PETER B. MOYLE
Department of Wildlife, Fish, and Conservation Biology
University of California
Davis, California

PAUL J. RANDALL
Department of Wildlife, Fish, and Conservation Biology
University of California
Davis, California

RONALD M. YOSHIYAMA
Department of Wildlife, Fish, and Conservation Biology
University of California
Davis, California

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Potential Aquatic Diversity Management Areas in the Sierra Nevada

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INTRODUCTION

This chapter is a supplement to the chapter by Moyle in SNEP Volume 2, called "Options for the conservation of aquatic biodiversity in the Sierra Nevada." One of the main options discussed is the establishment of a system of Aquatic Biodiversity Management Areas (ADMAs), consisting of two main types of ADMAs: watersheds and Significant Natural Areas (SNAs). The "Options" chapter should be consulted for definitions and descriptions of the the two types of ADMAs and how the examples presented here were chosen. In this chapter, we present descriptions of 42 ADMA watersheds (Table 1) that were selected for their representativeness of habitat conditions throughout the range and for their ability to support native aquatic organisms. We also present three descriptions of potential SNAs, as examples of a much more extensive system that needs developing..

The 42 ADMA watershed accounts constitute a catalog of potential ADMA watersheds for the Sierra Nevada. Each entry in the catalog presents a short description of the watershed to indicate why it has been chosen for inclusion in the ADMA watershed system. This catalogue should be considered to be a starting place for the development of a representative system of watersheds given special management to maintain aquatic biodiversity in the Sierra Nevada. Suggestions for additions and deletions are welcome, as is additional information on the watersheds proposed here.

We emphasize that all watersheds in the Sierra Nevada should be managed as if biodiversity matters. This catalog is designed, however, to help set priorities for biodiversity management, given limited resources.

Table 1. Potential ADMA watersheds of the Sierra Nevada region.

WEST SIDE DRAINAGES

Sacramento River Tributaries

1. Antelope Creek
2. Dye Creek
3. Mill Creek
4. Pine Creek
5. Deer Creek
6. Big Chico Creek

Feather River Drainage

7. Yellow Creek
8. Middle Fork Feather River

Yuba River Drainage

9. Lavezolla Creek/Downey River

American River Drainage

10. North Fork, American River
11. Rubicon River above Hell Hole Res.
12. Jones Fork of Silver Fork (above Union Valley Reservoir)
13. Rock Creek

Cosumnes River Drainage

14. Entire drainage

Calaveras River Drainage

15. North Fork Caleveras River

Mokelumne River Drainage

16. North Fork, Mokelumne River

Stanislaus River Drainage

17. North Fork, Stanislaus River
18. South Fork, Stanislaus River above Pinecrest Reservoir
19. Rose Creek

Tuolumne River Drainage

20. Clavey River
21. South Fork, Tuolumne River

Merced River Drainage

22. Entire drainage above McClure Reservoir

Upper San Joaquin Drainage

23. Mariposa Creek above Mariposa Reservoir
24. East Fork, Chowchilla River
25. Finegold Creek

Kings River Drainage

26. Rancheria Creek
27. South and Middle Forks, Kings River

Tule River Drainage

28. North and Middle Forks, Tule River

Kaweah River Drainage

29. South Fork, Kaweah River

Tulare Lake Foothill Drainages

30. Deer Creek

Kern River Drainage

31. Kern River above Isabella Reservoir
32. North Fork, Kern River
33. South Fork, Kern River

EAST SIDE DRAINAGES

Eagle Lake Drainage

34. Entire drainage, including Pine Creek

Susan River/Honey Lake Drainage

35. Willow Creek

Truckee River Drainage

36. Upper Little Truckee River
37. Sagehen Creek

Carson River Drainage

38. East Fork, Carson River

Walker River Drainage

39. West Walker River drainage
40. Buckeye Creek

Mono Lake Basin

41. Mono Lake

Owens River Drainage

42. Convict Creek

ADMA WATERSHED

Name: Antelope Creek **Drainage:** Sacramento

Cal Watershed No.: 509.63000 **County:** Tehama

Location: Entire drainage from headwaters on Turner Mountain to its mouth on the Sacramento River, just south of Red Bluff.

Elevation: 70 to 2079 m; mean 1074 m **Drainage Area:** 374 km^2

Description: Antelope Creek is a three-forked stream draining the slopes of Turner Mountain; its north fork begins at Pear Lake, the middle fork at Diamond Lake and the south fork originates on the southeast slope of Turner Mountain. It flows through dense conifer forest in its upper reaches, drops rapidly through a deep shady canyon lined with conifers, and continues through oak woodland and grassland where it leaves the Lassen National Forest. Deep pools in the reach between Paynes Place and the NF and SF confluence provide limited holding habitat for spring run chinook salmon. The stream then flows through the Tehama Wildlife Refuge Management Area and eventually into the Sacramento Valley, through land which is occupied by privately owned ranchland and orchards. Multiple diversions are present in the lowermost reach, resulting in reduced water flows in the spring and summer. The channel is highly braided in the lower reaches and finally reaches the Sacramento River in several locations.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2120 Conifer forest snowmelt stream; A2140 Foothill canyon ephemeral stream; A2412 Forest stream; A2413 Spring stream; A2421 Resident rainbow trout stream; A2422 Rainbow trout/cyprinid stream; A2431 Spring run chinook stream; A2442 Fall run chinook spawning stream; A2443 Hardhead/squawfish stream.

Native Fishes: Spring run chinook salmon (R), fall run chinook salmon (R), rainbow trout (A), Pacific lamprey (R), squawfish (C), hardhead (R), Sacramento sucker (C), riffle sculpin (C), speckled dace (C) and California roach (C).

Amphibians: Foothill yellow-legged and California newts present in Indian Creek, tributary to Antelope Creek. Overall status of amphibians in Antelope Creek is uncertain, but populations are likely where habitat is suitable.

Other Vertebrates: Beaver present. Western pond turtle, aquatic garter snake also reported on Indian Creek. Important corridor for Tehama deer herd and golden eagle nesting habitat.

Invertebrates: Summer sampling in the upper reaches found macroinvertebrates neither diverse nor abundant. A cursory survey of Indian Creek indicated many species of aquatic insects present.

Riparian: Upper reaches of Antelope Creek banded by thin strip of alders, dogwoods, cedars, willows, firs, leafy emergents and grasses. Riparian woodland for lower half of Indian Creek described in ecological survey by Keeler-Wolf.

Human Impacts: Logging (clearcuts are present), cattle grazing, and recreation (fishing, camping) impact upper drainage. There are 4WD roads throughout most of the watershed, but stream access is mostly limited to foot trails. In the lower reaches, water diversions reduce flow during spring and summer, reducing access for anadromous fishes and providing habitat for introduced fishes. Grazing, agriculture, roads, and other land uses have greatly altered lowermost reaches of creek.

Ownership: Upper drainage mostly in Lassen National Forest, some private lands; lower drainage is mostly privately owned with a small area managed by the state (Tehama Wildlife Refuge).

Existing Protection: Fishing is limited to catch and release only in Tehama Wildlife Refuge. Indian Creek is managed by USFS as a Research Natural Area.

IBI Score: 80

Significant Natural Area (Aquatic): Indian Creek

Overall Quality Rating: 2.4 above diversions; 2.8 for valley floor reach; 2.0 for Indian Creek.

Reasons for Rating: A relatively modest sized drainage with no dams but considerable impacts from logging, grazing and roads. A small population of spring run chinook still spawns in this creek. It is the northernmost tributary to Sacramento River that supports a spring chinook spawning run before Red Bluff Diversion Dam. Indian Creek drainage is a nearly pristine habitat containing threatened foothill yellow-legged frogs and other native aquatic organisms.

Notes: Antelope forms a cluster of spring run chinook streams with Deer, Antelope, and Butte Creeks and is part of a group of Sacramento River tributaries dominated by native fishes.

UCD Surveys?: Yes, most recently in 1993.

Sources:
1.Lassen National Forest Management Plan, Appendix E: Wild and Scenic Rivers Evaluation.
2. Keeler-Wolfe, T. 1990. Ecological Surveys of Forest Service Research Natural Areas in California, Technical Report PSW-125.

Date of Compilation: 19 December 1994 **Compiler:** PR & PBM

ADMA WATERSHED

Name: Mill Creek **Drainage:** Mill Creek

Cal Watershed No.: 509.42000 **County:** Tehama

Location: Entire drainage from headwaters in Lassen National Park to Sacramento River.

Elevation: 65 to 3130 m; mean 1597 m

Drainage Area: 402 km^2

Description: Mill Creek headwaters include hot mineral-laden water from springs in Lassen Volcanic National Park and small, high gradient streams in heavily forested areas.These tributaries coalesce in Mill Creek Meadows, where the creek is a meandering meadow stream. The creek then flows along Highway 172 through a heavily used mixed conifer forest before plunging into a deep canyon, which flows in part through the Ishi Wilderness Area. The upper canyon contains deep pools that harbor spring run chinook salmon, while the lower canyon is remarkably deep, narrow, and swift. The valley reaches flow through private ranchland and orchards and the creek is diverted at several places so little flow reaches the Sacramento River. The lower reaches are also altered

by channelization and contain smallmouth bass and other exotic fishes. They are also important spawning areas for fall run chinook and other migratory fishes.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2120 Conifer snowmelt stream; A2140 Foothill/canyon ephemeral stream; A2412 Forest stream; A2413 Spring; A2416 Hot springs outflow; A2421 Resident rainbow trout; A2431 Spring run chinook stream; A2442 Fall chinook spawning stream; A2443 Hardhead/squawfish stream.

Native Fishes: Fall run chinook salmon (R), spring run chinook salmon (R), Pacific lamprey (R), rainbow trout (A), Sacramento squawfish (C), hardhead (R), Sacramento sucker (C), California roach (C), riffle sculpin (C).

Amphibians: Cascade frogs, foothill yellow-legged frogs, Pacific tree frogs, California newts.

Other Vertebrates: Pacific pond turtles, aquatic garter snakes.

Invertebrates: Abundant and diverse.

Riparian zone: Mostly in good condition, except in lowermost reaches. Oaks, cottonwood, willow, and sycamores grow along the lower reaches of the creek. Foothill pine and chaparral vegetation is common in the middle reaches. Mixed conifer is found in the upper reaches.

Human Impacts: Logging, cattle grazing, camping and fishing all occur in USFS lands. Access to middle reaches of Mill Creek is limited to foot trails, providing some natural protection. Mill Creek meadows has been heavily grazed. Water diversions in lower reaches significantly reduces flow so little water reaches the Sacramento River in the summer. Clough Dam represents a partial barrier to movements of migratory fish. Town of Los Molinos is along the last km or of stream. Introduced fishes are present in lower reaches.

Ownership: Headwaters are in Lassen National Park. About half the upper drainage is in Lassen National Forest, including the Ishi Wilderness Area in the lower elevations. Below the USFS boundary the land is all privately owned.

Existing Protection: National Park manages headwaters; Ishi Wilderness Area in middle reaches. The Nature Conservancy has a conservation easement on Mill Creek meadows.

Significant Natural Areas (Aquatic): None described.

Overall Quality Rating: 2.1 above valley floor; 2.8 on valley floor.

Reasons for Rating: Mill Creek has no dams or diversions except in its lowest reach. Native fish communities are still present including spring run chinook salmon.

IBI Score: 93

Notes: Spring run chinook salmon probably qualify as a threatened species under both state and federal law, but efforts are now underway to protect its populations without listing. A Mill Creek Conservancy has been formed by private landowners to develop conservation plans for the watershed.

UCD Surveys?: Yes. Survey of entire drainage done in 1987.

Sources:

Wild and Scenic River Evaluation; EIS for Forest Plan, Lassen National Forest.

Sato, G. S. and P. B. Moyle. 1988. Survey for fish populations on Deer and Mill Creeks, unpublished report.

Date of Compilation: 23 December 1994 **Compiler:** PR and PBM

ADMA WATERSHED

Name: Dye Creek **Drainage:** Upper Sacramento River

Cal Watershed No.: 509.62000 **County:** Tehama

Location: Entire drainage from headwaters to Sacramento River.

Elevation Range: 67 to 700 m; mean 383 m

Drainage Area: 105 km^2

Description: Dye Creek is a small foothill drainage sandwiched between the Mill Creek and Antelope Creek watersheds. It has two main forks, both in deep lava-walled canyons that are cool enough to support trout populations. There is a well-developed, if narrow, corridor of riparian trees and vines along the creek. During summer, the creek in the lower canyon is a trickle between pools and supports large populations of California roach and speckled dace. As the creek emerges from the canyon, there is a steep cascade that flows into a long deep pool that seems to mark the upstream limit of squawfish and hardhead. A pond on a dammed section of creek at the headquarters of the Dye Creek Preserve (TNC) serves as source of exotic fish and frogs in the drainage. The lower reaches of the creek flow through seasonal pasturelands and sections of it are rip-rapped. The reach just above the Sacramento River is used seasonally as a rearing area for juvenile chinook salmon and other riverine fishes.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2140 Foothill/canyon ephemeral stream; A2412 Forest stream; A2413 Spring; A2421 Resident rainbow trout; A2442 Fall chinook spawning stream (?); A2443 Hardhead/squawfish stream.

Native Fishes: Fall run chinook salmon (R), Pacific lamprey (?), rainbow trout (C), Sacramento squawfish (C), hardhead (?), Sacramento sucker (C), California roach (A), speckled dace (A).

Amphibians: Bullfrogs abundant in lower canyon, but native frogs may be present higher. California newts.

Other Vertebrates: Pacific pond turtles, aquatic garter snakes.

Invertebrates: In a cursory survey (June 1995), they did not appear to be particularly abundant or diverse.

Riparian zone: Mostly in good condition, except in lowermost reaches. Oaks, cottonwood, willow, fig (non-native) and sycamores grow along the lower reaches of the creek. Foothill pine and chaparral vegetation is common in the middle reaches. Condition of riparian zone is improving because of TNC management practices.

Human Impacts: Cattle grazing and hunting (mainly pigs) have been the principal activities in the past, which have been continued by TNC, although at a reduced level. Water diversions in lower reaches probably reduce

flow so little water reaches the Sacramento River in the summer. Introduced fishes and frogs are present in lower reaches and a pond at the TNC headquarters is probably a major source.

Ownership: Almost the entire drainage is owned by The Nature Conservancy, with exception of some land along the lower most reaches.

Existing Protection: The Nature Conservancy manages the watershed as both as reserve and as a working cattle ranch.

Significant Natural Areas (Aquatic): None described

Overall Quality Rating: 2.1 above ranch headquarters; 2.8 below.

Reasons for Rating: Dye Creek has no dams or diversions except in its lowest reach. Native fish communities are still present, although bullfrogs seem to dominate the amphibian community.

IBI Score: 80

Notes: TNC welcomes research on their land.

UCD Surveys?: Yes. Quick survey of lower drainage done in June, 1995 by R. L. Leidy and P. B. Moyle.

Sources: Paul Maslin, CSU Chico, personal communication; George Stroud, TNC.

Date of Compilation: 16 July 1995 **Compiler:** PBM

ADMA WATERSHED

Name: Pine Creek **Drainage:** Upper Sacramento R.

Cal Watershed No.: 509.16000 **County:** Tehama

Location: Entire drainage from headwaters (Bennett Spring) on Cohasset Ridge to Sacramento River.

Elevation: 55 to 1220 m; mean 637 m

Drainage Area: 281 km^2

Description: Pine Creek is a small foothill drainage just south of the Deer Creek drainage and north of the Big Chico Creek drainage. Typical summer flows are 0.23 m3/sec but the creek dries up in its lowermost reaches. The upper creek and its tributaries flow through a deep lava-walled canyons and is cool enough to support trout. There is a well-developed, if narrow, corridor of riparian trees and vines along the creek. During summer, the creek in the lower canyon is a trickle between pools and presumably supports large populations of California roach and speckled dace. As the creek emerges from the canyon, there is a large diversion dam over which the water plunges into a deep (4+m) pool that seems to be the upper limit to squawfish and hardhead. The lower reaches of the creek flow through seasonal pasturelands (some irrigated). The reach just above the Sacramento River is used seasonally as a rearing area for juvenile chinook salmon and other riverine fishes.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2140 Foothill/canyon ephemeral stream; A2412 Forest stream; A2413 Spring; A2421 Resident rainbow trout; A2442 Fall chinook spawning stream (?); A2443 Hardhead/squawfish stream.
Native Fishes: Fall run chinook salmon (R), Pacific lamprey (C), rainbow trout (C), Sacramento squawfish (C), hardhead (C), Sacramento sucker (C), California roach (A), speckled dace (A), riffle sculpin (C), hitch (R), tule perch (R).

Amphibians: Not known

Other Vertebrates: Not known

Invertebrates: Not known

Riparian zone: Mostly in good condition, except in lowermost reaches. Oaks, cottonwood, willow, fig (non-native) and sycamores grow along the lower reaches of the creek. Foothill pine and chaparral vegetation are common in the middle reaches.

Human Impacts: Cattle grazing and water diversions are main factors affecting watershed. Water diversions in lower reaches probably reduce flow so little water reaches the Sacramento River in the summer. Introduced fishes and probably frogs are present in lowermost reaches but not particularly abundant.

Ownership: Private, although uppermost headwater are in Lassen NF.

Existing Protection: None

Significant Natural Areas (Aquatic): None described

Overall Quality Rating: 2.1 above diversion dam (131 m elevation); 2.4 below.

Reasons for Rating: Pine Creek is dominated by native fishes, even in its lowermost reaches. Presumably the rugged country through which it flows limits access of both people and cattle to much of the stream.

IBI Score: 80

Notes: Similar to nearby Dye Creek

UCD Surveys?: No

Sources:

Paul Maslin, CSU Chico, personal communication.

Grant, G. C. 1992. Selected life history aspects of Sacramento squawfish and hardhead minnows in Pine Creek, Tehama County, California. Unpublished M.S. thesis, CSU Chico. 86 pp.

Date of Compilation: 16 July 1995 **Compiler:** PBM

ADMA WATERSHED

Name: Deer Creek **Drainage:** Sacramento River

Calwater No.: 509.20000 **County:** Tehama

Location: Entire drainage from headwaters to mouth on Sacramento River north of Woodson Bridge State Recreation Area.

Elevation Range: 60 to 2389 m; mean 1224 m

Drainage Area: 540 km^2

Description: Deer Creek is the largest tributary to the lower Sacramento River without a major dam\reservoir. The headwaters are small, high gradient tributaries in mixed conifer forest, which coalesce in Deer Creek meadows. In the meadows, the creek is a meandering meadow stream that has been altered by grazing and recreational use. It then flows along Highway 32 in a heavily used (recreation, logging) ponderosa pine forest before plunging into a deep, inaccessible canyon. The lower part of the canyon reach, which flows through foothill pine-oak savannah, is in the Ishi Wilderness Area. The canyon contains deep pools that harbor spring run chinook salmon in summer and provide habitat for most of the native fishes, in a classic pattern of zonation. The lowermost reaches flow through private ranchlands and orchards, which are irrigated with creek water. Diversions in several places can dry up the creek in late summer. The lower reaches are also altered by channelization, levees, and roads but still provide spawning habitat for fall run chinook salmon and other native fishes ascending from the Sacramento River.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2120 Conifer snowmelt stream; A2412 Forest stream; A2421 Resident trout stream; A2431 Spring chinook stream; A2443 Hardhead-squawfish stream; A2442 Seasonal spawning stream.

Native Fishes: Pacific lamprey (C), fall (C) and spring run (C) chinook salmon, rainbow trout (A), hardhead (A), Sacramento squawfish (A), California roach (A), speckled dace (A), Sacramento sucker (A), riffle sculpin (A), tule perch (C).

Amphibians: Foothill yellow-legged frogs (R), cascade frogs (R), Pacific tree frogs (C), Sierra newts.

Other Vertebrates: Pacific pond turtle (P), otters (C), dippers (C).

Invertebrates: Abundant and diverse.

Riparian zone: Riparian vegetation not well-developed in most places because of steep canyons, but is typically mixed conifer. Deer Creek meadows is the largest meadow system in the drainage and has been altered by extensive grazing (few willows, etc., left). Lowermost reaches have floodplain with cottonwoods and oaks, whose condition varies with location.

Human Impacts: Roads (esp. Highways 32 and 36) affect parts of the upper drainage, providing access to anglers and campers. Upper drainage is heavily grazed, especially Deer Creek meadows, creating a degraded meadow stream and favoring exotic brown trout. Selective logging occurs throughout the drainage but impact on stream has been minimal, although roads on steep slopes are a potential problem. Diversions on lowermost reaches may create passage problems at times for salmon and other fishes, and make lower reaches uninhabitable for most native fishes. Extensive channel alteration has taken place between Sacramento River and Leninger Road. Poaching may affect salmon populations.

Ownership: About half the upper drainage is in Lassen National Forest, with a checkerboard of land ownership with private timber companies. The lowermost reaches are all on privately owned ranch and farmland.

Existing Protection: Part of the middle-lower reaches flow through the Ishi Wilderness Area. Catch and release fishing permitted only in canyon sections. Cub Creek is a USFS RNA.

Significant Natural Areas (Aquatic): Cub Creek

Overall Quality Rating: 2.2 overall. 2.1 for reaches above Leninger Road (2.3 for Deer Creek meadows) and 2.9 for valley floor reach.

Reasons for Rating: Deer Creek is still dominated by its native fish communities and is one of the last refuges for spring run chinook salmon. While the uppermost reaches are roaded and accessible, the middle reaches flow through some of the wildest country in California, especially considering the low elevations. This is the best example of a natural Sacramento River tributary stream remaining, through a combination of size and habitat variety. The lowermost reaches are highly altered but not irreversibly so, especially if summer diversions are reduced.

IBI Score: 93

Notes: Spring run chinook salmon probably qualify as a threatened species under both state and federal law, but efforts are now underway to protect its populations without listing. The Deer Creek Conservancy, an organization of landowners within the drainage, is actively seeking ways to reduce human impact on the watershed.

UCD Surveys?: Numerous because this has been a major study site for native fishes. Major survey in 1986-87.

Sources:

Baltz, D. M. and P. B. Moyle. 1993. Invasion resistance to introduced species by a native assemblage of California stream fishes. Ecol. Applications 3:246-255.

Moyle, P. B. and D. M. Baltz. 1985. Microhabitat use by an assemblage of California stream fishes: developing criteria for instream flow determinations. Trans. Amer. Fish. Soc. 114:695-704.

See also Mill Creek sources.

Date: 20 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Big Chico Creek **Drainage:** Sacramento River

Calwater No.: 509.14000 **County:** Butte and Tehama

Location: Entire drainage from Lassen National Forest near Chico Meadows to its confluence on Sacramento River.

Elevation: 50 to 1831 m; mean 940 m.

Drainage Area: 187 km^2

Description: Big Chico Creek begins in Lassen National Forest as the confluence of two small unnamed tributaries near Chico Meadows. For the first 55 km the stream flows through a deep, volcanic canyon surrounded by oak woodland in a north-south direction, adjacent to Highway 32. Deep, bedrock pools in this reach support a small number of spring run chinook salmon as well as native cyprinids. A barrier near Ponderosa Way crossing is the upstream end for salmon migration. About 8 km downstream is the Iron Canyon fish ladder which provides upstream passage for anadromous fishes. The creek then turns to the west and flows about 16 km through the Central Valley including Bidwell Park area in the City of Chico. The last few miles of stream run through ranches and farmlands where much of it gets diverted before it meets the Sacramento River. In many years there is insufficient flow for a fall run chinook spawning migration in Big Chico Creek.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2120 Conifer forest snowmelt stream; A2130 Foothill/valley ephemeral stream; A2140 Foothill canyon ephemeral stream; A2412 Forest stream; A2421 Resident rainbow trout stream; A2431 Spring chinook stream; A2442 Fall chinook spawning stream; A2443 Hardhead/squawfish stream.

Native Fishes: Fall chinook salmon (R), spring chinook salmon (R), Pacific lamprey (C), hardhead (C), Sacramento squawfish (C), Sacramento sucker (C), California roach (A), speckled dace (R), riffle sculpin (C), rainbow trout (A).

Amphibians: No records

Other Vertebrates: Yellow-billed cuckoos recorded near mouth.

Invertebrates: Benthic invertebrates were studied in detail from Ponderosa Way road crossing down to Bidwell park to see the effects of a rotenone treatment on the aquatic insects, by Paul Maslin of CSU Chico. Baseline data existed prior to treatment.

Riparian zone: Thin belt of riparian vegetation along much of stream, although some is urbanized. Bidwell Park in Chico contains excellent examples of Great Valley Mixed Riparian Forest and Valley Oak Riparian Forest. At the mouth are remnants of Great Valley Cottonwood Riparian Forest.

Human Impacts: Diversions (M & T pumps) are significant in the lower reaches causing reverse flow at the mouth of the Sacramento River during critical outmigration for salmonids, possibly directing the fish into unscreened pumps. The Iron Canyon fish ladder has been recognized as a partial barrier due to poor construction, but has been recently repaired. Rotenone treatment of lower reaches in 1986 killed most of the native fishes and recovery was slow due to drought. Smallmouth bass recolonized rapidly after treatment and have dominated in sections below Iron Canyon barrier. Recreational uses are high within Bidwell Park, including fishing, swimming and OHV use.

Ownership: Only 1 mile of the headwaters is within Lassen NF. Some land in middle reaches is managed by BLM. Downstream from USFS boundary is almost entirely private, except for Bidwell Park, managed by City of Chico.

Existing Protection: None

Significant Natural Areas (Aquatic): None identified

Overall Quality Rating: 2.3 above Iron Gate Dam; 2.5 through Bidwell Park/City of Chico; 2.9 downstream of city.

Reasons for Rating: One of the few remaining tributaries that can still support spring run chinook salmon. Lower reaches still have a native fish assemblage in foothill regions.

IBI Score: 60

Notes: Lower reaches were poisoned (rotenone) by CDFG in 1986 to benefit anadromous salmonid populations. Operation was of dubious success and mainly seemed to favor exotic smallmouth bass. This drainage is included as an ADMA despite its relatively low IBI score because of its high recovery potential.

UCD Surveys?: Yes, 1980s.

Sources:

CH2M Hill, Inc. 1993. Assessment of Big Chico Creek Salmon and Steelhead Production. Unpublished Report.

Lassen National Forest. Environmental Impact Statement of Forest Management Plan, Appendix E: Wild and Scenic Rivers Evaluation.

Maslin, P. 1987. Follow-up studies on the Rotenone Treatment of Chico Creek, Unpublished report, CSU Chico.

Maslin, P., et al. 1994. A Critical Evaluation of the Rotenone Treatment of Big Chico Creek. Unpublished report, CSU Chico.

Travanti, L. 1990. The effects of piscidal treatment on the fish community of a northern California stream. Unpublished M.S. thesis, CSU Chico. 67 pp.

Compiled: 16 July 1995 **Compiler:** PR and PBM

ADMA WATERSHED

Name: Yellow Creek **Drainage:** North Fork Feather River

Calwater No.: 518.43010-43020 **County:** Plumas

Location: Yellow Creek is a tributary to the North Fork Feather River. The confluence is along Highway 70 at the PG&E power plant. The upper and middle portions drain the mountains southwest of Lake Almanor in Lassen NF. Includes tributary Soda Creek.

Elevation: 735 to 2141 m; mean 1604 m

Drainage Area: 197 km^2

Description: Yellow Creek is a spring-fed meadow stream. The middle reaches are 3rd-4th order, with moderate gradients. The upper-middle sections (near the PG&E campground) are typical of a meadow/valley stream, consisting of a meandering channel lined with grasses and willows, having a low gradient, slow velocity, and muddy substrate. The lower-middle sections are higher velocity, medium gradient, run- and riffle-dominated sections.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1210 Alpine lake; A1240 Dystrophic pond; A2120 Conifer forest snowmelt stream; A2412 Forest stream; A2413 Spring stream; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout (C). Non-native brown trout (A) and brook trout (C) also present.

Amphibians: None seen in Yellow Creek by UCD survey crew in 1993, despite extensive searching, but native frogs probably present.

Other Vertebrates: Wolverine and goshawk reported around Green Island Lakes.

Invertebrates: Aquatic macroinvertebrates are abundant, diverse, and dominated by snails, perlid stonefly larvae, and corydalid larvae.

Riparian zone: Lake and bog type wetlands are present in headwaters of Soda Creek drainage. Wet meadows are present in much of the drainage but especially around Green Island Lakes and Soda Creek. Riparian zone often well developed, with alders, aspen, willows, and leafy emergent plants.

Human Impacts: Grazing is heavy in the upper and middle sections of Yellow Creek near the PG&E campground. Logging has occurred in the past although it is less evident in the downstream areas. Mining has been done extensively in the past and the portion of the stream nearest the campground receives heavy fishing and other recreational use.

Ownership: Lassen National Forest

Existing Protection: Green Island Lakes and Soda Ridge are USFS Research Natural Areas. Yellow Creek is managed as a wild trout stream by the California Department of Fish and Game.

Significant Natural Areas (Aquatic): Green Island Lakes, Soda Creek

Overall Quality Rating: 2.5 Yellow Creek; 2.1 Soda Creek and Green Island Lakes

Reasons for Rating: Yellow Creek is a fairly typical Sierra drainage in that it has been heavily used by for grazing, logging, mining, recreation, etc. However, its unique attributes (e.g. springs, Soda Creek, meadows) are gradually being recognized and improvements are happening.

IBI Score: 68

Notes: Soda Creek is relatively inaccessible and needs to be surveyed for amphibians and other organisms. Yellow Creek has an excellent reputation for its wild trout fishery.

UCD Surveys?: Yes, 1993.

Sources:

Keeler-Wolf, T. 1990. Ecological surveys of Forest Service Natural Areas in California. PSW Tech. Rpt. 125.

Date: 27 December 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: Middle Fork Feather River **Drainage:** Feather River

Calwater No.: 518.3000 **County:** Butte, Plumas

Location: From Oroville Reservoir upstream 175 km. to headwaters in Sierra Valley.

Elevation: 305 to 2631 m; mean 1653 m

Drainage Area: 2919 km^2

Description: The Middle Fork begins in the flat, agricultural Sierra Valley, into which flow numerous small tributaries. The river in this area consists of a series of parallel but meandering channels (many of them channelized) on the valley floor, many of which are dry in summer. Collectively, the Sierra Valley above Portola contains 200 km of trout stream, 50 km of warmwater stream and at least 160 km of canals and sloughs. Also present are one natural lake, and two major reservoirs (Frenchman Reservoir, Davis Reservoir). Some water from the Truckee River is diverted into the Valley via a canal.

Between the mouths of Big Grizzly Creek and Sulphur Creek (at Clio), the Middle Fork is generally a low gradient, slow moving river with mostly warm water fishes, including several exotic species. Sulphur Creek is a cold spring-fed tributary containing a large wild trout population in addition to native cyprinids. The river below Clio runs through flat pastures in Mohawk Valley and is typically warm water containing few trout. Between Graeagle and Nelson Point the stream gradient increases, channel becomes more narrow, and cooler waters support more trout and fewer cyprinids. River is very developed along this reach and road access creates heavy fishing pressure.

Nelson Creek is a major tributary that enters near the top of the Middle Fork canyon and contains a large population of wild rainbow trout. The lower reaches contain numerous pools and spawning gravel, making it one of the most important spawning tributaries of the Middle Fork. Below Nelson Creek, the Middle Fork drops into a canyon with some reaches containing steep granitic walls over 600 m high and numerous cascades. Wild rainbow trout are the dominant species with native nongame fish present in small numbers. This section of river has good water quality, high aquatic insect production and an abundant rainbow trout population. The Middle Fork then empties into Oroville Reservoir. The Fall River enters the Middle Fork near its mouth on Oroville, cascading over Feather Falls (206 m high); it may deserve status as a separate ADMA.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1210 Alpine lakes; A2120 Conifer forest snowmelt stream; A2130 Foothill/valley ephemeral stream; A2412 Conifer forest stream; A2413 Spring; A2414 Meadow stream; A2421 Resident rainbow trout stream; A2422 Rainbow trout/cyprinid stream; A2443 Hardhead/squawfish stream; A2446 Squawfish/sucker spawning stream.

Native Fishes: Sacramento squawfish (C), Sacramento sucker (C), hardhead (P?), California roach (?), speckled dace (C), riffle sculpin (C), rainbow trout (A).

Amphibians: No amphibians were seen by UCD survey crew sampling Nelson Creek in 1993 but native frogs should be present.

Other Vertebrates: Waterfowl habitat in Sierra Valley.

Invertebrates: Moderately diverse and abundant in Nelson Creek.

Riparian Zone: Sierra Valley was presumably once a continuous marsh/meadow. Today, freshwater marshes are located in scattered areas on the west side of Sierra Valley and in the Marble Hot Springs area. Riparian vegetation of the Sierra Valley is typically willow, alders, cottonwoods and grasses. Canyon is steep sided with little room for riparian vegetation.

Human Impacts: Oroville Dam cuts off access of chinook salmon and steelhead to drainage. Grazing and water diversion is extensive in Sierra Valley; riparian zone and freshwater marsh habitats have been reduced. Introduced fish species are common in the Valley and Upper Middle Fork. Northern pike were introduced illegally into Frenchman Reservoir and it is not certain whether or not eradication efforts by CDFG were successful. Lahontan redside, mountain sucker, and other fishes from the Great Basin have been introduced via an irrigation canal from the Little Truckee River. Two upper drainages have dams on them. Recreational use, including fishing, is high for middle and upper reaches and in the tributary streams. Logging has been a major activity in the drainage and suction dredging and other mining operations have been active for decades in the upper drainage.

Ownership: Much of the drainage is in Plumas National Forest with some in Tahoe National Forest. The Sierra Valley and most of the land along the main river down to mouth of the canyon is privately owned. In addition, the upper watershed contains Plumas-Eureka State Park and two large state game refuges.

Existing Protection: Entire river between Beckwourth (Sierra Valley) and Oroville Reservoir is designated a Wild and Scenic River. The lowermost reaches are included in Feather Falls National Scenic Area. Nelson Creek is managed as a wild trout stream by CDFG.

Significant Natural Areas (Aquatic): None noted.

Overall Quality Rating: 2.9 for main river in Sierra Valley; 2.4 for un-dammed tributaries in upper drainage on National Forest land; 2.5 for river from Portola to Nelson Creek; 2.4 for Middle Fork canyon reach and tributaries.

Reasons for Rating: The Middle Fork of the Feather is a large drainage with aquatic habitats ranging from irreversibly degraded to near-pristine. It therefore provides a good representation of the aquatic habitat types in this portion of the Sierra Nevada. Although there are two large reservoirs on the upper end, there is sufficient flow down most of the river to still maintain a natural hydrologic regime. Many of the tributaries are also in good condition and maintain a diversity of aquatic organisms. The Sierra Valley has been highly altered by human activity yet is unusual for its extensive marshlands and spring systems; special consideration should be given to expanding natural/protected areas in the valley.

IBI Score: 63. The Middle Fork is included as an ADMA despite this score because of the diversity of habitats and the high potential of many areas to respond to biodiversity-oriented management.

Notes: A thorough review of existing information on the watershed is needed, along with additional surveys of aquatic and riparian habitats. Invertebrate and amphibians surveys are needed for spring areas in Sierra Nevada to identify the biologically richest remaining areas.

UCD Surveys?: Nelson Creek, 1993.

Sources:

Palmer, T. 1993. The Wild and Scenic Rivers of America.

California Department of Fish and Game. July, 1961. Fish and Wildlife Resources of Proposed Water Development on the Middle Fork Feather River.

California Department of Water Resources. October, 1973. Natural Resources of the Sierra Valley Study Area.

Date: 28 December 1994 **Compiler**: RY, PBM

ADMA WATERSHED

Name: Lavezolla Creek / Upper Downie River **Drainage:** Yuba River

Cal Watershed No.: 517.52000 **County:** Sierra

Location: From headwaters to union just above Downieville.

Elevation: 935 to 2253 m; mean 1680 m

Drainage Area: 74 km^2

Description: The Lavezzola Creek and the Upper Downie River unite above Downieville to form a major tributary to the North Fork Yuba River. Both streams cascade through deep, steep-walled canyons lined with a mixture of second-growth conifers and oaks. The upper reaches of the two streams appear to accessible only by trail and the watersheds appear to be in good condition. However, in the 1850s much of the watershed was denuded to supply timber for the building of Downieville and its mines. Placer mining also took place in the creeks and they are still the locus of mining claims. The headwaters include some small lakes (e.g., Spencer Lakes, Hawley Lake). Wild rainbow trout are common to abundant in most areas but their native distribution is not known. Lavezzola Creek is managed as a wild trout stream by CDFG.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pools (?); A1152 Mountain ponds; A1210 Mountain lakes; A2120 Conifer forest snowmelt stream; A2412 Forest stream; A2413 Spring; A2414 Meadow stream; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout (A), other fishes may be present in lowermost reaches, just above their confluence.

Amphibians: Unknown, but mountain yellow-legged frogs may present.

Other Vertebrates: Deer migration corridor through North Fork Yuba River drainage.

Invertebrates: Not known but a caddisfly proposed for federal listing as an endangered species (category 1), *Goeracea oregona*, is endemic to New York Ravine, a downstream tributary to NF Yuba. Two other caddisfly species that are federally listed (category 2) also occur in NY Ravine.

Riparian, Wetland Habitats: Narrow riparian zone along creek reasonably well developed.

Human Impacts: Some mining,logging, grazing, and recreational use take place in drainage.

Ownership: Entirely within Tahoe NF, with small private inholdings and mining claims scattered throughout drainage.

Existing Protection: Lavezzola Creek managed as a wild trout stream by CDFG.

Significant Natural Areas (Aquatic): None identified.

Overall Quality Rating: 2.3

Reasons for Rating: Two streams are in reasonably good condition because of their steep terrain which discourages use. Although they were devastated during the Gold Rush, they have shown remarkable recovery, which should be allowed to continue.

IBI Score: 67

Notes: More information is needed on this drainage, especially about invertebrates.

UCD Surveys?: No

Sources:

US Forest Service. 1994. Wild and Scenic River Assessment in Environmental Impact Statement for the Tahoe National Forest.

Gerstung, E., et al. 1977. Sierra County Wildlife Conservation Element. Unpublished Report, Dept. of Fish and Game, June 1977.

Date: 28 December 1994 **Compiler**: RY, PBM

ADMA WATERSHED

Name: North Fork American River **Drainage:** American River

Calwater No.: 514.50000 **County:** Placer

Location: From the headwaters in the Cedars area down to Iowa Hill Bridge, SE of Colfax.

Elevation: 183 to 2709 m; mean 1302

Drainage Area: 900 km^2

Description: The North Fork American headwater area is characterized as a broad glaciated valley composed of several steep gradient tributaries surrounded by patches of forest interspersed with exposed granite bedrock. Much of this area is on private land and contains two separate research reserves. The river below Serena Creek changes to a high gradient stream with numerous rapids and several falls 20-50 feet high in a V-shaped canyon. The canyon at Royal Gorge has depths up to 1050 meters. Below the Gorge the gradient decreases and the river becomes more braided and meandering within a narrow alluvial valley. Red fir and mixed conifer forest is the dominate vegetation type in the upland area. The streambed widens to 100 feet in some places and contains extensive gravel beds. The canyon narrows then widens at Green Valley then closes again at Giant Gap, where the river becomes constricted by a narrow bedrock canyon. Oak woodland and chaparral are the dominant vegetation in the lower reaches. The reach ends at Iowa Hill Bridge, site of the upper end of the proposed Auburn Dam.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pools (?), A1152 Mountain ponds; A1210 Alpine lakes; A2120 Conifer forest snowmelt stream; A2130 Foothill/valley ephemeral stream; A2412 Forest stream; A2413 Spring; A2421 Resident rainbow trout stream; A2422 rainbow trout/cyprinid stream.

Native Fishes: Rainbow trout (A); Sacramento sucker (A); Sacramento squawfish (C); hardhead (C); California roach (C); riffle sculpin (C). Chinook salmon and steelhead once present but excluded by downstream dams.

Amphibians: Mountain yellow-legged frogs reported in some areas.

Other Vertebrates: Golden Eagle and Peregrine Falcon nesting areas in upper canyon.

Invertebrates: No records.

Riparian zone: Very diverse group of plant communities along the river canyon. Dense overstory on the north facing slopes dominated by conifers and more sparse vegetation on the south facing slopes with canyon live oak as a common species. Unaltered red fir and yellow pine stands along the river canyon have been identified as California Natural Areas. CNPS lists *Veronica cusickii* as the only rare plant in the North Fork (1977) and it is found in high alpine meadows on north facing slopes. Remoteness of the canyon, unaltered flows and the limited timber harvesting has resulted in little impacts to streamside vegetation.

Human Impacts: Timber harvest and mining activity has been very limited although some private timber lands could have some adverse impacts to river in the future. Privately landowners in the Cedar area have taken an active role in protecting the area and public access is very limited. There are only two road crossings in the entire reach, the Iowa-Hill Bridge at the lowest end and the Soda Springs crossing in the Cedar area. Most river access is by foot trails. Hiking, fishing and boating are the major recreational uses on the river.

Ownership: 42 km of the main river is in Tahoe National Forest, 19.2 km on BLM land. Private lands in the Cedars and scattered sections throughout the drainage.

Existing Protection: From the Cedars to Iowa Hill Bridge over 61 km is designated as National Wild and Scenic River. Most of this same section, over 59 km, is managed as a Wild Trout Stream. There are two research areas, the University of California Natural Reserve System (6.9 km2) and the USFS Onion Creek Experimental Forest (11.7 km2). The private landowners association is also very active in preserving the upper reaches of the river. There are 10 km2 acres of Natural Areas in the watershed representing unaltered stands of red fir, yellow pine, meadow and riparian areas.

Significant Natural Areas (Aquatic): The Cedars (UCNRS Reserve); Sugar Pine Point RNA; Onion Creek RNA

Overall Quality Rating: 2.3

Reasons for Rating: Much of the drainage is unaltered because of its rugged features and roadless areas. There are over 60 km of free-flowing river with most of its original native fishes still present except for anadramous fish. Large areas of protected or recognized natural areas.

IBI Score: 70

Notes: This river has potential for restoration of salmon and steelhead, if the fish can be moved over Folsom and Natomas dams.

UCD Surveys?: Yes, 1993

Sources:

US Forest Service. 1978. North Fork American Wild and Scenic River Study Report, Tahoe National Forest, 1978.

California Department of Fish and Game. 1977. North Fork American River Waterway Management Plan, California Department of Fish and Game, 1977.

Palmer, T. 1993. The Wild and Scenic Rivers of America.

Date Compiled: December 19, 1994 **Compiler:** PR

ADMA WATERSHED

Name: Rubicon River **Drainage:** American River

Cal Water Basin No.: 514.45000 **County:** El Dorado

Location: From headwaters in Desolation Wilderness to inlet to Hell Hole Reservoir.

Elevation Range: 1447 to 2990 m; mean 2215 m

Drainage Area: 172 km^2

Description: The headwaters of the Rubicon begin in the Rockbound Valley of Desolation Wilderness Area, which was originally without fish. Steep gradient snowmelt tributaries flow into alpine lakes, which discharge their water into the river. The river is characterized by long runs and riffles with frequent pools. At the lower end of Rockbound Valley the flow is captured in part by Rubicon Reservoir and Rockbound Lake, which are connected by a tunnel. The river then drops into a steep, glaciated canyon with patches of late successional forests adjacent to stream. Stream access is limited to foot trails for the entire drainage. The river eventually flows into Hell Hole Reservoir.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pools; A1152 Mountain ponds; A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forest snowmelt stream; A2412 Forest stream; A2413 Spring; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout. Non-native brown trout and brook trout also present.

Amphibians: Mountain yellow-legged frogs

Other Vertebrates: No records.

Invertebrates: No records.

Riparian Zone: Narrow and coniferous along most of river because of steep canyon walls.

Human Impacts: Stream partially regulated for power production. Hiking, camping, fishing are main activities in the watershed. Some logging also present. Grazing a major problem in meadows.

Ownership: El Dorado NF with some private inholdings

Existing Protection: Desolation Wilderness and Granite Chief wilderness areas for headwaters.

Significant Natural Areas (Aquatic): None designated.

Overall Quality Rating: 2.5.

Reasons for Rating: This alpine watershed is in a glaciated landscape that is largely in wilderness areas, containing native frogs etc. Presumably rainbow trout were native to the canyon below 2000 m. While the lower half of this river reach is partially regulated, the flow regime is close to the one that originally existed. This watershed is a good example of a high alpine systems fed by many small lakes.

IBI Score: 64

Notes: The upper Rubicon may not be the best choice for a high alpine ADMA in the middle Sierra Nevada but most other regions have similar drawbacks (introduced trout, small dams).

UCD Surveys?: Yes, 1993

Sources:

Wild and Scenic Affected Environment, Tahoe NF EIS, 1994.

Personal communication with Tahoe NF hydrologist, James Bergman.

Date: 28 December 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: Jones Fork, Silver Fork **Drainage:** South Fork American

Calwater No.: 514.34010 and 34011 **County:** El Dorado

Location: From headwaters in Desolation Wilderness to Union Valley Reservoir.

Elevation: 1522 to 2818 m; mean 1926 m

Drainage Area: 66 km^2

Description: Jones Fork originates in the Desolation Wilderness around Maud and Gertrude Lakes, which are located in subalpine meadows. The stream flows over exposed granitic rock and drops into a high gradient, boulder dominated channel surrounded by coniferous forest. In the lower reaches the creek becomes a low gradient channel composed of many large, sandy bottomed shallow pools with undercut banks and abundant root wads. Sacramento suckers inhabit this low gradient reach along with rainbow trout. There are large patches of gravel in the riffle areas that have been reported to support a kokanee spawning run from Union Valley Reservoir. There is a steep bedrock drop just upstream of the reservoir that is a fish barrier during low flows.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pool (?); A1151 Mountain pond; A1210 Alpine lake; A2120 Conifer forest snowmelt stream; A2412 Forest stream; A2421 Resident rainbow trout stream; A2422 Rainbow trout/cyprinid stream.

Native Fishes: Rainbow trout, Sacramento sucker; non-native brown trout, brook trout, and kokanee also present.

Amphibians: Pacific treefrogs and western toads reported in the meadow areas around Maud Lake. Mountain yellow-legged frogs present in scattered areas.

Other Vertebrates: Mountain garter snakes observed in meadow areas.

Invertebrates: No records

Riparian zone: Because of steep rocky terrain, the riparian zone is narrow and sparse, consisting of alders, willows, grasses, shrubs and cedars. Indian rhubarb is abundant within stream channel in the lower reaches.

Human Impacts: Large clearcuts on private land are present in drainage above Union Valley Reservoir. Grazing has degraded stream banks and created significant erosion in the middle reaches. Camping and fishing pressure is high along middle reaches as well as the headwater areas. Some stream restoration work was attempted in the middle reaches to help gravel recruitment, but substrate is mostly fines and small gravels.

Ownership: Mostly El Dorado NF, with private timber lands in lower drainage.

Existing Protection: None

Significant Natural Areas (Aquatic): None noted

Overall Quality Rating: 2.4

Reasons for Rating: Although the watershed has been disturbed by grazing, logging, roadbuilding and recreational activities, it is basically in good condition and contains native fish and amphibians. However, high elevation areas were originally fishless.

IBI Score: 68

Notes: Jones Fork is one of a few places where Sacramento suckers are found above 1400 m elevation.

UCD Surveys?: Yes, 1993

Sources: Personal communication, George Elliot, El Dorado NF, 1994.

Date: 29 December 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: Rock Creek **Drainage:** South Fork American

Calwater No.: 514.32020-32031 **County:** El Dorado

Location: From headwaters along Georgetown Divide, south of Wentworth Springs Road, to the confluence to South Fork American River, about 4 km north of Placerville.

Elevation: 305 to 1427 m; mean 844 m

Drainage Area: 216 km^2

Description: The headwaters of Rock Creek are on the southern slopes of Georgetown Divide. The watershed includes other large drainages such as Whaler Creek, Bear Creek and Traverse Creek. The main creek is a third order, low elevation canyon stream flowing in a north-south orientation over steep granitic substrate. The watershed is extensively roaded as the result of a long history of mining and logging but access to much of the creek is limited by steep terrain.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2130 Foothill/valley ephemeral stream; A2412 Forest stream; A2413 Spring; A2421 Resident rainbow trout stream; A2422 Rainbow trout/cyprinid stream; A2445 California roach stream.

Native Fishes: Rainbow trout, Sacramento sucker, riffle sculpin, Sacramento squawfish, California roach.

Amphibians: Pacific treefrogs common. Bullfrogs present in some areas. Historical report of red-legged frog where bullfrogs now exist. Foothill yellow-legged frogs may be present but not verified.

Other Vertebrates: Western pond turtles and aquatic garter snakes reported in Whaler Creek.

Invertebrates: El Dorado NF has conducted a study for EIS on effects of OHV stream crossings on aquatic insects. Preliminary results indicate over 130 taxa (down to genera) occur in Rock Creek. Presence of endemic or rare species is not known.

Riparian zone: Condition of zone variable, depending on amount of mining and recreational activity.

Human Impacts: Logging, gravel mining and OHV use are present in the drainage (there are several OHV stream crossings in the upper drainage). Although housing development is in close proximity to the upper drainage, access to the stream is limited to 4WD in most places. There is a small diversion dam just below Rock Creek road crossing, but it has minimal impact on downstream flows.

Ownership: Much of drainage is in El Dorado NF while the remainder is private, mainly private timber lands.

Existing Protection: None

Significant Natural Areas (Aquatic): None designated. Traverse Creek may deserve this designation because of its native fish populations.

Overall Quality Rating: 2.6

Reasons for Rating: Rock Creek is a fairly large drainage in foothill region that has no major dams and minimal diversions and is largely on USFS lands. The watershed has been fairly heavily used for mining, logging, and recreation over the past 140 years but has not been irreversibly damaged. One of the best examples of a diverse foothill drainage remaining.

IBI Score: 78

Notes: The IBI score may be a high because it assumes native frogs are present.

UCD Surveys?: Yes, 1993.

Sources:

Personal communication, George Elliot, El Dorado NF, 1994.

Stream surveys by BLM, 1979-80.

Date: 28 December 1994 **Compiler**: RY, PBM

ADMA WATERSHED

Name: Cosumnes River **Drainage:** San Joaquin

Calwater No.: 532.2000 **County:** El Dorado (upper), Amador, Sacramento

Location: Entire drainage from headwaters on Iron Mountain Ridge to its mouth on the Mokelumne River, just above the Delta.

Elevation: 59 to 2342 m; mean 824 m

Drainage Area: 1638 km^2

Description: The Cosumnes River drains much of southern El Dorado County, with the North, Middle, and South Forks uniting in the vicinity of Highway 49 to form the main river. The main river joins the Mokelumne River just before it enters the Delta. The upper reaches of the three forks (and their tributaries) are perennial, high gradient streams traversing through forests of mixed conifer and deep granitic canyons. Channels are complex, with substrates dominated by boulders and cobble. The upper drainage is heavily roaded from logging and mining. In the middle reaches, there are many small diversions on tributary streams, but flow regimes and native fish communities are largely intact. Below Highway 49, the main river flows through the oak savannahs of large ranches. There are frequent large pools. The lowermost reaches meander through orchards, farmland, and the expanding suburbs of Sacramento. At the mouth, the river is lined with remnant riparian forest.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1110 Floodplain pool (?), A1260 Valley marsh; A1330 Valley sloughs and backwaters; A2120 Conifer snowmelt stream; A2130 Foothill ephemeral stream; A2412 Forest stream; A2413 Spring; A2414 Meadow stream; A2421 Resident trout stream; A2422 rainbow trout/cyprinid stream; A2442 Fall chinook spawning stream; A2443 Hardhead/squawfish stream; A2445 California roach stream; A2446 Sucker-squawfish spawning stream.

Native Fishes: Rainbow trout (A), Sacramento squawfish (C), Sacramento sucker (A), California roach (C), speckled dace (R), hardhead (C), chinook salmon (R), Pacific lamprey (C). Other lowland fishes, such as hitch, Sacramento blackfish, and splittail present in lower river.

Amphibians: Poorly known but native ranid frogs are scarce.

Other Vertebrates: Poorly known but presumably a fairly complete representation of the native fauna, from otters to dippers to pond turtles.

Invertebrates: Aquatic insects diverse and abundant in many areas. A number of unusual or endemic stoneflies (Plecoptera) in drainage. More than 300 taxa of aquatic insects are known from the drainage, including 70 species of stoneflies.

Riparian Zone: Highly variable in condition but most riparian types for the western Sierra are in the watershed.

Human Impacts: This drainage has been heavily altered by logging, grazing, placer mining, and recreation, as well as agriculture along its lowermost reaches. There are many small diversions but no large dams. The human population of the region is growing rapidly and so increasing demands on the river and its watershed are likely.

Ownership: Upper drainage is largely in El Dorado National Forest; lower drainage (below highway 49) is largely privately owned. The Nature Conservancy has a preserve near the mouth.

Existing Protection: TNC Cosumnes River Preserve at mouth

Significant Natural Areas (Aquatic): Jackass Canyon; Bendorf stream and spring; Stump Spring; Camp Creek

Overall Quality Rating: 2.8.

Reasons for Rating: This drainage has received heavy human use since the Gold Rush but the lack of a major dam on the system means that the hydrograph is fairly natural. Non-native fishes have invaded or been planted in much of the drainage but there are significant areas with native fishes still present. The drainage contains the southernmost populations of speckled dace in the Sacramento-San Joaquin drainage. Camp Creek above its diversion is a fairly large tributary drainage (to the North Fork) that rates higher (2.4) than most of the rest of the drainage because its nearly inaccessible canyon has reduced human impacts.

IBI Score: 60

Notes: This drainage is the focus of a major watershed management effort led by The Nature Conservancy. The remaining native biota of the drainage should respond well to biodiversity-oriented management.

UCD Surveys?: Yes, 1993.

Sources:

Bottorff, R. L. 1990. Ph.D. dissertation, UC Davis; R. L. Bottorff, personal communication.

Date: 28 December 1994 **Compiler:** PBM, PR

ADMA WATERSHED

Name: North Fork Calaveras River **Drainage:** Calaveras River

Cal Watershed No.: 533.20000 **County:** Calaveras

Location: From headwaters just above Calaveras Reservoir, located about 24 km east town of Jackson, to New Hogan Reservoir.

Elevation: 244 to 1403 m, mean 637 m

Drainage Area: 317 km^2

Description: This is a fourth order foothill stream flowing almost entirely on private land. The flow is intermittent in the summer but the channel contains deep pools that support mostly native species. The river flows through oak woodland and chaparral plant communities with a diverse riparian community along the channel.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2130 Foothill/valley ephemeral stream; A2443 Hardhead/squawfish stream; A2445 California roach stream; A2446 Squawfish/sucker spawning stream.

Native Fishes: Rainbow trout (C), California roach (A), Sacramento squawfish (P?), Sacramento sucker (C), Hardhead (P?).

Amphibians: Foothill yellow-legged frogs present

Other Vertebrates: Western pond turtles

Invertebrates: Unknown

Riparian, Wetland Habitats: Unknown

Human Impacts: Cattle grazing is present throughout the drainage.
Mining and private timber harvest are also widespread. There is a small reservoir in the headwaters, but holds little water, and flow is mostly unimpeded.

Ownership: Mostly private with some BLM parcels.

Existing Protection: None

Significant Natural Areas (Aquatic): None identified.

Overall Quality Rating: 2.6

Reasons for Rating: Past stream surveys on BLM land have observed a large percentage of native fishes as well as rare amphibians and turtles. Flows have been reported to be largely unaltered. Due to private land ownership, condition of the land is mostly unknown. Presence of native species indicates drainage is still in relatively good shape.

IBI Score: 80

Notes: Gary Fregane of State Parks and Recreation owns over 80 acres along the NF Calaveras River and supplied the information on native aquatic fauna.

UCD Surveys?: None

Sources:

Bureau of Land Management. 1980. Fisheries Inventory of Sierra Foothill Streams on Public Land in 1979, unpublished, 1980.

Fregane, Gary, private land owner and State Parks and Recreation biologist, personal communication, November, 1994.

Date: 30 December, 1994 **Compiler:** PR

ADMA WATERSHED

Name: North Fork Mokelumne River **Drainage:** San Joaquin

Calwater No.: 532.60010-60023 **County:** Calaveras, Amador, Alpine

Location: From Highland Lakes to Salt Springs Reservoir.

Elevation Range: 1214 to 3100 m; mean 2354 m

Drainage Area: 402 km^2

Description: The upper 14 km of river are a meadow stream flowing through a broad glaciated valley containing well defined red fir, sub-alpine and riparian vegetation. This section is closely paralleled by highway 4 and receives high recreational use. Hatchery trout are stocked in this reach. The remaining 29 km of river flow within the Mokelumne Wilderness Area. The river makes a rapid descent at the upper wilderness boundary into a deeply incised canyon which is over 1200 m deep in places. There are several waterfalls and the canyon walls are very steep, making river access difficult. Wild trout fishing is excellent and angling pressure is low. The river eventually flows into Salt Springs Reservoir which is operated by PG&E for hydroelectric power.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pools (?), A1152 Mountain ponds; A1210 Alpine lake; A2120 Conifer snowmelt stream; A2412 Forest stream; A2413 spring; A2414 Meadow stream; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout. Non-native brown trout also present.

Amphibians: No recent records available but mountain yellow-legged frogs probably present.

Other Vertebrates: Possible pine marten and fisher migration corridor. Dippers and beaver also present.

Invertebrates: No records available

Riparian, Wetland Habitats: Variable from meadow type in headwater area to narrow band in river canyon. Condition and vegetation types unknown.

Human Impacts: Recreational use in headwater area includes hiking, camping and fishing with motorized access. Access to wilderness areas is limited to foot trails. Salt Springs Reservoir limits upstream and downstream movement for trout.

Ownership: Entire stretch of river (approx. 43 km) is within Stanislaus NF.

Existing Protection: Over 29 km is within Mokelumne Wilderness Area which receives limited public use due to rugged terrain and roadlessness.

Significant natural areas (aquatic): None designated

Overall Quality Rating: 2.3

Reasons for Rating: Much of the drainage is lightly disturbed, especially portion in the wilderness area, although non-native trout present in lakes and streams.

IBI Score: 64

Notes: Relative low IBI score due to high percentage of watershed that was originally fishless but now contains trout.

UCD Surveys?: No

Sources:

Wildlife and Scenic River Study Appendix E of the Environmental Impact Statement for the Stanislaus National Forest.

Date: 30 December 1994 **Compilers:** PR, PBM

ADMA WATERSHED

Name: South Fork Stanislaus River **Drainage:** San Joaquin

Calwater No.: 534.30010 and 30011 **County:** Tuolumne

Location: From headwaters in Emigrant Wilderness to Pinecrest Reservoir.

Elevation Range: 1645 to 3001 m; mean 2450 m

Drainage Area: 71 km^2

Description: Roughly 22 km of the upper South Fork has no road access. The headwaters are in Emigrant Wilderness Area where the stream flows through broad glacial valleys with some meadows and patches of fir and mixed conifer forests. The river then descends into a U-shaped, glacially carved granitic canyon. Recreational use is moderate in the Wilderness Area with fishing and hiking present.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pools (?); A1152 Mountain ponds; A1210 Alpine Lakes; A2120 Conifer forest snowmelt stream; A2412 Forest stream; A2413 Spring; A2414 Meadow stream; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout (A)

Amphibians: Tree frogs and western or Yosemite toad tadpoles observed in Three Meadows, 1993.

Other Vertebrates: Migration corridor for martens, fishers and wolverines.

Invertebrates: Unknown

Riparian, Wetland Habitats: Variety of wetland habitat types from wet meadows in headwater region to narrow bands of riparian in river canyon.

Human Impacts: Recreational use in headwaters include fishing and camping with access provided only by foot trails. Pinecrest Reservoir region is heavily used for recreation. Livestock grazing and some OHV use present in meadow areas.

Ownership: Entire reach is within Stanislaus NF.

Existing Protection: Upper half of drainage flows within Emigrant Wilderness Area. Proposed Wild and Scenic River from headwaters to New Melones Dam.

Significant Natural Areas (Aquatic): Three Meadows

Overall Quality Rating: 2.1

Reasons for Rating: Watershed is in excellent condition because of limited human use in most of it. Large native amphibian population is present.

IBI Score: 53

Notes: Low IBI score the result of extensive invasion of high elevation areas by non-native trout.

UCD Surveys?: Yes, 1993.

Sources:

Wild and Scenic River Study in Appendix E of Environmental Impact Statement for Stanislaus NF.

Date: 30 December 1994 **Compilers:** PR, PBM

ADMA WATERSHED

Name: Rose Creek **Drainage:** Stanislaus River

Calwater No.: 534.22010-22013 **County:** Tuolumne

Location: Rose Creek drains Star Ridge north of Sonora, and empties into New Melones Reservoir.

Elevation Range: 307 to 1600 m; mean 1020 m

Drainage Area: 113 km^2

Description: Rose Creek is located in a deep, steep-sided, low elevation canyon. Summer flows are low and much of the bottom substrate is dominated by granite bedrock. Habitat in late summer is generally shallow riffles connecting deep pools.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2130 Foothill/valley ephemeral stream; A2422 Rainbow trout/cyprinid stream; A2445 California roach stream.

Native Fishes: Rainbow trout (C), California roach (C).

Amphibians: None observed in 1993.

Other Vertebrates: Unknown

Invertebrates: Aquatic insects were moderately diverse and abundant.

Riparian Zone: Often dense thickets of willow and blackberry.

Human Impacts: Mining is extremely heavy in the area and occurs in many forms including suction dredging. Several claims and many people are involved. Recreational use is heavy, especially ORV use. Some parts of the stream contain human refuse.

Ownership: Mostly within Stanislaus NF with some fragments of private land.

Existing Protection: None

Significant Natural Areas (Aquatic): None

Overall Quality Rating: 2.9

Reasons for Rating: Watershed is heavily abused by mining activity but it merits inclusion as an ADMA watershed because much of the watershed is restorable and portions are in reasonably good condition as indicated by riparian vegetation. It could become an important refuge for California roach, an increasingly uncommon fish in the San Joaquin drainage.

IBI Score: 68

Notes: Taxonomic status of roach merits investigation.

UCD Surveys?: Yes, 1993.

Sources:

Date: 29 December 1994 **Compiler:** RY, PBM

ADMA WATERSHED

Name: Clavey River **Drainage:** Tuolumne River

Calwater No: 536.40000 **County:** Tuolumne

Location: Entire drainage, from headwaters to mouth on Tuolumne River. Includes Cottonwood Creek, Thirteenmile Creek, Hull Creek, Two Mile Creek, Trout Creek, Reed Creek, and Bear Creek.

Elevation Range: 306 to 2808 m; mean 1409

Drainage Area: 930 km^2

Description: The main river (length ca. 51 km) is a 5th order tributary to the Tuolumne River. Lower reaches flow through steep, north-south oriented granitic canyon. Much of habitat consists of deep pools connected by short riffles and runs, with frequent waterfalls. Tributaries are steep, bouldery, and lined with granite outcrops and deep forest. The upper reaches are accessible by forest roads but easy access for the reach from 3NO1 bridge to mouth is only at a single crossing, 1NO4 bridge.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1151 Outcrop pools (?); A1152 Mountain ponds; A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forests snowmelt stream; A2411 Alpine stream; A2142 Forest stream; A2413 Spring; A2421 Resident rainbow trout stream; A2422 Rainbow trout\cyprinid stream; A2443 Sacramento sucker\squawfish stream

Native Fishes: Rainbow trout (A), California roach (A), hardhead (C), Sacramento squawfish (C), Sacramento sucker (A). Squawfish and hardhead are confined to the lower 2-3 km. Rainbow trout are throughout the drainage.

Amphibians: Foothill yellow-legged frogs (R), mountain yellow-legged frog (R), Pacific tree frog (C), western toad (C); Sierra newt (C), ensatina (C), California slender salamander (R), arboreal salamander (R), limestone salamander (R).

Other Vertebrates: Pacific pond turtles may be present. Dippers and other aquatic birds common.

Riparian Zone: Riparian zone is narrow because of steep canyons but is mostly in good condition.

Invertebrates: Aquatic insects abundant and diverse.

Human Impacts: Proposed site of major dam(s) for Turlock Irrigation District. Logging and roads in upper watershed create some erosion, along with camping and ORV use. Some gold dredging in accessible areas.

Ownership: Entirely in Stanislaus National Forest

Existing Protection: Wild Trout Stream (CDFG); proposed for Wild and Scenic River Status.

Significant Natural Areas (Aquatic): Bell Meadow RNA; Bourland Meadow candidate RNA.

Overall Quality Rating: 2.0

Reasons for Rating: Because of its north-south orientation and steep canyon, there has been comparatively little human use of this drainage. It is one of the most pristine drainages in California. It is remarkable in that it is one of the few large drainages (perhaps the only such drainage) in the Sierra Nevada containing **only** native fishes. The lack of exotic trout is especially unusual. The Clavey River watershed also contains a good representation of the native amphibian fauna.

IBI Score: 92

UCD Surveys?: Yes, 1993.

Notes: The proposed dam project was shelved in 1995 for environmental and economic reasons. There is active interest in protecting the Clavey River by Friends of the River, Friends of the Clavey, Tuolumne River Preservation Trust, and other environmental groups.

Sources:

EA Engineering, Science and Technology. 1990. Clavey River Project Exhibit E: Environmental Report. Report 3: Fish, Wildlife and Botanical Resources. Turlock Irrigation District.

California Department of Fish and Game. 1985. Unpublished wild trout surveys.

Date: 20 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: South Fork Tuolumne River **Drainage:** Tuolumne

Calwater No.: 536.8000 **County:** Tuolumne

Location: Entire drainage from headwaters (Yosemite National Park) to mouth on Tuolumne River.

Elevation Range: 486 to 2802 m; mean 1660 m

Drainage Area: 233 km^2

Description: Headwaters in YNP are typical high gradient, boulder dominated streams in mixed conifer forests. Main river has moderate gradient and is crossed repeatedly by Highway 120 and other roads through Stanislaus National Forest. Lowermost reaches (below Highway 120) are in steep canyon, where the habitat is dominated by bouldery riffles and runs which periodically open into large, deep pools.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2412 Forest stream; A2421 Resident rainbow trout stream; A2422 Rainbow/trout cyprinid stream; A2443 Sacramento sucker/squawfish stream

Native Fishes: Rainbow trout (A), Sacramento sucker (C), Sacramento squawfish (C), California roach (C), hardhead (R?). Some brown trout present as well.

Amphibians: No recent records of ranid frogs.

Other Vertebrates:

Invertebrates: Aquatic insect fauna moderately diverse and abundant.

Riparian Zone: Mostly narrow in canyons but typically in good condition.

Human Impacts: Drainage has been logged and grazed in many areas. Moderate recreational use in middle reaches because of easy road access.

Ownership: Headwaters, Yosemite National Park. Most of rest of drainage is Stanislaus National Forest.

Existing Protection: YNP headwaters, lower portions included in Wild and Scenic River designation for Tuolumne River

Significant Natural Areas (Aquatic): None identified

Overall Quality Rating: 2.3

Reasons for Rating: Although watershed is fairly accessible and has been logged, roaded, and grazed, the headwaters (1.0?) and the mouth are in exceptionally good condition (2.1). It appears to have a largely native fish fauna.

IBI Score: 72

Notes:

UCD Surveys?: Yes, 1986, 1993.

Sources:

Date: 6 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Merced River **Drainage:** Merced River

Calwater No.: 537.30000-60000 **County:** Mariposa and Madera

Location: Entire drainage from headwaters on Mt. Lyell to McClure Reservoir, including North Fork (origins on Pilot Ridge) and South Fork (origins in Yosemite).

Elevation Range: 303 to 3850 m; mean 1823 m

Drainage Area: 2361 km^2

Description: The Merced is a free-flowing river that has its origins in rugged, glacially-carved mountains (most famously in the spectacular cliffs and domes of Yosemite National Park) and then plunges through a deep gorge and through the foothills before being stopped by McClure Reservoir (Exchequer Dam). The mainstem flows through a complete range of mountain-foothill vegetation types, although it has Highway 140 running along it for much of its length. The North Fork is primarily a foothill drainage (with origins on Pilot Ridge, elevation ca. 1500-1800 m), while the South Fork also has its origins in Yosemite N.P. (2000-2500 m). The South Fork descends through a rugged canyon after leaving YNP. The North Fork is perhaps the least disturbed of the three forks, including Bull Creek, a mid-elevation tributary.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1152 Mountain ponds; A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forest snowmelt stream; A2130 Foothill ephemeral stream; A2411 Alpine stream; A2412 Forest stream; A2421 Resident rainbow trout stream; A2422 Rainbow trout/cyprinid stream; A2443 Hardhead/squawfish stream; A2445 California roach stream(?).

Native Fishes: Rainbow trout (A), riffle sculpin (A), Sacramento sucker (A), Sacramento squawfish (C), hardhead (R?), California roach (C). Introduced smallmouth bass and brown trout present in main river, which may limit native fishes, especially hardhead. Main river is planted with catchable rainbow trout by CDFG.

Amphibians: Mountain and foothill yellow-legged frogs historically present; both now very rare. Other native amphibians also increasingly rare in drainage, although bullfrogs are common in the North Fork drainage.

Other Vertebrates: Western pond turtles, river otters, dippers, many riparian species.

Invertebrates: Moderately abundant and diverse.

Riparian Habitats: There is a narrow strip of riparian vegetation along most of the main river that has been altered by human activity. As a result there are six threatened/rare plant species: *Allium yosemitense*; *Clarkia lingulata*; *Eriophyllum congdonii*; *E. nubigenum*; *Lewisis congdonii*; and *L. disepala*. However, the riparian corridor is more or less continuous on non-roaded banks and in reasonably good condition along North and South forks. Riparian vegetation in especially good condition in lower Bull Creek, tributary to North Fork, although upper part of drainage burned in 1987.

Human Impacts: Because Highway 140 runs along much of the main river, there are homes, power lines and other structures along the corridor. The river receives heavy recreational use in Yosemite National Park and along much of the corridor. In-river gold dredging is widespread outside the Park. Much of lower drainage, esp. along North and South Forks was site of intensive mining activity in past. Considerable roading in lower drainage. In many sections, access is limited by steep canyon walls. Grazing seems to be a problem in some areas (e.g., headwaters, Sweetwater Creek).

Ownership: Much of drainage is in Yosemite National Park, Sierra and Stanislaus National Forests, and land managed by BLM. Only about 4% of the river proper flows through private land.

Existing Protection: Headwaters in Yosemite National Park. The Merced River above Briceburg and the South Fork Merced were declared Wild and Scenic in 1987. The portions on public land were designated for "moderate use" by the USFS (Record of Decision, 1991).

Significant Natural Areas (Aquatic): Bishop Creek (Research Natural Area 55).

Overall Quality Rating: Overall rating is 2.6, with headwaters rating 2.1, mainstem from Yosemite to Briceburg, 2.8, foothill reaches of all three forks 2.5; upper South Fork, 2.2, upper north fork, 2.3.

Reasons for Rating: Ratings are tentative. Headwaters of mainstem in Yosemite often in near-pristine condition, although non-native trout widespread; other headwaters crossed by roads. Mainstem has highway on banks and non-native fish in stream along with natives. Foothill areas often heavily roaded and mined. These areas need to be more carefully surveyed for native fishes and amphibians, including main river below Briceburg.

IBI Score: 63 (North Fork, 67).

Notes: Spring-run chinook salmon may have once occurred as high as Yosemite Valley. Drainage was site of early investigations of animal distributions (J. Grinnell and T. I. Storer. 1924. Animal life in the Yosemite, Univ. California Press). Some spring systems present that need to be inventoried, especially in limestone areas of North Fork (Bower Cave area).

UCD Surveys?: Yes, 1993.

Sources:

Appendix E. Forest Plan, Sierra National Forest.

California Department of Fish and Game. 1984. Unpublished field notes, Wild Trout Program.

Date: 6 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Mariposa Creek **Drainage:** San Joaquin

Calwater No.: 538.00010-00060 **County:** Mariposa

Location: Entire drainage, from ca. 1 km above Mariposa Reservoir to headwaters near town of Mariposa

Elevation Range: 182 to 1278 m; mean 580

Drainage Area: 242 km^2

Description: A small (1-2 cfs in late summer, wetted channel 1-2 m wide), warm, frequently intermittent foothill stream that flows through oak woodland and small rocky canyons. Much of the summer water is in sandy-bottomed pools and gradients are generally low, especially in lower reaches.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2130 Foothill ephemeral stream; A2444 Hitch stream; A2445 California roach stream

Native Fishes: Hitch (C), California roach (C), Sacramento sucker (C). Introduced green sunfish and mosquitofish abundant in lower reaches of stream.

Amphibians: No recent records

Other Vertebrates: No recent records

Invertebrates: No recent records

Riparian Zone: Upper reaches often with fairly good canopy over stream (50-60%) but lower reaches exposed, with few riparian trees.

Human Impacts: Heavy grazing in riparian zone and surrounding hills, roads along streams in places.

Ownership: Entire drainage is on private lands.

Existing Protection: None

Significant Natural Areas (Aquatic): None noted

Overall Quality Rating: 2.8

Reasons for Rating: Mariposa Creek is an example of a small foothill drainage that contains mainly hitch and California roach, two declining fish species in the San Joaquin drainage. The lower reaches are now dominated

by non-native fishes, which may be expanding their range upstream in response to decline in habitat quality (e.g., reduced pool depth, increased temperatures, etc.) caused by grazing and other activities.

IBI Score: 64

Notes: This creek needs a thorough biological survey. Mariposa County has had a stream restoration program in place for the reaches near the town of Mariposa.

UCD Surveys?: Some sampling done in 1970 and 1986.

Sources: Brown and Moyle 1987, 1993.

Date: 23 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: East Fork, Chowchilla River **Drainage:** San Joaquin

Calwater No.: 539.11020-11031 **County:** Madera and Mariposa

Location: From mouth (junction with Middle Fork) to headwaters in Sierra National Forest

Elevation Range: 303 to 1948 m; mean 978 m

Drainage Area: 151 km^2

Description: The East Fork is largely a foothill stream, intermittent in places during summer, flowing through oak-digger pine woodland and grazing land. The middle to lower reaches contain large deep, boulder and bedrock pools, often with sandy bottoms. These reaches have exposed channels with little riparian cover and show the effects of heavy grazing. The upper reaches and headwaters are small trout streams dominated by boulders with some deep (2 m) pools.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2130 Foothill ephemeral stream; A2412 Forest stream; A2413 Spring (?); A2421 Resident rainbow trout stream; A2443 Hardhead/squawfish stream.

Native Fishes: Hardhead (A), Sacramento squawfish (A), Sacramento sucker (C), California roach (C), rainbow trout (C, headwaters).
Exotic green sunfish present in small numbers.

Amphibians: No recent records

Other Vertebrates: No recent records

Invertebrates: No recent records

Riparian Zone: Very limited in foothill areas because of canyon walls and heavy grazing. Often well developed in forested upper reaches and headwaters.

Human Impacts: Heavy grazing throughout drainage. Upper part of drainage extensively roaded.

Ownership: Mostly on private land; headwaters in Sierra NF

Existing Protection: None

Significant Natural Areas (Aquatic): None noted so far but springs in drainage (e.g., Salt Spring) merit investigation.

Overall Quality Rating: 2.7

Reasons for Rating: Much of the drainage flows through foothill land that has been heavily grazed so the banks are collapsed and the channel is wide and sandy in places. However, it supports largely native fishes, including exceptionally large numbers of hardhead, a species disappearing rapidly from the San Joaquin drainage.

IBI Score: 58

Notes: Has considerable restoration potential.

UCD Surveys?: Yes. Sampled in both 1970 and 1985-86 surveys.

Sources: Brown and Moyle 1987, 1993.

Date: 22 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Finegold Creek **Drainage:** San Joaquin

Calwater No.: 540.11010 to 540.11022 **County:** Merced

Location: Entire drainage from headwaters to mouth on Millerton Reservoir

Elevation Range: 182 m to 1462 m; mean 638 m

Drainage Area: 243 km^2

Description: Finegold Creek is a largely intermittent foothill stream that flows through digger pine-oak woodland and pastureland. Many of the smaller tributaries dry up completely although some (e.g., Little Fine Gold Creek) have permanent flows. Most reaches consist of a few bouldery pools 1-2 m deep in summer, connected by long sandy-bottomed sections of stream. The pools are the principal fish habitat because flows often become subsurface in summer in the sandy sections. The creek and its larger tributaries are small in summer (1-2 m wide) but flows rise quickly during winter rains.

Aquatic Province: Sacramento-San Joaquin.

Habitat Types: A2130 Foothill/valley ephemeral stream; A2413 springs; A2444 Hitch stream; A2446 Squawfish-sucker stream.

Native Fishes: Sacramento sucker (R), hitch (C). Lower reaches are dominated by non-native fishes, especially green sunfish, which can invade from Millerton Reservoir.

Amphibians: None recorded in recent years

Other Vertebrates: No records

Invertebrates: No records

Riparian Zone: Many areas heavily grazed with collapsing banks, but oaks, digger pine, and willows still provide 30-60% shade of stream in most areas.

Human Impacts: Most of drainage is grazed by livestock. Numerous roads through drainage, and some houses. Stockponds store water of seasonal tributary drainages. Reservoir at lower end is constant source of non-native fishes.

Ownership: Mostly private land; some headwater areas in Sierra NF.

Existing Protection: None

Significant Natural Areas (Aquatic): Little Fine Gold Creek

Overall Quality Rating: 2.9

Reasons for Rating: This drainage is marginal as an ADMA watershed but most similar drainages in the foothills are in even worse condition. The aquatic fauna is dominated by non-native fishes in most of the drainage, except in Little Finegold Creek which is dominated by Sacramento hitch. Roads, grazing, and reservoir have reduced the overall quality of the watershed.

IBI Score: 50

Notes: If efforts were made to restore the riparian habitats and pools of the creek, much of the drainage could be recolonized by hitch.

UCD Surveys?: 1970 and 1983.

Sources: Brown and Moyle, 1993.

Date: 3 December 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Rancheria Creek **Drainage:** North Fork, Kings

Calwater No.: 552.33060-3306 **County:** Fresno

Location: Entire drainage from headwaters to mouth on North Fork of Kings River

Elevation: 1441 to 3043 m; mean 2489 m

Drainage Area: 67 km^2

Description: Rancheria Creek is a high gradient alpine stream that has its origins in the small streams and lakes of the John Muir Wilderness area. It then plunges downward through some of the least disturbed late successional mixed conifer forest in the southern Sierra Nevada.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1152 Mountain pond; A1210 Alpine lake; A2110 Alpine snowmelt stream; A2120 Conifer snowmelt stream; A2411 Alpine stream; A2412 Forest stream; A2414 Meadow stream; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout

Amphibians: No records

Other Vertebrates: No records

Invertebrates: No records

Riparian Zone: Narrow but near-pristine most areas.

Human Impacts: Only one small road enters the watershed so the main impacts have been light recreation and some grazing.

Ownership: Entirely in Sequoia National Forest

Existing Protection: Headwaters in John Muir Wilderness Area

Significant Natural Areas (Aquatic): None identified

Overall Quality Rating: 1

Reasons for Rating: This is one of the most pristine drainages anywhere in the Sierra Nevada, thanks to its relative inaccessibility and steep terrain which has prevented most logging.

IBI Score: 92. This score assumes rainbow trout were originally found in most of drainage and that ranid frogs are present.

Notes: A thorough survey of the watershed is needed.

UCD Surveys?: No

Sources: E. Beckwitt, personal communication.

Date: 29 December 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Middle and South Forks, Kings River **Drainage:** San Joaquin

Cal Watershed No.: 552.34000 **County:** Fresno

Location: From the confluence of North Fork Kings River upstream to the headwaters of both Middle Fork and South Fork. Also includes Mill Flat Creek as well as other tributaries.

Elevation Range: 304 to 4313 m; mean 2601

Drainage Area: 2471 km^2

Description: The Kings River begins in Kings Canyon National Park, flowing entirely through public land and has the greatest vertical drop without a dam in the U.S. Most of this reach has been designated as a Wild and Scenic River. The river is one of the largest of California's designated wild trout streams and is noted for its extremely high water quality.

The Middle Fork begins near Muir Pass at Helen Lake, at 3541 m elevation. The upper reaches of the river plunges over dozens of waterfalls and through several meadow habitats in a classic V-shaped canyon. No roads access the river, only the Pacific Crest Trail provides public access. The canyon walls rise up to 2000 meters in some sections with spectacular granite peaks like Tehipite Dome adding to the high scenic quality of the river. The lower 11.2 km flows through Monarch Wilderness and has no trail access.

The South Fork begins below Mather Pass in a broad granitic basin with several glacial lakes and some of the southernmost glaciers in the U.S. Trails parallel sections of the river and penetrate most of the high country. The middle reaches of the South Fork flow within a heavily forested, U-shaped valley characterized by wooded flats and meadows. Highway 180 parallels the river from Cedar Grove recreation area to Boyden Cave. The lower section of the river plunges down through one of the deepest canyons in the nation and consists of a series of cascades and chutes with numerous deep pools. The lower 18 km is managed as a Wild Trout stream by CDFG.

The Middle and South Forks converge below Highway 180 bridge crossing, each of comparable size to form the beginning of the mainstem. The Kings River is free-flowing for roughly 32 km until it empties into Pine Flat Reservoir. In the upper reaches the river runs fairly straight, moderate gradient hemmed in by steep slopes. In the middle and lower reaches, the channel widens and the river often meanders around large cobble and boulder bars. Long pools connected by shorter, turbulent riffles are the predominant habitat type. This section is the largest in volume of California's wild trout rivers.

Mill Flat Creek is a large tributary that empties into the Kings River about 3 miles upstream of the North Fork. The creek is a low gradient, low elevation stream and is an important spawning stream for several native fishes in the Kings river. The lower most sections are in foothill oak woodland with deep (1-2 m) pools and extensive sand and gravel bottomed riffles and runs. Summer flows are typically 6-10 m3/min and summer temperatures are usually 22-28 C.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1152 Mountain pond; A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forest snowmelt stream; A2130 foothill ephemeral stream; A2411 Alpine stream; A2412 Forest stream; A2413 Spring; A2414 Meadow stream; A2415 Glacial melt stream; A2421 Resident rainbow trout stream; A2422 Rainbow trout/cyprinid stream; A2443 Hardhead/squawfish stream.

Native Fishes: Rainbow trout (A), Sacramento sucker (A), California roach (C), hardhead (R), Sacramento squawfish (A), riffle sculpin (C), Kern brook lamprey (R).

Amphibians: Foothill and mountain yellow-legged frogs (R?), Pacific tree frogs (C), Mt Lyell salamander (R), Sierra newt (C). Non-native bullfrogs present in lower Mill Flat Creek.

Other Vertebrates: Abundant and diverse, e.g. western pond turtles, aquatic garter snakes, bald eagle, peregrine falcon, willow flycatcher, dippers, and other aquatic birds.

Invertebrates: Aquatic insects appear to be abundant and diverse.

Riparian Zone: Much of the upper drainage has a very narrow riparian community in the steep canyon areas. Meadows in the glacial basin and sections of the canyons add to the diversity of plant communities. State listed rare plants observed in the upper watershed are Tompkins sedge, Congdon's bitterroot, Muir's raillardella and Tehipite jewel flower (last 2 only found on the MF). Other unusual plants include Hall's daisy and Kings Canyon Jewel flower. The Cedar Grove valley reach of the South Fork is lined with a narrow band of alder, cottonwood, black oak, willow, and pine.

Human Impacts: Most of the drainage is protected by the National Park and by its relatively inaccessible terrain. The South Fork and mainstem Kings probably receive the most impact from recreation in the form of camping, fishing, hiking and boating. There has been a proposal to build the Rodgers Crossing dam about 3 km above Pine Flat Reservoir. Road access is limited to sections of the mainstem Kings above Pine Flat Reservoir and from Highway 180, which runs along 29 km of the South Fork. The amount of timber harvest occurring on USFS land is not known. Monarch Wilderness on the lower Middle Fork would prevent any harvest activity.

Ownership: The entire watershed is on public land, with a few private inholdings. 88.8 km are in the Kings Canyon National Park and 59.2 km flow within Sequoia and Sierra National Forest. The Middle Fork has 43.2 km in Kings Canyon NP, while the lower 12.8 km are in Sierra NF. The South Fork has 45.6 km in Kings Canyon NP and 19.2 km in Sierra NF. The 30 km of the mainstem Kings River from the confluence of the forks to Pine Flat Reservoir has Sierra NF on the north and Sequoia NF on the south.

Existing Protection: National Wild and Scenic River status was designated from the headwaters of the Kings River to about 9.6 km below the confluence of the Middle and South Forks. The lower 17.6 km of the Kings is classified as a special management area; only an act of Congress can approve the construction of a dam. The California Department of Fish and Game manages the lower section of the South Fork and the mainstem Kings above Pine Flat Reservoir as a Wild Trout Stream. The lower reaches of the Middle Fork is in the Monarch Wilderness. Most of the Mill Flat Creek drainage has no special protection.

Significant Natural Areas (Aquatic): None identified but Zumalt Meadows and other areas in Kings Canyon N.P. qualify. Fox Springs and other spring systems in the Mill Flat Creek drainage merit investigation.

Overall Quality Rating: 2.0 for the Middle Fork, 2.2 for the South Fork and mainstem.

Reasons for Rating: Extensive protection throughout the drainage exists in the form of Wild and Scenic River status, National Park management area, and Wild Trout management by Fish and Game. The wild trout population is considered one of the best in California. Several native nongame fish species are present, including a rare population of brook lamprey above a major dam. Several endemic plant species are present in the drainage as well as giant sequoia groves. The Middle Fork deserves a higher rating because the entire drainage is protected either by National Park or USFS Wilderness areas. It also has no road access and limited trail access.

IBI Score: 80

Notes:

UCD Surveys?: Yes, 1986, 1993 (Mill Flat Creek).

Sources:

Brown, L. R. and _____. 1993. Distribution, ecology, and status of the fishes of the San Joaquin River drainage, California. California Fish and Game 79:96-114.

California Department of Fish and Game. 1985. Wild trout surveys (unpublished data).

Committee to Save the Kings River. 1987. The Kings River, A Report on its Qualities and its Future.

Mulligan, M. J. 1975. The ecology of fish populations in Mill Flat Creek: tributary to the Kings River. Unpublished M.S. thesis, CSU Fresno, 135 pp.

Palmer, T. 1993. The Wild and Scenic Rivers of America.

US Forest Service. 1990. Kings River Special Management Area and Kings, South Fork Kings and Middle Fork Kings Wild and Scenic Rivers Draft Environmental Impact Statement, USFS Sierra NF and Sequoia NF.

Snider, W. M. 1981. Wild trout management of a west slope Sierra Nevada stream. California Department of Fish and Game Inland Fisheries Admin. Rpt. 81-3. 21 pp.

Date: December 16, 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: North and Middle Forks, Tule River **Drainage:** Tule River

Calwater No.: 555.12000 **County:** Tulare

Location: Approximately 24 km east of Porterville. From the headwaters of the North Fork and Middle Fork to the confluence of both forks, just east of Springville.

Elevation Range: 301 to 3088 m; mean 1477 m

Drainage Area: 540 km^2

Description: Headwaters of the North Fork and North Fork of the Middle Fork (NFMF) begin in the southern boundary of Sequoia National Park. The NFMF Tule River flows mostly within Sequoia National Forest through a steep rugged canyon surrounded by mixed conifer forest in the upper reaches and oak woodland in the lower end. Steep gradients along with large granitic boulders create a series of cascading plunge pools interspersed with some riffle and runs. Doyle Springs contributes significant mineral laden water to the stream, resulting in heavy travertine deposits downstream. The travertine has been reported to reduce macroinvertebrate habitat as well as trout spawning habitat. There are two diversion dams on NFMF and a pump in Doyle Springs that reduce flows for hydroelectric power.

The South Fork of the Middle Fork Tule River originates near Camp Nelson in Sequoia National Forest flowing through a rocky canyon surrounded by mixed conifer in the upper reaches and vegetated by scrub oak, chamise and scattered yucca plants in the lower sections. Highway 170 runs adjacent to stream from Camp Nelson to town of Springville, but stream access is limited by steep canyon walls. A water diversion exists just below the confluence of the north and south forks of the Middle Fork Tule River. Below the diversion, the gradient begins to flatten, water temperatures increase, and trout are replaced by warm water fish species.

The North Fork begins as a steep gradient, forested stream dominated by trout. The creek decreases in gradient at Milo, and flows through private grazed pastureland. Flows are somewhat reduced by diversions for stock water ponds and very little flow makes it to the mainstem in the summer months.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2120 Conifer forest snowmelt stream; A2130 Foothill/valley ephemeral stream; A2140 Foothill canyon ephemeral stream; A2412 Forest stream; A2413 Spring; A2414 Meadow stream; A2421 Rainbow trout stream; A2422 Rainbow trout/cyprinid stream; A2443 Hardhead/squawfish stream; A2445 Roach stream.

Native Fishes: Hardhead (R), Sacramento squawfish (C), Sacramento sucker (C), California roach (A), Rainbow trout (A).

Amphibians: Unknown

Other Vertebrates: Rattlesnakes, dippers, garter snakes.

Invertebrates: Some work done on the NFMF Tule River has shown relatively low abundance of aquatic invertebrates as a result of mineralized deposition from Doyle Springs. It is possible that endemic species are associated with mineral springs in the upper Middle Fork. No information is known for the North Fork.

Riparian, Wetlands: White alder is the dominant riparian species in the MF Tule River. One study found no significant difference in alder growth for diverted sections on the NFMF Tule with non-diverted sections on the SFMF Tule river. Diversions on the NFMF may promote the abundant population of floating aquatic plants and the heavy travertine deposition. Doyle Springs supplies a constant year round flow to the NFMF, although over 5 cfs gets diverted. Other springs on the un-diverted SFMF also create travertine deposition downstream. The mainstem middle Fork flows mostly through foothill pine oak woodland plant community, with large cottonwood and alders along the stream floodplain. The North Fork flows through mixed conifer forest and sequoia stands in the upper reaches. The lower section run through a broad grassland with several cattle ranches.

Human Impacts: There are two water diversions on the NFMF, one on Hossack Creek, and a pump in Doyle Springs. They collectively divert water to the Tule River Conduit which leads to a PG&E powerhouse at the confluence of the forks. Another diversion is just below the forks and runs to another powerhouse, operated by Southern Cal Edison near Springville. Blowout of this diversion ditch eroded hillside and deposited high levels of sediment into the Middle Fork. Highway 170 runs along the Middle Fork in the lower sections and there is heavy fishing pressure in the upper reaches of the Middle Fork at Doyle Springs residential area and Camp Nelson. Brown trout dominate the sections below the NFMF diversions and the upper reaches of the SFMF. Introduced species are found in the lower reaches of the MF and NF. Much of the water in the North Fork Tule is diverted for pastureland and little reaches the mainstem in the summer.

Ownership: A small section of the headwater area is in Sequoia National Park. Most of the Middle Fork drainage and a small section of the North Fork is in Sequoia National Forest. Most of the NF Tule is on private ranchlands, with a small section of private forested land in the headwaters. A section of the upper NFMF Tule flows through Mountain Home State Forest.

Existing Protection: Headwaters in Sequoia National Park. Small area in State Forest.

Significant Natural Areas (Aquatic): Doyle Springs and other mineral springs need to be investigated.

Overall Quality Rating: 2.7

Reasons for Rating: Several native fishes exist in the lower reaches of the North and Middle Forks although introduced fishes are also present and flows are partially regulated. Upper reaches of the forks are more remote, have unaltered flows and conditions favor native rainbow trout. The presence of so many diversions makes this drainage a tenuous choice as an ADMA watershed; however much of the river is very restorable and native fishes

are still present. The watershed was chosen in part for its many unusual features that may include endemic invertebrates.

IBI Score: 56

Notes: The reaches of stream affected by diversions have been intensively studied by PG&E.

UCD Surveys?: Yes, 1970, 1986, 1993.

Sources:

Brown, L. and Moyle, P. 1987. Survey of the fishes of the mid-elevation streams of the San Joaquin Valley. Unpublished Report. 263 pp.

California Department of Fish and Game. 1985. Unpublished surveys, Wild Trout Program.

Woodward Clyde Consultants. 1985. Tule River Project (FERC 1333) Fisheries, Riparian and Water Quality Technical Reports.

Date Compiled: December 12, 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: South Fork Kaweah River **Drainage:** San Joaquin

Calwater No.: 553.42000 **County:** Tulare

Location: Entire drainage, from headwaters to mouth on mainstem Kaweah River, just above Kaweah Reservoir.

Elevation Range: 218 to 3430 m; mean 1520 m

Drainage Area: 224 km^2

Description: A classic small (summer flows ca. 8-10 cfs) San Joaquin tributary stream. It is a permanent stream, with boulder-bedrock substrate dominating. Lowermost reaches are warm in summer, supporting native cyprinids and suckers in deep pools among the boulders. Some houses and roads are present near the stream, but the riparian zone is largely continuous. Middle reaches are in a canyon with deep pools, in which the water is often cool enough to support trout. Upper reaches flow through Sequoia National Park and originate in part from a number of alpine lakes.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forest snowmelt stream; A2130 Foothill/valley ephemeral stream; A2411 Alpine stream; A2412 Forest stream; A2421 Resident rainbow trout stream; A2443 Hardhead/squawfish stream.

Native Fishes: Rainbow trout (A), Sacramento squawfish (C), California roach (A), Sacramento sucker (A), hardhead (R), riffle sculpin (C). Chisel-lipped variety of California roach predominant, indicating isolation of drainage (Brown et al. 1993).

Amphibians: Foothill yellow-legged frogs formerly in lower reaches of river but now probably absent. Mountain yellow-legged frogs may be present in high elevation areas.

Other Vertebrates: Dippers.

Invertebrates: No records available.

Riparian Zone: Thin because of steep topography but well-developed where possible, with cottonwoods and willows. Largely continuous.

Human Impacts: Housing development in lower reaches. Several road crossings provide access to river. Some water diversions occur on private lands in lower section of river. National Park waters in upper reaches have been stocked with trout, although lakes and streams historically were probably fishless.

Ownership: Upper reaches in Sequoia National Forest (Grouse Creek) and Sequoia National Park: middle and lower reaches on private lands.

Existing Protection: Headwaters in Sequoia NP. Lower reaches protected in part by steep terrain but have no formal protection.

Significant Natural Areas (Aquatic): None identified.

Overall Quality Rating: 2.1 for headwaters; most of rest of drainage averages 2.5.

Reasons for Rating: Headwaters contain introduced trout populations, otherwise would probably rate 1. Watershed outside SNP is grazed and logged and contains scattered housing but is a reasonably good condition.

IBI Score: 72

Notes: Middle Fork of Kaweah (including Marble Fork) probably also qualifies as ADMA watershed (confined to Sequoia National Park). Has been sampled by CDFG Wild Trout Program and contains rainbow trout, brown trout, and Sacramento suckers.

UCD Surveys?: Yes, 1973, 1986.

Sources:

Brown, L. R., _____, W. A. Bennett, B. D. Quelvog. 1992. Implications of morphological variation among populations of California roach *Lavinia symmetricus* (Cyprinidae) for conservation policy. Biological Conservation 62:1-10.

Brown, L. R. and _____. 1993. Distribution, ecology, and status of the fishes of the San Joaquin River drainage, California. California Fish and Game 79:96-114.

Date: 6 October 1994 **Compiler**: PBM

ADMA WATERSHED

Name: Deer Creek **Drainage:** Buena Vista Lake

Calwater No.: 555.20000 **County:** Tulare

Location: This is a small independent drainage located about 25 km northwest of Isabella Reservoir. Its headwaters are in Sequoia National Forest (California Hot Springs area) and it disappears into the canals and fields of the San Joaquin Valley floor. Presumably it was once tributary to the now-drained Buena Vista Lake (Kern River sink).

Elevation Range: 182 to 2512 m; mean 994 m

Drainage Area: 297 km^2

Description: The headwaters of Deer Creek (including Tyler Creek and Cold Springs Creek) are forest streams of moderate gradient flowing through steep rocky canyons. The southernmost grove of giant sequoia is present in the headwaters. Middle reaches fed by hot springs, mostly developed. In the foothills, Deer Creek is small (summer flows less than 5 cfs) and warm (22-30 C), flowing over gravel and bedrock with scattered shallow (< 1 m) pools. The channel is increasingly shallow and braided as the result of grazing.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2130 Foothill ephemeral stream; A2412 Forest stream; A2413 Spring (?); A2421 Rainbow trout stream; A2422 Rainbow trout\cyprinid stream; A2446 Squawfish/sucker stream.

Native Fishes: Rainbow trout (A), California roach (C), Sacramento squawfish (C), Sacramento sucker (A).

Amphibians: No observations

Other Vertebrates: No observations

Invertebrates: Aquatic insects seem to be diverse and abundant in forested reaches.

Riparian Zone: In forested areas, there is a good riparian canopy although understory is sparse. In foothills, there are scattered cottonwoods, oaks, and willows but the riparian vegetation is largely depleted by grazing.

Human Impacts: Heavy grazing along lower creek. Heavy recreational use in California Hot Springs area. Road runs along much of middle reaches of creek.

Ownership: Headwaters in Sequoia National Forest. California Hot Springs area mostly private, as are the foothill portions of watershed.

Existing Protection: None, except that provided to giant Sequoia groves.

Significant Natural Areas (Aquatic): None known but spring systems (including hot springs) should be investigated.

Overall Quality Rating: 2.2 in headwaters, 2.7 in foothills

Reasons for Rating: Generally has high restoration potential. Headwaters in Sequoia NF in reasonably good condition, as indicated by populations of wild trout. Lower reaches contain only native fishes but there is some evidence the channel is gradually becoming wider and shallower, so less likely to sustain native fish populations.

IBI Score: 68

Notes: This watershed is one of three small "independent" watersheds in the region (others: White River and Posos Creek) that still contain predominately native fishes. Deer Creek seems to contain the most fishes and be in the best condition, although the other two watersheds also merit special management. All three need thorough surveys for native fishes, invertebrates, and amphibians.

UCD Surveys?: Yes, 1973, 1986, 1993.

Sources:

Brown, L. R. and _____. 1993. Distribution, ecology, and status of the fishes of the San Joaquin River drainage, California. California Fish and Game 79:96-114.

Date: 20 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: North Fork, Kern River **Drainage:** Kern

Calwater No.: 554.24000 **County:** Tulare

Location: Headwaters to junction with South Creek, above crossing of Highway 41 (about 30 km above Isabella Reservoir); includes entire Little Kern River drainage.

Elevation Range: 1181 to 4412 m; mean 2666 m

Drainage Area: 2034 km^2

Description: This watershed drains on the steep, granitic slopes of the high Sierra through dozens of small streams. Much of the Little Kern River basin was glaciated, so the river flows through a U-shaped valley and drains a number of small cirque lakes. Below this area, most of the basin was not glaciated so the river meanders through broad alluvial flats that are separated by low pine-covered ridges. The meadows are composed of unconsolidated sands and sediments, so are highly subject to erosion as the result of grazing. The valley streams are typically low gradient, shallow, meandering streams, with sand and gravel substrates. There is little riparian vegetation, so the streams are fairly exposed.

Aquatic Province: Sacramento-San Joaquin.

Habitat Types: A1152 Mountain pond; A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forest snowmelt stream; A2411 Alpine stream; A2412 Forest stream; A2414 Meadow stream; A2423 Kern golden trout stream.

Native Fishes: Little Kern golden trout (C), Sacramento sucker (C). Non-native fishes include rainbow trout(C) and brown trout (C)

Amphibians: Mountain yellow-legged frog; endemic slender salamanders.

Other Vertebrates: No information available.

Invertebrates: No information available.

Riparian Zone: Little true riparian vegetation in meadows. In canyons there are typically sparse growths of pine where soil conditions permit.

Human Impacts: The introduction of non-native rainbow and brown trout greatly reduced the populations of native golden trout and efforts are now underway to restore many of the streams to golden trout only streams. Grazing is a major factor increasing erosion of the streams in the unstable soils of the meadows. Recreational use is relatively light.

Ownership: Almost entirely in Sequoia National Forest, with some private inholdings.

Existing Protection: Some headwaters in Golden Trout Wilderness Area. The Little Kern golden trout is a federally listed threatened species, which confers considerable protection on its habitats.

Significant Natural Areas (Aquatic): Kern Hot Spring, Soda Springs Creek

Overall Quality Rating: 2.3

Reasons for Rating: Although this is a high mountain region that minimally disturbed by logging and mining, grazing has had a major impact on the meadows and secondarily the streams. The Kern Plateau region contains many endemic or unusual animals and plants.

IBI Score: 76

UCD Surveys?: No

Sources:

Knapp, R. A. and T. L. Dudley. 1990. Growth and longevity of golden trout, *Oncorhynchus aquabonita*, in their native streams. California Fish and Game 76:161-173.

Date: 30 December 1994 **Compiler:** PBM

ADMA WATERSHED

Name: South Fork, Kern River **Drainage:** Kern

CalWater Basin No.: 554.23000 **County:** Kern

Location: Entire drainage, from mouth on Isabella Reservoir to headwaters in Golden Trout Wilderness Area, Inyo National Forest.

Elevation: 874 to 3688 m; mean 2347 m

Drainage Area: 1374 km^2

Description: The South Fork Kern River drains some of the highest peaks in the Sierra Nevada, dropping through steep granitic gorges and long, wide meadows and fed by numerous tributaries. The drainage is in the Kern Plateau, a region which was not glaciated during the Pleistocene and contains many unusual biotic and geologic features as a result. The meadows are typically dominated by pinon pine, juniper, and sagebrush. Monache Meadows is the largest meadow system in the Sierra Nevada. The drainage is mostly in wilderness areas so has

few roads although Highway 178 parallels the last 15 km of river. The high elevation parts of the drainage are covered with subalpine forests dominated by foxtail and lodgepole pine. A large cottonwood-alder riparian forest exists along part of the lowermost reaches.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1152 Mountain pond; A1210 Alpine lakes; A2110 Alpine snowmelt stream; A2120 Conifer forest snowmelt stream; A2411 Alpine stream; A2412 Forest stream; A2414 Meadow stream; A2423 Kern golden trout stream.

Native Fishes: South Fork Kern golden trout (C), Sacramento sucker (C). Non-native fishes include rainbow trout(C) and brown trout (C).

Amphibians: Mountain yellow-legged frog; endemic slender salamanders.

Other Vertebrates: Yellow-billed cuckoo (lower reaches).

Invertebrates: No information available.

Riparian Zone: The lowermost reaches supports the largest contiguous cottonwood/willow riparian forests in the state. In gorges, the riparian zone is narrow and rocky. The meadow systems are large and expansive and of a unique physiographic variety found only in the southern Sierra.

Human Impacts: The river ends in a reservoir. Farms and ranches occur along the lowermost reach, which is also paralleled by a highway. Extensive grazing by livestock occurs in meadows throughout the drainage. The drainage is a popular back country recreation region including off-road vehicle use in some areas. A small airport exists in Monache Meadows. Introduced fishes, especially brown trout, displace native golden trout.

Ownership: 88% of the drainage is in Sequoia and Inyo National forests, while 12% is private (mostly the lowermost reach in South Fork Valley).

Existing Protection: 76% of the drainage is in three wilderness areas (Dome Land, Golden Trout, South Sierra) and another 12% is managed by the USFS as well. The Nature Conservancy has created the Kern River Preserve to protect riparian forest in South Kern Valley. The USFS sections have been given Wild and Scenic River designation.

Significant Natural Areas (Aquatic): None identified.

Overall Quality Rating: 2.2 for reaches in wilderness areas, 2.5 for reach in South Fork Valley.

Reasons for Rating: Except for the effects of grazing, motorized recreation, and introduced trout, the USFS portions of the drainage are fairly pristine. The South Fork Valley contains a remarkable riparian forest but the river is dominated by non-native fishes.

IBI Score: 72

Notes: A considerable amount of research on the flora and fauna of this watershed has been conducted.

UCD Surveys?: No.

Sources:

Sequoia National Forest Long Range Management Plan.

Odion, D. C., T. L. Dudley, and C. M. D'Antonio. 1988. Cattle grazing in southeastern Sierran meadows: ecosystem change and prospects for recovery. Pages 277-292 in C. A. Hall and V. Doyle-Jones, eds. Natural history of the White-Inyo Range. Vol. 2. White Mountain Research Station, UC Los Angeles.

Date: 10 November 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Eagle Lake **Drainage:** Eagle Lake

CalWater No.: 637.31000 and 32000 **County:** Lassen

Location: Entire drainage, including Pine Creek watershed.

Elevation Range: 1585 to 2444 m; mean 1789 m

Drainage Area: 1113 km^2

Description: The Eagle Lake watershed is closed basin with Eagle Lake as its terminus. It is located in a semi-arid plateau landscaped by ancient volcanoes and lava flows. The southern half of the basin is characterized by steep, pine-covered slopes, while the northern half is more arid, with rounded mountains (including the highest peak, Fredonyer) dominated by juniper and sagebrush. The principal drainage that feeds the lake is Pine Creek, which has its headwaters in alpine lakes in the Caribou Wilderness near Lassen National Park and flows 70 km to reach Eagle Lake. Other much smaller drainages include Papoose Creek and Merrill Creek. The alpine tributaries of Pine Creek are intermittent most of the time and the creek does not become permanent until Stephen's Meadow, the first of a series of wide meadows (Pine Creek Valley, McCoy Flat) through which the creek flows and gathers water before reaching the lake. The lowermost reaches flow through mixed conifer forest and are intermittent or dry in summer. Eagle Lake is a large (area ca. 90 km^2), alkaline (pH 8.4-9.6), lake with three basins, two shallow (max depth ca. 5 m) and one deep (max. depth ca. 23 m). There are numerous springs in the basin, which may or may not drain into lake tributaries. The only outlet to the lake is Bly Tunnel, built in 1922, and now blocked, but still siphoning some water from the lake.

Aquatic Province: Great Basin

Habitat Types: C1120 Mountain pond; C1210 Alpine lake; C1221 Great Basin scrub perennial pool; C1222 Spring pool; C1313 Caldera lake; C1320 Eagle Lake; C2110 Alpine snowmelt stream; C2120 Conifer snowmelt stream; C2130 Great Basin scrub snowmelt stream; C2212 Exposed alpine stream; C2213 Spring stream; C2215 Meadow stream; C2333 Pine Creek; C2340 Speckled dace stream.

Native Fishes: Eagle Lake trout (C), Eagle Lake tui chub (A), speckled dace (A), Tahoe sucker (A), Lahontan redside (A). Non-native brook trout present in Pine Creek.

Amphibians: Pacific tree frogs (C), western toad (C), Cascade frog (R), spadefoot toad (U)

Other Vertebrates: Osprey, bald eagle, white pelican, western grebe, Clark's grebe, eared grebe, double crested cormorant, various herons and egrets are abundant on Eagle Lake, as are a variety of migratory shorebirds and waterfowl. Three species of garter snakes are common along the streams.

Invertebrates: Fauna of lake is low in diversity but abundant; several presumably endemic molluscs. Wide variety of forms in ponds and streams in drainage.

Riparian Zone: Meadow and sagebrush flats (presumably once meadow) predominant riparian habitat along permanent streams. Lake shore ranges from Jeffrey-yellow pine forest to juniper-sagebrush desert.

Human Impacts: Grazing and logging in the past have caused major changes to the Pine Creek drainage, making it largely inaccessible to Eagle Lake trout. Both activities still taking place but at reduced levels. Recreational use of the lake and lake shore is fairly heavy in places and a small community (Spaulding) exists that is expanding. Drainage is extensively roaded.

Ownership: Pine Creek drainage is mostly in Lassen National Forest, although Stephens Meadow (a crucial spawning and rearing area for Eagle Lake trout) is privately owned. The land around the lake is a mixture of public (USFS, BLM) and private ownership.

Existing Protection: Some headwaters in Caribou Wilderness Area but most has no special protection. Eagle Lake is managed by the California Department of Fish and Game as a trophy trout fishery.

Significant Natural Areas (Aquatic): Stephens Meadow, Papoose Meadow, Mahogany Lake.

Overall Quality Rating: 2.3

Reasons for Rating: Eagle Lake is largest lake in California still without significant exotic species, an intact native lake ecosystem. However, Eagle Lake trout are maintained entirely by hatcheries. The drainages feeding the lake are in the process of being restored, although they have suffered heavy logging, grazing, and roading in the past.

IBI Score: 72

Notes: CSU Chico and UC Davis maintain a field station on Eagle Lake for teaching and research in the area. Lassen National Forest is developing a Coordinated Resource Management Plan for the Pine Creek watershed.

UCD Survey Numbers: Several years of quantitative sampling of Pine Creek and Eagle Lake.

Sources:
Unpublished reports, P. B. Moyle, University of California, Davis
Eagle Lake Ranger District, Lassen NF, 1994. Draft Environmental Assessment, Pine Creek Coordinated Resource Management Plan. 33 pp. + appendices.

Date: 30 November 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Willow Creek **Drainage:** Susan River

Calwater No.: 637.40010-40030 **County:** Lassen

Location: Entire drainage, from headwaters (Murrer's Meadows, near Eagle Lake) to bridge on Belfast Road, which marks the approximate spot where the creek emerges from the canyon to flow through agricultural land.

Elevation Range: 1275 to 2401 m; mean 1659

Drainage Area: 653 km^2

Description: Headwaters are springs along meadow and Bly Tunnel, from Eagle Lake. Upper ca. 12 km heavily grazed meadow/forest stream, <1% gradient. Diverted for irrigation and channelized etc. through Willow Creek valley (ca. 15-20 km), including state wildlife refuge. Lower 20-25 km of mainstem flows through deep lava canyon, often steep and rocky (1-4% gradient), water tea-colored. Minimum summer flows 5-15 m3 per min., highest in lower reaches. Summer temperatures approach or exceed 25 C in most areas, so marginal for trout. Large brown trout present in lower canyon in low numbers and are sought by anglers, although access is difficult. Tributaries (e.g., Pete's Creek) to the lower creek drain large areas of dry scrub and canyon and have been unexplored from a biological perspective. One of the sources of Pete's Creek is Horse Lake, a large playa which is usually dry in summer.

Aquatic Province: Great Basin

Habitat Types: C1110 Alkali playa lake; C2120 Conifer forest snowmelt stream; C2213 Spring stream (seeps); C2332 Sucker/dace/redside stream.

Native Fishes: Tui chub (C), Lahontan redside (A), speckled dace (A), Tahoe sucker (A), mountain sucker (C, only occurrence in Susan River Drainage.), Paiute sculpin (C). Abundance very high in canyon. Mountain sucker present in small numbers in canyon only. Very small numbers of rainbow trout in upper reaches; brown trout in canyon.

Amphibians: Non-native bullfrogs abundant throughout drainage.

Other Vertebrates: Upper reaches important feeding areas for aquatic birds (egrets, herons, terns, etc.). Three species of garter snakes in riparian areas (western, aquatic, common).

Invertebrates: Diverse aquatic insect and mollusc fauna, very dense in places, especially where aquatic plants abundant. Signal crayfish present in lowermost reaches (mouth of canyon).

Riparian Zone: Heavily impacted by grazing throughout, especially meadow systems. Riparian zone narrow in canyons.

Human Impacts: Heavily grazed in upper reaches, so little development of riparian vegetation, stream wide and shallow. Valley is irrigated pasture/hay lands/wildlife refuge, so water returned to stream is warm and turbid. BLM lands in canyon have also been heavily grazed but impact reduced in recent years. Logging and wildfires in surrounding hills.

Ownership: Most of upper reaches through Willow Creek Valley in private ranch land, although forested land in drainage a mixture of public (USFS) and private ownership. Some CDFG land in valley (refuge). Canyon is mainly BLM land.

Existing Protection: Canyon is in proposed wilderness area. BLM recognizes unique nature of canyon and is managing it to reduce human impacts.

Significant Natural Areas (Aquatic): None identified, although Murrer's Meadow (headwaters) may qualify.

Overall Quality Rating: Upper reaches, 2.6, valley reaches, 2.9, canyon reaches 2.2.

Reasons for Rating: With the exception of cutthroat trout, the drainage contains all the native fishes of the region, including mountain sucker (a CDFG Species of Special Concern). The invertebrate fauna is rich and probably contains a number of endemic species, especially molluscs. While the entire drainage has been heavily

grazed and logged, none of the damage to the stream system is irreversible, except the replacement of native leopard (?) frogs by bullfrogs.

Notes: Headwaters are close to the Eagle Lake Field Station (CSU Chico) so creek has been used for student studies. Bly Tunnel delivers some Eagle Lake water to the creek.

IBI Score: 68

UCD Surveys?: Yes, by students from Eagle Lake Field Station

Sources:

Houk, A., R. Kaufman, and P. B. Moyle. 1994. Distribution and status of fishes of Willow Creek, Lassen County. Unpublished Report, UC Davis.
Aceituno, M. 1980. 1980 Willow Creek survey. File Report BLM, Susanville.
Moyle, P. B., et al. 1991. Fishes of Bly Tunnel, Lassen County, California. Great Basin Naturalist 51:267-270.

Date: 20 October 1994 **Compiler:** PBM

ADMA WATERSHED

Name: Upper Little Truckee River **Drainage:** Truckee River

Calwater No.: 636.00010-00022 **County:** Sierra (mostly); Nevada (some headwaters)

Location: Entire upper drainage, from headwaters to Stampede Reservoir. Includes Independence and Webber Lakes, Independence Creek and Cold Stream. Some of lower reaches run along Highway 89.

Elevation Range: 1704 to 2767 m; mean 2114 m

Drainage Area: 232 km^2

Description: Headwaters are a small, high gradient forested streams. Independence and Webber lakes are large natural alpine lakes containing native fishes. The streams reaches below the lakes are largely a braided meadow streams with a fine-substrate bottoms and dense riparian vegetation (in places). Perazzo Meadows along the main lower Truckee River are broad, heavily grazed, and surrounded by mixed conifer forest on the uplands.

Aquatic Province: Great Basin

Habitat Types: C1240 Fen; C1311 Alpine lake (with native fish); C2120 Conifer forest snowmelt stream; C2214 Conifer forest stream; C2310 Trout headwater; C2331 Sucker/dace/redside stream with cutthroat trout; C2350 Whitefish/cutthroat trout/sucker stream.

Native Fishes: Lahontan cutthroat trout (upper Independence Creek and Independence Lake) (R), mountain whitefish (C), Tahoe sucker (A), Lahontan redside (A), Lahontan speckled dace (A), mountain sucker (C), Paiute sculpin (A). Non-native brown trout and rainbow trout in most streams sections. Other non-native fishes in lakes.

Amphibians: Not known

Other Vertebrates: Various aquatic birds (dippers, egrets, etc.). Introduced beaver may play a major role in stream ecology.

Invertebrates: Moderately diverse and abundant.

Riparian Zone: Willow often abundant in meadows but riparian areas often altered by livestock.

Human Impacts: Much of the drainage has been logged in recent years. Independence Lake is "notched" and levels are lowered annually for water deliveries, increasing late-season flows down Independence Creek. Much of the flow of the Little Truckee above its confluence with Independence Creek is diverted (in part illegally) into a ditch for use by ranchers in the Sierra Valley (Erman 1992). Heavy grazing in meadows and on streambanks. Considerable recreational use of drainage. Highway 89 runs along part of the main Little Truckee River and other roads parallel the river and tributaries.

Ownership: Mixed private and public ownership, although headwaters are mostly in Tahoe NF.

Existing Protection: None

Significant Natural Areas (Aquatic): Independence Lake

Overall Quality Rating: 2.6

Reasons for Rating: Drainage has been logged and grazed for 100+ years and has been extensively roaded but it is still in good enough condition so that it supports a full spectrum of native fishes. Independence Lake and upper Independence Creek are among the few places where Lahontan cutthroat (federally listed threatened species) still persist in their natural range (rating 2.2). The Little Truckee River from the diversion to Stampede Reservoir is rated 2.9 because of the combined effects of Highway 89, Stampede Reservoir, the upstream diversion, high late summer flows down Independence Creek, and heavy grazing on the surrounding meadows. Lakes in drainage are among few in Sierra Nevada to which fish are native.

IBI Score:

Notes: This is one of two several watersheds (including Sagehen Creek, also listed as an ADMA watershed) that are part of the Little Truckee River drainage but that are now isolated from each other by Stampede and Prosser Reservoirs. The upper Little Truckee Watershed is the only watershed of the three containing cutthroat trout and large lakes.

UCD Surveys?: Yes, 1993 and previously.

Sources:

E. Gerstung, CDFG, personal communication; D.Erman, UCD, personal communication.

Erman, D. C. 1992. Historical background of long-term diversion of the Little Truckee River. Pages 415-427 in C. A. Hall, V. Doyle-Jones, and B. Widawski (eds.). The history of water: Eastern Sierra Nevada, Owens Valley, White-Inyo Mountains. White Mountain Research Station Symposium 4.

Date: October 20, 1994 **Compiler**: PBM

ADMA WATERSHED

Name: Sagehen Creek **Drainage:** Truckee

Calwater No.: 636.00030-00031 **County:** Nevada and Sierra

Location: Headwaters on Carpenter Ridge and Sagehen Hills to mouth on Stampede Reservoir

Elevation Range: 1827 to 2623 m; mean 2091

Drainage Area: 44 km^2

Description: Sagehen Creek is a small alpine stream that drains numerous boggy meadows and logged-over forest lands. Its uppermost headwaters are high gradient, rocky streams while the lower tributaries are short, often seasonal, forest and meadow streams. The middle reaches are lined with meadows and mixed conifer forest and there are numerous beaver dams that create a succession of small ponds. Below the crossing of highway 89, the creek meanders through meadows between forested hills before ending in Stampede Reservoir. The reservoir is created by a dam on the Little Truckee River. Besides the creek, the watershed contains numerous springs of various sizes and chemistry, most with constant temperatures (3.5-9 C). There are also a number of fens in the drainage.

Aquatic Province: Great Basin

Habitat Types: C1120 Mountain pool; C1240 Fen; C2110 Alpine snowmelt stream; C2120 Conifer forest snowmelt stream; C2213 Springs; C2214 Conifer forest stream; C2215 Meadow stream; C2310 Trout headwater; C2320 Trout/sculpin stream; C2331 Sucker/dace/redside stream.

Native Fishes: Piaute sculpin (A), Tahoe sucker (A), mountain sucker (R), Lahontan redside (C), speckled dace (?), mountain whitefish (R). Nonnative trout (brown, rainbow, brook) abundant.

Amphibians: Few records

Other Vertebrates: Garter snakes common, dippers, etc.

Invertebrates: Abundant and diverse. N. Erman (1989) identified 77 species of caddisflies (Tricoptera) from the drainage and noted the diversity of other aquatic invertebrates as well, although the exceptional diversity is partly related to the many studies that have taken place in the watershed.

Riparian Zone: Much of the riparian zone is alpine meadow and fens.

Human Impacts: Drainage has been extensively logged and grazed, especially by sheep. Sagehen Creek is heavily fished, especially where Highway 89 crosses it. Stampede Reservoir has a major effect on the fish fauna of the lower reaches (D. Erman 1986).

Ownership: Entire drainage is in Tahoe National Forest.

Existing Protection: No fishing allowed in vicinity of Sagehen Creek Field Station.

Significant Natural Areas (Aquatic): See notes

Overall Quality Rating: 2.4

Reasons for Rating: Drainage is in reasonably good condition considering the history of use and the creek is dominated by native aquatic species (except for trout).

IBI Score:

Notes: Site of the Sagehen Creek Field Station of University of California, Berkeley. As a consequence, the creek and surrounding areas are among the most studied ecosystems in the Sierra Nevada. The size of the watershed is smaller than other ADMA watersheds in the Sierra Nevada but unified landownership, the spring-fed nature of the stream, its present isolation (by the reservoir) and the intensive studies in the drainage justify its treatment as an ADMA watershed rather than a significant natural area.

UCD Surveys?: Yes

Sources:

Erman, D. C. and N. A. Erman. 1975. Macroinvertebrate composition and production of some Sierra Nevada minerotrophic peatlands. Ecology 56:591-603.

Erman, D. C. 1986. Long-term structure of fish populations in Sagehen Creek, California. Trans. Amer. Fish. Soc. 115:682-692.

Erman, N. A. 1989. Species composition, emergence, and habitat preferences of Trichoptera of the Sagehen Creek basin, California, USA. Great Basin Naturalist 49:186-197.

Date: 26 November 1994 **Compiler:** PBM

ADMA WATERSHED

Name: East Fork Carson River **Drainage:** Carson River

Cal Watershed No.: 632.10000 **County:** Mono

Location: From headwaters to the confluence with Bryant Creek (including Bryant Creek) in Nevada.

Elevation: 1522 to 3459 m; mean 2325 m

Drainage Area: 893 km^2

Description: The river originates at the eastern base of the Sierra Nevada crest in the Carson-Iceburg Wilderness Area which is managed by the Toiyabe National Forest. Steep gradient tributaries flow north through forested canyons and subalpine meadows which contain the last refuges for Paiute cutthroat trout. Most of these meadows are grazed by cattle, but some areas contain cattle exclosures to protect trout habitat. The upper reaches are only accessible by foot trails. The river through the East Carson River Canyon, in a wide flood plain vegetated with willow and aspen groves. Highways 89 and 4 follow the lower reaches of the river canyon altering the topography of the east bank. The river continues into Nevada and eventually meets the West Fork and empties in the Carson Sink.

Aquatic Province: Great Basin

Habitat Types: C1311 Alpine lakes; C2110 Alpine snowmelt stream; C2120 Conifer forest snowmelt stream; C2130 Great basin scrub snowmelt stream; ?C2212 Alpine stream; C2213 Spring stream; C2214 Conifer stream; C2215 Meadow stream; C2310 Trout headwater; C2320 Cutthroat trout/Paiute sculpin stream; C2350 Whitefish/cutthroat trout/sucker stream.

Native Fishes: Paiute cutthroat trout (R), Lahontan cutthroat trout (R), mountain whitefish (C), Paiute sculpin (A), Tahoe sucker (A), mountain sucker (C), speckled dace (C), Lahontan redside (C).

Amphibians: Mountain yellow-legged frogs observed in Whitecliff Lake.

Other Vertebrates: Dippers.

Invertebrates: Many streams have fairly fine substrates, so invertebrate diversity is low in these areas.

Riparian, Wetland Habitats: Riparian vegetation ranges from sedge/rush and grass/forbs/sagebrush to mixed conifer forest in the uplands. Meadow streams have been heavily grazed although some sections of streams are protected by cattle exclosures. Meadow vegetation is dominated by Nebraska sedge and silver sagebrush communities.

Human Impacts: Grazing occurs in most of the meadow areas, although riparian areas of the river with Paiute cutthroat trout have been fenced off. Camping and fishing are present throughout the drainage; fishing pressure is especially high along the highway sections. Mine tailings and effluent is a problem in the lower reaches. Introduced trout are displacing the native cutthroat, leaving small headwater tributaries with barriers as the last refuges.

Ownership: Predominantly in Toiyabe NF with some sections in BLM land and private lands. Lower section in State of Nevada.

Existing Protection: Wild Trout Management Area in the headwaters of the drainage allows no fishing in areas that still contain Paiute cutthroat trout. Headwaters are also in the Carson-Iceburg Wilderness Area which allows access only by foot.

Significant Natural Areas (Aquatic): Silver King Creek above Llwellyn Falls (Paiute cutthroat trout stream); Whitecliff Lake (fishless lake with frogs)

Overall Quality Rating: 2.3 in Wilderness , 2.5 below Silver King Creek confluence.

Reasons for Rating: Headwater tributaries are one of the last remaining refuges for Paiute cutthroat trout, a federally listed endangered species. Wilderness Area has only trail access. Outside the wilderness areas, the river and the watershed is accessible and roaded, but the fish fauna is largely native.

IBI Score: 64

Notes:

UCD Surveys?: Informal, 1994.

Sources:

California Department of Fish and Game. 1986. Survey of Fish Populations in Carson River Drainage, IFD Admin. Report 86.

California Department of Fish and Game. 1983. Fish survey of Carson River drainage, 1983. IFD admin. report no. 86-1.

Compiled: December 23, 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: West Walker River **Drainage:** Walker River

Cal Watershed No.: 631.40000 **County:** Mono

Location: From the headwaters adjacent to Hoover Wilderness Area to Sonora Junction at the confluence of Little Walker River, including the Little Walker River drainage.

Elevation Range: 1557 to 3566 m; mean 2505 m

Drainage Area: 846 km^2

Description: West Walker River originates on the eastern slope of the Sierras in Toiyabe National Forest just north of Yosemite National Park. Little Walker River has its headwaters in Hoover Wilderness Area. The headwater tributaries flow north through steep forested terrain eventually coming together in a broad valley near Sonora Junction. Most of the drainage is inaccessible by road with the exception of Highway 108 which runs parallel to the West Walker River in the lower section of the watershed.

Aquatic Province: Lahontan

Habitat Types: C1311 Alpine lakes; C2120 Alpine snowmelt stream; C2120 Conifer forest snowmelt stream; C2130 Great basin scrub snowmelt stream; C2212 Alpine stream; C2213 Spring stream; C2214 Conifer stream; C2215 Meadow stream; C2310 Cutthroat trout headwater; C2320 Cutthroat trout/Paiute sculpin stream; C2350 Whitefish/cutthroat trout/sucker stream

Native Fishes: Lahontan cutthroat trout (R), speckled dace (C), mountain whitefish (C), Paiute sculpin (C), Lahontan redside (C), mountain sucker (R), Tahoe sucker (A). Non-native rainbow trout, brook trout, and brown trout abundant.

Amphibians: Unknown

Other Vertebrates: Unknown

Invertebrates: Moderately diverse and abundant (description for Molybdenite Creek)

Riparian, Wetland Habitats: Dense willow and aspen thickets in riparian areas, but meadows affected by grazing.

Human Impacts: Hunting, horseback riding and fishing occurs in drainage. Few roads restrict public access. Area along Highway 395 is altered by road, USMC Mountain Warfare Training Center, and other roadside development.

Ownership: USFS Toiyabe NF for most of the drainage with a portion of privately owned land at Sonora Junction.

Existing Protection: Headwaters of Little Walker River is in Hoover Wilderness Area.

Significant Natural Areas (Aquatic): Little Walker River (headwater sections with Lahontan cutthroat trout)

Overall Quality Rating: 2.4

Reasons for Rating: Some sections of headwater streams still contain Lahontan cutthroat trout, although introduced trout are present in downstream areas. Most of the drainage is accessible by foot trails only, so disturbance to streams is relatively low.

IBI Score: 68

Notes:

UCD Surveys?: Yes, 1993

Sources:

Ellison, J. P. 1980. Diets of mountain whitefish, *Prosopium williamsoni*, and brook trout, *Salvelinus fontinalis*, in the Little Walker River, Mono County, California. California Fish and Game 66:96-104.

Compiled: 30 December, 1994 **Compiler:** PR

ADMA WATERSHED

Name: Buckeye Creek **Drainage:** East Walker River

Calwater No.: 630.40020-40022 **County:** Mono

Location: From headwaters to Bridgeport Valley. By-Day Creek is a disjunct part of the watershed.

Elevation: 2071 to 3604 m; mean 2787 m

Drainage Area: 91 km^2

Description: Third order, moderate gradient, boulder substrate dominated eastern Sierran trout stream.

Aquatic Province: Great Basin

Habitat Types: C2120 Conifer forest snowmelt stream; C2214 Conifer forest stream; C2310 Trout headwater.

Native Fishes: Lahontan cutthroat trout (R, in By-day Creek only); Mountain whitefish (C). Non-native rainbow, brown, and brook trout present.

Amphibians: No records

Other Vertebrates: No records

Invertebrates: No records

Riparian Zone: Riparian zone consisting of aspen, willow, cottonwood and Jeffery Pine in reasonably good condition in much of middle drainage. Heavily grazed meadows present in many areas.

Human Impacts: Grazing has degraded stream banks and reduced riparian vegetation in important meadow areas that support threatened cutthroat trout. Logging is also present in the drainage.

Ownership: Most of the drainage is within Toiyabe NF. Meadows in middle reaches of By-day Creek are privately owned.

Existing Protection: None, although Lahontan cutthroat trout are a federally listed threatened species.

Significant Natural Areas (Aquatic): By-Day Creek (not usually connected directly to creek since it flows into Bridgeport Valley).

Overall Quality Rating: 2.5

Reasons for Rating: Watershed has many natural attributes, including native fishes, but has been degraded by grazing, road, and introduced trout.

IBI Score:

Notes: By-Day Creek are one of the few remaining streams in California where native cutthroat trout still occur.

UCD Surveys?: Yes, 1993 and previously.

Sources:

Coffin, P. D. and W. F. Cowan. 1995. Lahontan cutthroat trout *(Oncorhynchus clarki henshawi*) recovery plan. USFWS, Portland. 108 pp.

Date: 29 December 1994 **Compiler:** PBM, PR

ADMA WATERSHED

Name: Mono Lake **Drainage:** Mono Lake

Calwater No.: 601.00000 **County:** Mono

Location: Entire drainage from headwaters to Mono Lake, including "dry" drainages on Nevada side.

Elevation: 2179 to 3976 m; mean 2428

Drainage Area: 1747 km^2

Description: The Mono Basin has three broad aquatic habitat areas: (1) Mono Lake, a large, terminal, alkaline lake, (2) steep forested drainages on the eastern side of the Sierran Crest and (3) broad desert washes of the Great Basin. Mono Lake is a highly saline lake with an abundant population of endemic brine shrimp (*Artemia monica*) and other aquatic invertebrates which are an important food source for migrating waterfowl. The lake is renowned for its tufas, towers of calcium carbonate and argonite, that rise up above the water surface. The area around the lake is geologically diverse, comprised of lava buttes, sand dunes and desert washes. The major tributaries to Mono Lake originate from snowmelt of the eastern Sierras and springs. These streams and alpine lakes were historically fishless but now contain at least six species of fish. The streams are all regulated and the lower reaches of Rush, Lee Vining, and other creeks had been dry as the result of diversions until recently. They are now in a recovery phase.

Aquatic Province: Great Basin

Habitat Types: C1120 Mountain pool; C1130 Great Basin scrub pool; C1210 Alpine lake; C1222 Spring pool; C1232 Mono Lake; C2110 Alpine snowmelt stream; C2120 Conifer forest snowmelt stream; C2130 Great Basin scrub snowmelt stream; C2211 Glacial melt stream; C2213 Spring stream; C2214 Conifer forest stream; C2215 Meadow stream; C2221 Desert scrub stream.

Native Fishes: No fish were native to the basin; the streams flowing into Mono Lake now contain rainbow, brown and eastern brook trout, as well as threespine stickleback, Owens sucker, and tui chub.

Amphibians: Great Basin spadefoot toads breed in small permanent ponds in the dunes. Mountain yellow-legged frog in some high elevation areas.

Other Vertebrates: Over 100 species of waterbirds and shorebirds have been observed at Mono Lake. California Gull, Eared Grebe, Wilson's Phalarope, and Red-necked Phalarope are especially dependent on brine shrimp and flies during significant portions of their life cycle.

Invertebrates: The endemic Mono brine shrimp, alkali fly (and seven other species of flies) are a major food source for several species of birds. The brine shrimp have been proposed for inclusion on the federal endangered species list.

Riparian Zone: The once expansive riparian forests along the creeks died following the complete diversion of the streams. With the restoration of minimum stream flows, some recovery of riparian communities is expected. Willows and wild rose are common along streams. At higher elevations, aspen groves are found along streams as well as hillsides where spring and seeps are present. Wet meadows, dominated by sedges, grasses and forbs are found in the basin as well. Approximately 35 percent of the exposed lake shore is a marsh plant community, mostly with a mosaic of bullrush and saltgrass. There are numerous alpine lakes and alpine meadows in the upper drainages on the eastern Sierra crest (upper Lee Vining watershed well described in the USFS ecological survey for the Harvey Monroe Hall RNA; one of the best botanically known RNAs).

Human Impacts: Water diversions by City of Los Angeles from Rush, Parker, Walker and Lee Vining Creeks have significantly lowered Mono Lake water level and increased salinity levels as well as drying up streams. Recent historic legal settlements have resulted in increased flows in the creeks and to the lake. A subsequent reduction in invertebrate populations have decreased the available food supply for several species of migratory waterfowl. Sheep and cattle grazing have degraded riparian and meadow areas. Recreational uses range from OHV use to sightseeing to fishing in the streams.

Ownership: Most of the land area is managed by Inyo NF. Mono Lake is owned by the State of California.

Existing Protection: The Mono Basin National Forest Scenic Area is managed by Inyo National Forest. Harvey Monroe Hall Research Natural Area is the oldest RNA in California (1933). Recent (1994) decisions by the State Water Resources Control Board will raise lake levels and maintain permanent flows in the streams.

Significant Natural Areas (Aquatic): Harvey Monroe Hall Research Natural Area, located 1.6 km north of Tioga Pass, includes 15 alpine lakes, several meadows and 3 glaciers.

Overall Quality Rating: 2.1 Mono Lake, 2.5 headwater areas, 3+ for streams below diversions.

Reasons for Rating: Mono Lake's unique saline ecosystem is still intact and has been protected by recent actions and decisions. The upper watershed is in USFS Wilderness Areas with high diversity of plant communities and wetland habitats, although exotic fish are common. The streams below the diversion will take many years to recover from the devastation they experienced and even then the "recovered" ecosystems will be dominated by exotic trout.

IBI Score: 36 for stream systems overall (but should improve as riparian and instream habitats recover). The lake cannot be scored using the IBI system but has high biotic integrity.

Notes: Mono Lake and the surrounding basin have been intensively studied because of the long dispute over the water rights (resolved in 1994).

UCD Surveys?: Yes (Lee Vining Creek).

Sources:

Keeler-Wolf, T. 1990. Ecological Surveys of Forest Service Research Natural Areas, PSW Technical Report No. 125.

Patten D. T. and Mono Basin Ecosystem Study Committee. 1987. The Mono Basin Ecosystem: effects of changing lake level. National Academy Press, Washington, D.C. 272 pp.

State Water Resources Control Board. 1994. Mono Lake basin water right decision 1631. 212 pp.

USFS. 1989. Inyo National Forest, Mono Basin National Forest Scenic Area, Comprehensive Management Plan.

Compiled: 28 December, 1994 **Compiler:** PR, PBM

ADMA WATERSHED

Name: Convict Creek and Lake **Drainage:** Owens River

Calwater No.: 603.10060-10061 **County:** Mono

Location: From headwaters lakes on the northeast slope of the Mammoth Crest to Crowley Reservoir.

Elevation Range: 2058 to 3909 m; mean 2854 m

Drainage Area: 72 km^2

Description: Convict Creek arises from several small lakes on the northeast slopes of Mammoth Crest and flows north dropping rapidly into Convict Lake. Below Convict Lake the stream is a series of boulder-strewn pools and cascades until it drops into Long Valley where the creek turns east toward Crowley Reservoir. The creek meanders through sagebrush flats, meadows, and pasturelands that are heavily grazed by cattle (land managed by Los Angeles Water and Power).

Aquatic Province: Great Basin

Habitat Types: C1210 Alpine Lakes; C2110 Alpine snowmelt stream; C2120 Conifer forest snowmelt stream; C2130 Great Basin scrub snowmelt stream; C2212 Exposed alpine stream; C2214 Conifer forest stream; C2215 Meadow stream.

Native Fishes: Owens sucker were originally found in the lower creek up to and including Convict Lake (the only lake in the Owens drainage with native fish). Dominant non-native fishes are rainbow trout, brown trout, and brook trout.

Amphibians: Mountain yellow-legged frogs present.

Other Vertebrates: Nothing unusual

Invertebrates: Abundant and diverse, but altered by predation from exotic fish.

Riparian Zone: Riparian vegetation is largely absent from the lowermost reaches due to grazing. In the reaches above Convict Lake, riparian vegetation (willows, alder) is often well-developed.

Human Impacts: Introduced trout dominate the fish biota for most of the drainage. Cattle have degraded the lower reaches of the creek, causing bank instability and removal of riparian vegetation. The meadows along the creek in this area may be flood irrigated.

Ownership: Most of watershed down to Highway 395 is in Inyo National Forest; the lowermost reaches are LADWP land.

Existing Protection: Watershed above Convict Lake is in John Muir Wilderness Area

Significant Natural Areas (Aquatic): None identified.

Overall Quality Rating: 2.4 above Convict Lake, 2.6 in the lake and below.

Reasons for Rating: Drainage in wilderness area mainly affected by exotic trout, grazing and recreational use. Lowermost reaches heavily grazed.

IBI Score: 68

Notes: Site of Sierra Nevada Research Laboratory of the University of California.

UCD Surveys?: No

Sources:

Deinstadt, J. M., G. F. Sibbald, J. D. Knarr, and D. M. Wonmg. 1985. Surveys of Fish Populations in streams of the Owens River drainage: 1983-84. California Department of Fish and Game IFD Admin. Report 85-?. 102 pp.

Reimers, N., J. A. Maciolek, and E. P. Pister. 1955. Limnological study of the lakes in Convict Creek Basin, Mono County, California. USFS Fishery Bulletin 56:437-503.

Date: August 1 1995 **Compiler**: PBM

AQUATIC SIGNIFICANT NATURAL AREAS OF THE SIERRA NEVADA: EXAMPLES

Aquatic Significant Natural Areas (SNAs) are watersheds or portions of watersheds that are notable for their concentration of native organisms, as habitat for rare or endangered species, or for their relatively pristine nature. They also are small in area so are less suitable for “multiple use” management than watershed ADMAs . Most

require fairly intense management and protection to maintain their value for the protection of aquatic biodiversity and are therefore more likely to be thought of as traditional preserves. The areas listed here are only examples because we lacked the time during the SNEP process to do an intensive identification investigation of potential SNAs.

AQUATIC SIGNIFICANT NATURAL AREA

Name: Independence Lake and Creek **Drainage:** Little Truckee River

Calwater No.: 105.31026 **County:** Nevada

Location: Upper Independence Creek from headwaters to (and including) Independence Lake.

Elevation: 2118 (lake)-2500 m

Drainage Area:

Description: Drainage above Independence Lake is a small, high gradient forested stream. Independence Lake is a large natural alpine lake. The exit from the lake has been "notched" so that the lake level can be lowered for water supply.

Aquatic Province: Great Basin

Habitat Types: C1310 Alpine lake (with native fish); C2120 Conifer forest snowmelt stream; C2214 Conifer forest stream; C2310 Cutthroat trout headwater; C2331 Sucker/dace/redside stream with cutthroat trout.

Native Fishes: Lahontan cutthroat trout (C), Tahoe sucker (A), Lahontan redside (A), Lahontan speckled dace (C), mountain sucker(?), Paiute sculpin (C).

Amphibians: Not known

Other Vertebrates: Not known

Invertebrates: Moderately diverse and abundant.

Riparian Zone: Narrow but present

Human Impacts: Much of the drainage has been logged in recent years. Lake has been "notched" at mouth so levels can be lowered annually for water deliveries. Heavy grazing occurs in meadows and on streambanks in places. Considerable recreational use of drainage, but access mainly by foot trail.

Ownership: Headwaters and part of lake is in Tahoe NF but half of lake near outlet is privately owned, as is first 2 km of stream below lake.

Existing Protection: Lahontan cutthroat trout is a federally listed threatened species.

ADMA Watershed: Part of Upper Little Truckee River ADMA watershed.

Overall Quality Rating: 2.3

Reasons for Rating: Drainage has been logged and grazed for 100+ years but is still in reasonably good condition. Lake and upper creek are among the few places where Lahontan cutthroat trout still persist in their natural range.

IBI Score: 84

Notes: Independence Lake is unusual for an alpine lake in the Sierra Nevada in that it naturally contained fishes.

UCD Surveys?: Yes, 1993.

Sources:

E. Gerstung, CDFG, personal communication; D. Erman, UCD, personal communication.

Date: 20 October 1994 **Compiler:** PBM

SIGNIFICANT NATURAL AREA

Name: Three Meadows **Drainage:** South Fork Stanislaus

Calwater No.: **County:** Tuolumne

Location: Upper headwaters of northern tributary to South Fork Stanislaus River. About 1.5 km north of Waterhouse Lake on the Emigrant Wilderness boundary.

Elevation: ca. 2400 m

Drainage Area:

Description: Small subalpine meadow with perennial, fishless stream. Meadow has mostly grasses and low herbaceous groundcover surrounded by red fir forest. Stream biota included large number of tree frogs and toad tadpoles.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A2120 conifer forest snowmelt stream; A2412 Forest stream; A2414 Meadow stream

Native Fishes: None

Amphibians: Pacific tree frogs abundant in lower meadow; *Bufo* sp. in middle meadow. Mountain yellow-legged frog probably present.

Other Vertebrates: Unknown.

Invertebrates: A cursory survey indicated aquatic insects were not particularly diverse or abundant, but unusual or endemic forms are probably present.

Riparian, Wetland Habitats: Wet meadow habitat with riparian vegetation along water's edge.

Human Impacts: Cattle grazing and ORV use in meadows.

Ownership: Entirely within Stanislaus NF.

Existing Protection: None

ADMA Watershed?: Part of South Fork Stanislaus ADMA watershed.

Overall Quality Rating: 2.4

Reasons for Rating: A natural meadow system that shows signs of continuous abuse by humans and livestock, yet seems to be an important breeding area for amphibians.

IBI Score: Not applicable

Notes: A thorough biological inventory of this meadow system is needed.

UCD Surveys?: Yes, 1993.

Sources:

Date: 29 December 1994 **Compiler:** PR, PBM

SIGNIFICANT NATURAL AREA

Name: Mill Creek **Drainage:** Feather River

Calwater No.: 518.42000 **County:** Plumas

Location: From headwaters in Bucks Lake Wilderness to inlet at Bucks Lake.

Elevation Range: 1571-2111 m

Drainage Area:

Description: The watershed contains 1st to 4th order streams with an estimated mean annual precipitation of ca. 230 cm inches. The upper reaches are in a steep granitic canyon which has limited access. The lower section of the creek is more accessible and contains a 20 m waterfall, about 3 km above Bucks Lake, that historically was an upstream fish barrier. Mill Creek is surrounded by a mixed conifer forest dominated by red firs, interspersed with large patches of manzanita chaparral.

Aquatic Province: Sacramento-San Joaquin

Habitat Types: A1280 Sphagnum bog; A2120 Conifer snowmelt stream; A2412 Forest stream; A2421 Resident rainbow trout stream.

Native Fishes: Rainbow trout. Non-native brook trout present above barrier.

Amphibians: Unknown

Other Vertebrates: Unknown

Invertebrates: 1993 summer spot survey describes aquatic insects as being low in diversity and abundance dominated by small mayflies.

Riparian, Wetland Habitats: Short alder and willow thickets along stream margin. Submerged and raised bog habitat types as well as wet and moist meadow wetlands are present within the USFS Research Natural Area.

Human Impacts: Cattle grazing has been a consistent pressure in this watershed for many years. By end of summer, grazing exerts a strong visual impact on the vegetation of the bog, meadow and riparian areas. Camping and fishing pressure also have negative impacts to the area above Bucks Lake. However, a significant stretch of the stream is very difficult to access from the road and should be relatively undisturbed.

Ownership: Mostly Plumas NF land interspersed by private land.

Existing Protection: Bucks Lake Wilderness Area in the upper reaches and Mount Pleasant Research Natural Area, both managed by Plumas NF. Potential USFS RNA.

ADMA Watershed?: No

Overall Quality Rating: 2.2

Reasons for Rating: Unique assemblage of aquatic habitats with existing management to protect these areas.

IBI Score: Not rated because of uncertainty of original fish distribution

Notes: May contain one of the fastest maturing and reproducing red fir forests in the Sierras. Unusually high mean annual precipitation creates unusual ecological conditions.

UCD Surveys?: Yes, 1993.

Sources:

Keeler-Wolfe, T. 1990. Ecological Surveys of USFS Research Natural Areas in California, Gen. Tech. Report PSW-125.

Date: 24 December 1994 **Compiler:** PR, PBM

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