershed as well as the largest drainage in the county covering 44 square miles. Novato Creek drains into a lagoon known as Bel Marin Keys and then flows east to enter the Estuary immediately south of the Highway 37 bridge near Black Point.

Novato Creek

As part of a fish distribution study, Novato Creek was sampled by pole seine and dip net during September, 1981. No *O. mykiss* were found at the three locations sampled between 7th Street in downtown Novato and the Novato Reservoir spillway (Leidy 1984).

Leidy electrofished seven sites on Novato Creek in June 1997. He found one *O. mykiss* (195 mm FL) in a 15-meter reach downstream from Diablo Avenue (Leidy 2002). In a ten meter reach along Hicks Valley Road approximately one mile below Stafford Lake Dam, he caught two *O. mykiss* (90, 130 mm). Immediately upstream he found four *O. mykiss* (55-65 mm) in a 30-meter reach. No *O. mykiss* were found when electrofishing at a 15 meter reach at the upper end of tidal influence, at a 20 meter reach immediately below the water treatment plant discharge at Stafford Lake Dam, or at a 12 meter reach above Stafford Lake (Leidy 2002).

In July 1997, Leidy electrofished a 30 meter reach at Hicks Valley Road within Miwok Park and caught 12 *O. mykiss* (52-152 mm) (Leidy 2002). Adult steelhead were observed in Novato Creek in 2000 and 2001 (Jones 2001). In April 2002, Leidy and Lewis observed abundant (>200 individuals) *O. mykiss* juveniles (25-35 mm TL) in a reach extending from the confluence with Bowman Canyon Creek downstream 150 meters (Leidy and Lewis 2002).

Arroyo Avichi

Arroyo Avichi flows northeast off the north slope of Big Rock Ridge and covers 1.8 square miles. Arroyo Avichi was sampled by dipnet at South Novato Boulevard in September 1981 as part of a fish distribution survey. No fish of any kind were found (Leidy 1984).

Warner Creek

Warner Creek is formed by the confluence of Vineyard Creek and Wilson Creek in the town of Novato. It flows east approximately 1.5 miles parallel to Novato Creek before the two creeks merge. Warner Creek was sampled by dip net and pole seine at McClay Road and at Diablo Road as part of a September 1981 fish distribution survey. No *O. mykiss* were encountered at either location (Leidy 1984).

Vineyard Creek

Vineyard Creek drains an area of 1.7 square miles. The creek flows northeast off the northwestern end of Big Rock Ridge, joining with Wilson Creek to form Warner Creek in the city of Novato.

In April 2002, Leidy and Lewis observed abundant (>200 individuals) *O. mykiss* juveniles (20-30 mm TL) in a reach extending 100 meters upstream from Mill Road (Leidy and Lewis 2002). Leidy also observed *O. mykiss* juveniles (25-30 mm TL) to be common (25-200 individuals) downstream from the concrete apron at the intersection of Santa Maria Drive and Brooke Drive. No fish were observed upstream of this concrete apron/invert, suggesting that it posed a complete barrier to upstream movement of fish.

Bowman Canyon Creek

Bowman Canyon Creek flows south out of Bowman Canyon, joining Novato Creek west of the city of Novato. In September 1981, Bowman Canyon Creek was sampled upstream of Hicks Valley Road by dip-net as part of a fish distribution survey. Three *O. mykiss* (61, 82, 86 mm FL) were collected (Leidy 1984). Steelhead YOY were observed in Bowman Canyon Creek in 1998 (Jones 2001). In April 2002, Leidy and Lewis observed *O. mykiss* juveniles (20-30 mm TL) to be common (25-200 individuals) from Novato Boulevard downstream to the confluence with Novato Creek (Leidy and Lewis 2002).

Assessment: The Novato Creek watershed has not been sampled adequately, although it certainly supported, and continues to support, anadromous *O. mykiss* populations. Multiple *O. mykiss* age classes have been found during recent sampling, and the drainage appears to offer spawning and rearing habitat despite being the driest of the Marin County drainages.

Table VII-2. Distribution status of *O. mykiss* in San Francisco Estuary streams of Marin County, California^a

Watershed	Stream/ Tributary	Yrs. Surveyed/ Quant. Data	Max. Period of Record	Data Type	Life Hist. Stage/ No.Yrs. Data	Anad. Life-Cycle Possible	O. mykiss		Evidence of Pop. Decline	Current Pop. Status	References (Pers. Comm.)
							Hist.	Current			
Coyote Creek	Coyote	1/0	0 1981	0, 1, 3	-	N	PB	NP	Y	0	15, 16 (1)
Arroyo Corte Madera del Presidio	Arroyo Corte Madera del Presidio	6/6	1946- 97	1, 2, 3	J/6; R/2	Y	DF	DF	Y	1, 2, 3	6-8, 15, 16, 20, 22, 24
	Willow Reed	1/0	1870s- 2004	1	J/1	Y	DF	DF	-	1,2,3	21 (2)
	Warner	3/1	1963 2004	1, 3	J/2	Y	DF	DF	Y	1, 2, 3	6, 17 (2)
	Old Mill	5/4	1946- 97	1, 2, 3	J/5; R/2	Y	DF	DF	Y	1, 2, 3	6, 14-16, 20, 22, 25
	Cascade	5/1	1963- 97	1, 2, 3	J/2	Y	DF	DF	Y	1, 2, 3	6, 15, 16, 20
Corte Madera Creek	Corte Madera	17/10	1960- 99	0, 1, 2, 3	J/11; R/1	N	DF	DF	Y	1, 2, 3	1, 8, 9, 13, 15, 17-19, 20, 21, 23
	Larkspur	1/1	1981	3	J/1	UNK	DF	UNK	-	0	15
	Tamalpais	3/2	1969- 2002	1, 2	J/3	N	DF	DF	Y	1, 2, 3	13, 14, 17
	Murphy	1/0	0 2002	1	-	N	UNK	UNK	-		17
	Ross	6/3	1960- 2002	0, 1, 2	J/4; R/1	N	DF	DF	Y	1, 2, 3	3, 13, 14, 16, 17, 21
	Sleepy Hollow	4/3	1960- 99	0, 2, 3	J/3; R/2	N	DF	DF	Y	1, 2, 3	5, 13-15, 16, 21

Watershed	Stream/ Tributary	Yrs. Surveyed/ Quant. Data	Max. Period of Record	Data Type	Life Hist. Stage/ No.Yrs. Data	Anad. Life-Cycle Possible	O. mykiss		Evidence of Pop. Decline	Current Pop. Status	References (Pers. Comm.)
							Hist.	Current			
	San Anselmo	5/4	1936- 2003	1, 2	J/4; R/1	N	DF	DF	Y	1, 2, 3	4, 11-13, 16, 21
	Fairfax	3/0	1960 2002	1	J/1	N	DF	DF	Y	1, 2, 3	2, 13, 17 (2)
	Cascade	2/2	1969- 99	1, 2	J/2	N	DF	DF	Y	1, 2, 3	4, 14, 21
Miller Creek	Miller	4/4	1981- 2001	2	J/4; S/1; R/3	Y	DF	DF	Y	1, 2, 3,	10, 15, 16
Pacheco Creek	Pacheco	1/0	0 1981	2	-	N	PS	NP	-	0	15 (1)
Arroyo San Jose	Arroyo San Jose	3/2	1981- 2001	2	J/1	Y	DF	DF	Y	1	14, 15
Novato Creek	Novato	3/1	1997- 2002	2	J/2	Y	DF	DF	Y	1, 2, 3	14-17
	Arroyo Avichi	1/0	0 1981	3	-	UNK	UNK	UNK	-	0	15
	Warner	1/0	0 1981	3	-	UNK	UNK	UNK	-	0	15
	Vineyard	1/0	2002	1	J/1	Y	DF	DF	-	1, 2, 3	17
	Bowman Canyon	2/1	1981- 2002	1, 2	J/2	Y	DF	DF	Y	1, 2, 3	14, 15, 17

^a Table headings and codes are defined in the Methods section of this report.

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Personal Communications

1. Lewis, L., telephone conversation with G. Becker, CEMAR, September 12, 2003, 2003, regarding salmonid population and habitat observations for Marin County.
2. Lewis, L., interview with G. Becker, CEMAR, May 25, 2005, regarding *O. mykiss* distribution in Marin County streams.

MARIN COUNTY MAPS

Historical status of *Oncorhynchus mykiss* in streams of Marin County, California.

Current status of *Oncorhynchus mykiss* in streams of Marin County, California.

