

CHAPTER 8: FISHERY RESOURCES

Introduction

Auburn Ravine, Coon Creek, and Doty Ravine all have significant fish resources and have the potential to support higher levels of production after an ecosystem restoration program is implemented. These three watersheds support two anadromous (i.e., adults spawn in freshwater, juveniles emigrate to the ocean to rear and mature, and the adults return to freshwater to spawn) species, steelhead trout and chinook salmon. Steelhead trout are listed as threatened under the provisions of the Federal Endangered Species Act (FESA). Chinook salmon in the Central Valley have four life history strategies (runs) and two of these runs are listed “species” under the provisions of the FESA and the California Endangered Species Act (CESA), while one (fall chinook) is a Federal Candidate species.

These species are important factors in ecosystem restoration because their habitat, water temperature, and water quality requirements are more restrictive than other native fish species that occur in these watersheds. Another important factor is the fact that current water management practices (e.g., much higher than normal flows in April through October, generally cooler water temperatures because of the sources of imported water) provide a much higher quantity and quality of anadromous fish habitat than would have occurred historically.

General Life History Summary

Chinook Salmon

Chinook salmon life history patterns are more complicated than steelhead because they evolved four distinct patterns (technically referred to as runs, but are treated as species under the provisions of the FESA and CESA) in the Central Valley in order to fully utilize the range of water temperature regimes and seasonal flow characteristics historically found in California rivers and streams. The importance of these life history patterns will be discussed later in this chapter and a brief description of each pattern is described below:

- Fall-run chinook (fall chinook) - Federal Candidate Species - This run has become the most common life history pattern in the Central Valley. They evolved to take advantage of the natural hydrology and flow patterns of the lower foothills area and valley floor. Adults return to freshwater from August to December depending on water flows and temperature and generally spawn from October to December. Eggs hatch in approximately 30-60 days, depending on water temperature; fry rear in the gravel for approximately one month before emerging into the water column; juveniles then rear in the stream for about 2-3 months before emigrating to the ocean, usually during the period April to June. Historically, fall chinook juveniles would have emigrated early in this spring period because of increasing water temperatures.
- Spring-run chinook (spring chinook) - Federal and State Listed Threatened - This run was once the most abundant in the Central Valley. This run evolved to use the higher elevations of the upper Sacramento and San Joaquin river watersheds. Fish have been

documented up to 5,200 in elevation. Adults migrate to high, cold water elevations in April to June, they then spend all summer in cool water refugia, and spawn in early fall. Because of the cooler water temperatures at higher elevations, eggs take longer to hatch and fry growth is slower. As a result, these fish are not ready physiologically to emigrate to the ocean the spring following spawning. Instead, juveniles spend the summer and fall in upstream areas and emigrate to the ocean as approximately one-year old fish (yearlings) in late winter and early spring.

- Winter-run chinook (winter chinook) - Federal and State Listed Endangered - This run is highly specialized and only spawned in the Pit River watershed in northeastern California and possibly Battle Creek watershed near Red Bluff. Because these fish spawned in areas where the dominant water source was groundwater springs and summer water temperatures were not lethal, adults spawned in May and June; juveniles hatched in August and September and emigrated to the ocean from November through March. Completion of Shasta Dam blocked all access to their historical spawning areas and a relatively small population is maintained below Keswick Dam, near Redding in the Sacramento River.
- Late fall-run chinook (late fall chinook) - No special status - This run is similar to fall chinook, except that adults spawn in December and January. Because of this late spawning time and generally cooler water temperatures, it takes eggs longer to hatch and juveniles longer to reach smolt stage. As a result, these juveniles spend the summer like spring chinook and emigrate at about the same time. Because of this life history pattern, distribution is currently restricted to localized areas, notably Battle Creek.

More specific life history information on chinook salmon, steelhead, and splittail is presented in Appendix D. These life history patterns are important to the ecosystem restoration program because, depending on the run that uses the three watersheds under consideration here, the ecological stressors and potential solutions could be radically different. Also, a more comprehensive assessment of the upper portions of Auburn Ravine and Coon Creek could determine if habitat conditions were suitable for spring chinook, which never occurred in these watersheds historically.

Steelhead Trout

Steelhead in California have evolved to specifically deal with the natural hydrologic variations in precipitation and runoff found here in the southern extension of their range. There are two steelhead stocks in California, summer, which currently occurs primarily on the coast, and winter, which occur in the Central Valley. These fish migrate to the spawning areas, usually in the uppermost reaches of accessible areas, in November through March. Spawning can occur throughout this period and adults do not necessarily die after spawning. Unlike salmon, steelhead may return to the ocean and later migrate into the streams to spawn again. Because of the generally later spawning period than fall chinook and the location of spawning, water temperatures are generally cooler and thus the juveniles do not emigrate to the ocean in the spring following spawning. They spend the summer in upstream areas and emigrate when fall/winter/early spring flows increase. Thus these juveniles are older and much larger than fall chinook when they emigrate. Some river

systems that historically had high elevation watersheds and cooler water temperatures also have younger aged adults (often generically called “half pounders”) that may or may not be sexually mature and migrate into the streams in April and May. The closest examples of these drainages are the American, Feather, and Yuba rivers. Some fish exhibiting this life history pattern have been captured in Auburn Ravine and have been caught during all seasons of the year (Ron Otto pers. comm.).

Other Native Species

Most of the native species that occur in the three watersheds evolved a life history strategy specifically designed to deal with the variable flow, water temperature, and precipitation patterns of the region. In addition, the type of physical habitat and spawning substrate required for successful reproduction is reflective of the conditions that would have existed historically. In general, this group of native species has a higher water temperature tolerance than salmonids, spawn over sandy substrates, and tend to be opportunistic feeders. Fecundity would be high because of the high potential mortality of eggs and juveniles and these fish generally would be longer lived and spawn multiple times because of the annual variability in stream conditions.

One species that may be of concern is the splittail. The splittail is a native minnow that is listed as threatened under the provisions of the FESA. This species occurs in the Cross Canal and possibly Eastside Canal under certain conditions. This species spawns over flooded vegetation in slow water velocity areas during February and March. Individuals have been captured in the Cross Canal by the California Department of Fish and Game and informal contacts with fishermen west of Pleasant Grove indicate that they know the species and where to catch it (Randy Bailey pers. comm.). It is unlikely that splittail occur in Auburn Ravine or Coon Creek, but sampling has been inadequate to document their presence or absence.

General Fish Species Composition

Limited fish sampling has occurred in Auburn Ravine in connection with the City of Lincoln’s existing wastewater treatment plant expansion and construction of their new wastewater treatment and reclamation facility (WWTRF). More detailed information on fish sampling and the species captured is presented in Appendix D. Limited sampling in April 1994 and 1995 on Coon Creek, just west of Gladding Road, resulted in the capture of five native species that would be expected to inhabit this stream and three introduced species (Placer County Planning Department 2001). This document notes that the samplers saw 12 juvenile chinook salmon from the bank, but did not collect them. While juvenile salmonids could be identified from the bank, species specific identification seems improbable. Unpublished data from the California Department of Fish and Game documents fall chinook salmon spawning in Coon Creek, Doty Ravine, and Auburn Ravine in the fall of 1964. Numerous anecdotal accounts exist of fall chinook salmon spawning in Auburn Ravine and Coon Creek. Steelhead spawning and subsequent juvenile rearing have been documented in Auburn Ravine on several occasions.

Factors Influencing Aquatic Habitat Quantity And Quality

Water Flow Fluctuations

Water flows in Auburn Ravine are controlled by two primary factors. First is the natural pattern of precipitation that occurs in the watershed. The maximum elevation of the watershed is approximately 1,000 feet above mean sea level (MSL). Therefore, precipitation in the watershed falls nearly exclusively as rainfall. The annual timing of rainfall is fairly consistent, with the majority of a water year's precipitation occurring between November and April. However, the amount of precipitation can vary greatly on an annual basis, and individual storm cells can deliver a large amount of rainfall in a relatively short period, even during drought periods. For a more detailed discussion of water management in the three watersheds, see Chapter 4. Fish species native to the drainage are adapted to the natural precipitation pattern. Their life history patterns evolved to complete most migration, spawning, egg incubation, rearing, and emigration during the high flow and lower water temperature period. Steelhead rear during the summer and are generally confined to the upper portions of the watershed where water temperatures are cooler and heavily influenced by groundwater inflows (Figures 6-2, 6-3, and 6-4). Rainfall during the summer and fall are limited, which results in low natural stream flows. During drought conditions, fall rains may not begin until December, which has a major effect on the spawning migration of chinook salmon and steelhead and results in low flows, which decreases the quantity of suitable aquatic habitat. Conversely, during El Nino events, stream flows can be extremely high, resulting in mobilization of the stream bed, accelerating bank erosion and the introduction of large woody debris into the active channel, and changing the water velocity distribution of habitats. These high flow events change the distribution of aquatic habitat types, scour new habitats, fill existing habitats, increase mortality of incubating eggs and fry through mechanical damage, and redistribute juveniles to downstream locations.

The second factor which controls flow volumes in Auburn Ravine is water project operations and management by Pacific Gas and Electric Company (PG&E), Nevada Irrigation District (NID), Placer County Water Agency (PCWA), and South Sutter Water District (SSWD) (See Chapter 4: Water Resources). However, during the fall these supplies are diverted from the stream upstream of the City of Lincoln, resulting in extremely low flow events during the October-November period. The net result of water management in the stream is beneficial and negative effects. Water deliveries to Sutter County locations in the late spring and summer result in higher flow volumes, greater habitat diversity, increased quantity and quality of habitats, and lower summer water temperatures than would occur under natural conditions. However, these same water management practices often result in periods during the fall and early winter where stream flows are extremely low, often only a few cubic feet per second and sometimes no flow at all. These low flow periods can control chinook salmon and steelhead migration timing and the quantity and quality of habitat for rearing juveniles and smolts emigrating to the ocean.

Water Sources

The majority of water that flows down Auburn Ravine is imported from other watersheds. Currently, water from the Yuba River, Bear River, and Auburn Ravine watersheds flows down the stream. Water from the American River is currently seasonally imported from a Bureau of Reclamation temporary pumping station and delivered to the Ravine via the Ophir Tunnel. The result of having this blend of waters in Auburn Ravine is that migratory fish, like chinook salmon and steelhead, can be influenced to migrate into the Ravine from these adjacent drainages. This water management scenario increases the probability of straying by chinook salmon, steelhead and potentially splittail.

Sediment Deposition

Aquatic habitat surveys of Auburn Ravine, within and downstream of the City of Lincoln, indicate that a large percentage of the stream is dominated by sandy and silty substrates. The same problem is present in the middle reaches of Coon Creek and portions of Doty Ravine. Coarse sand, from a variety of sources and specific geology, causes the aquatic habitats in these areas to be of poor quality. Sand deposition smothers aquatic insect production and can limit spawning success for steelhead and chinook salmon. These bottom types are not considered to be high quality and are characterized by low instream productivity and low habitat diversity. See Chapter 5: Stream Sediment for more detailed information. The sources of these sediment inputs are not apparent, but the small grain size and continuously shifting nature of these substrate types contribute to what are considered low quality fish habitats. These substrate types eliminate, for all practical purposes, the spawning potential for chinook salmon and steelhead in areas downstream of the Highway 65 Bridge in Lincoln. In the areas west of Lincoln on Auburn Ravine and approximately west of Gladding Road on Coon Creek, the sand bottomed channels provide little in terms of habitat complexity and diversity and are not conducive to fish production. Only some introduced species would tend to prosper in this habitat type. These reaches of stream would be used as migratory corridors for anadromous species, with little extended rearing opportunity available.

Water Temperature

Water temperature is a critical factor in determining the suitability of a particular stream section to support initiation of spawning migration (chinook salmon and steelhead), egg viability after deposition, mortality of egg, alevin, fry, and juvenile life history stages, and smolt emigration for chinook salmon and steelhead. Water temperatures that exceed certain critical thresholds, depending on species and life history stage, increase the mortality of these life history stages progressively up to 100%. While cold water temperatures can hinder development, cold water temperatures are not considered a problem in Auburn Ravine.

Chinook Salmon

Healey (1979) summarized several studies of egg and fry survival from experiments conducted on American River and Upper Sacramento River chinook salmon stocks. His

review indicates that water temperature above 16.7 °C (62 °F) caused 100% mortality of eggs. Eggs incubated in water 15.6-16.7 °C (60-62 °F) experienced a 50% mortality to the eyed egg stage. Incubation temperatures of 12.8-13.3 °C (55–56 °F) caused 20% mortality. Eggs removed from the female in water temperatures of 15.6-16.7 °C (60-62 °F) and incubated in water 12.8-13.3 °C (55–56 °F) resulted in a 30% loss.

Healey's (1979) own results indicate 80- 90% mortality when incubation temperatures were consistently near 15.6 °C (60 °F). Healey also conducted a series of three experiments where the water temperatures exceeded 14.1 °C (58 °F) for approximately 10 days at the beginning of incubation for one of the three test groups. After 10 days, the temperatures never exceeded 14.1 °C (58 °F). Cumulative mortality of eggs and fry for this group exceeded 30%. Two other test groups in which the temperatures never exceeded 14.1 °C (58 °F) had cumulative mortalities of less than 10%. Water temperatures exceeding 14.1 °C (58 °F) during adult spawning migration, egg incubation, and early fry rearing life history stages increases the mortality and viability of eggs and fry.

Juvenile chinook salmon can tolerate slightly warmer water temperatures as they grow larger. While juveniles can tolerate water temperatures of 70-75 °F, temperatures in this range put the individual in a high chronic stress situation (U.S. Bureau of Reclamation 1997). Preferred temperatures are considered to be less than 64 °F in order to reduce stress and decrease vulnerability to predation.

Steelhead

Steelhead, while related to chinook salmon, have slightly different water temperature requirements for various life history stages because of their generally different spatial and temporal distribution. McEwan and Jackson (1996) recommend the following water temperature regime for steelhead trout:

- Adult Migration 46 - 52 °F
- Spawning 39 - 52 °F
- Egg Incubation and Fry Emergence 48 - 52 °F
- Fry and Juvenile Rearing 45 - 60 °F
- Smoltification < 57 °F

However, the U.S. Bureau of Reclamation (1997) in their review of literature for steelhead report the water temperature information presented in Table 8-1 below.

Table 8-1. Water Temperature Information for Steelhead

| Condition | Life History Stage | | |
|-----------------------|--------------------|--------------------------|-------------------------------|
| | Spawning | Fry and Juvenile Rearing | Emigration and Smoltification |
| Optimum | 46.0- 52.0 °F | 55.0-60.0 °F | 44.4-52.3 °F |
| Chronic Low Stress | 52.1-57.5 °F | 60.1-68.0 °F | 52.4-59.3 °F |
| Chronic Medium Stress | 57.6-61.0 °F | 68.1-72.5 °F | 59.4-63.2 °F |
| Chronic High Stress | >61.0 °F | >72.5 °F | >63.2 °F |

Source: U.S. Bureau of Reclamation, 1997

These two data sets indicate general agreement about the optimum temperatures required for steelhead, but the temperature regimes that provide protection for the fish are subject to some variation and interpretation.

Splittail

Splittail tolerate water temperatures higher than chinook salmon and steelhead. Cech and Young (1995) found that acclimation temperature influenced safe thermal maximum temperatures, while thermal minimum temperatures were not affected by acclimation temperature. They also found that splittail water temperature preferences ranged from 19-25 °C (66.2–75.0 °F).

Other Native Species

Other native species found in Auburn Ravine have adapted their physiology to mimic the conditions associated with foothill streams. These fish have evolved to tolerate the temperature regime that would have existed prior to human intervention. In general, the water temperatures that existed historically are higher than exist during the summer due to the delivery of water to Sutter County farmers.

Dissolved Oxygen

Suitable dissolved oxygen levels in water are essential for fish populations to survive and reproduce successfully. The effects of dissolved oxygen (DO) levels are well known for salmonid fishes. U.S. Environmental Protection Agency (U.S. EPA) recommends a minimum dissolved oxygen level of approximately 7.0 mg/L to protect coldwater fishes (U.S. EPA 1973). Bjorn and Reiser (1991) indicate that a dissolved oxygen level of 5.0 mg/L should meet the minimum requirements for salmonid fishes but suggest that at least 7.0 mg/L be maintained. Data summary tables in Appendix B show that DO concentrations from various locations in the watersheds are generally above 7.0 mg/, which is above the physiological threshold for resident and anadromous fish.

Contaminants

Growth and survival, especially of larval fish, may be reduced by the toxic effects of insecticides, herbicides, trace elements, ammonia, chlorine, and other toxic materials that have entered the stream from various sources, including mines, agricultural runoff, and municipal discharge. Toxic materials can affect larval fish directly and indirectly, causing mortality in a short period (e.g., days) or adversely affecting growth and development, thereby limiting chances for survival (Brown 1987). The effects of toxic materials are not limited to larval fish and can directly or indirectly affect all life stages and foodweb organisms.

The low ratios of opportunistic invertebrate species in the more varied habitats indicate that Auburn Ravine is fairly unpolluted. This suggests that the lower invertebrate diversity is related to the sandy substrate conditions and virtually zero flow that occurs in Auburn Ravine at times, generally in fall when PG&E stops its discharges. Non-native clams dominate the lower two-thirds of the stream in the project area, and Lumbricid worms are found throughout the project area. These animals tend to be resistant to adverse habitat conditions, but by themselves are not necessarily indicative of poor water quality. Relatively low densities of invertebrates most likely are attributable to flow variability and substrate quality (i.e., mobile sand substrate).

In Auburn Ravine, adverse effects of contaminants on the fish present are not apparent. Much more limited sampling has occurred on Coon Creek and none on Doty Ravine. For a more detailed discussion of contaminants, see Chapter 6 Water Quality.

Migratory Impediments

Water Diversion Structures

Numerous water diversion structures are located in the watersheds, with the majority in Auburn Ravine. These diversion structures are used to divert water for various beneficial uses and are generally highly seasonal in operation. Most diversions are used to divert water from the stream for agricultural uses and are usually placed across the stream channel in April and removed in October. However, at least one diversion is in place for longer periods in the fall, is used to pond water for diversion into a waterfowl club and currently blocks anadromous fish migration at a location in lower Auburn Ravine. None of the diversion structures provide for upstream fish passage during operation. Only one (Fowler Nurseries) pump diversion is screened to prevent fish from being pumped into irrigation ditches or fields. The degree to which any particular diversion affects fish populations is determined by a number of factors including:

- the timing of operation, size, design, and location (geographically and position in the channel)
- the seasonal and diurnal distribution and abundance of fish and the overlap of fish distribution and abundance with diversion operations

Effects on fishes included blockage or delay of upstream migration in the spring or fall, potential to entrain all life stages, increased predation mortality by ponding of water which increases predator opportunities, and increased mortality or potential mortality by increasing water temperatures in pool areas. Operation of diversion structures into the fall and early winter period has resulted in delay or elimination of access to Auburn Ravine by chinook salmon. Steelhead generally migrate into the stream after diversion structures are removed or high flows make the diversions passable. Larval and juvenile life history stages are most susceptible to entrainment, but the extent and effects of entrainment losses on fish populations are unknown. As part of this assessment, preliminary evaluations of fish passage issues at diversion dams and some pumping stations has been completed and is presented in Appendix D.

Beaver dams, although they minimally affect flow downstream of the dam, may prevent upstream and downstream movement of adult and juvenile chinook salmon and steelhead, especially during low-flow periods.

Effects of Water Removal on Migratory Pathways

Water management in these watersheds is driven by agricultural deliveries to land areas west of Highway 65. As a result, the volume of water in the stream continually decreases downstream, until agricultural return flows eventually increase the volume of water in the stream channel. However, once water deliveries decrease in the fall and the stream water may be of suitable water temperature to support chinook salmon and steelhead, there may physically not be sufficient water in the channel to allow upstream migration. Chinook salmon and steelhead have minimum water depths that are necessary in order for them to migrate upstream to spawning areas. The low gradient of these streams once they reach the valley floor, combined with a flat, sandy substrate, creates barriers to upstream migration under low flow conditions. These conditions can exist during most any month of the year during a severe drought.

Species Introductions

Introduction of non-native organisms has substantially altered the biological structure of the foothill streams, including Auburn Ravine. Non-native organisms may affect other species through competition, predation, and change in trophic dynamics. Introduced fish (e.g., bluegill, pumpkinseed, green sunfish, carp, and black bullhead) are abundant in Auburn Ravine and have been recorded in Coon Creek just west of Gladding Road.

Juvenile fall and spring chinook salmon have historically been released infrequently in the watersheds since the 1980s. Typically, about 100,000 fall chinook salmon from Nimbus Fish Hatchery are released (Barngrover pers. comm.). In March 1998, 140,000 fall chinook were released in Auburn Ravine. In 1984, the Department of Fish and Game (Department) released 77,400 spring chinook in Auburn Ravine and the same number in Doty Ravine (Cramer and Demko 1997). However, these out of natal watershed release

programs are being curtailed as the ecological impacts of these releases are better understood.

Rainbow trout historically were released in Auburn Ravine; however, the Department ended the release of rainbow trout in 1965 (Barngrover pers. comm.). Rainbow trout are stocked in water bodies connected to Auburn Ravine (e.g., the Bear River and associated reservoirs).

Release or straying of hatchery origin fish could detrimentally affect natural populations through competition and hybridization with any remaining wild stocks of anadromous fish.

Condition of the Riparian Community

The generally degraded condition of much of the riparian zone has a negative influence on stream productivity. Land use encroachment also reduces the resiliency of the stream to deal with perturbations. More detailed discussion of riparian communities is presented in Chapter 7.

Management Concerns

A number of management concerns with respect to fishery resources exist for these watersheds and are briefly summarized in Table 8-2 below.

Table 8-2. Resource Issues and Impacts Related to Fishery Resources

| Management Issue | Negative Ecological and Social Impacts | Positive Ecological and Social Impacts |
|---|---|---|
| FRM1. Inadequate provisions for adult anadromous fish passage at certain times of the year at diversion dam structures. | FRN1.1. Current water management practices at diversion structures prevent or delay adult anadromous fish (particularly chinook salmon) passage to upstream areas by either blocking or impeding migration to spawning areas. | FRP1.1. Diversion owners and operators have maximum flexibility to operate diversions in accordance with their current water rights and operational requirements. |

Table 8-2. Resource Issues and Impacts Related to Fishery Resources

| Management Issue | Negative Ecological and Social Impacts | Positive Ecological and Social Impacts |
|---|---|--|
| <p>FRM2. Low fall flows, after irrigation water deliveries are reduced to western area farmers, block or impede adult fall chinook migration to spawning areas and negatively impact overall aquatic resource productivity.</p> | <p>FRN2.1. Current water management results in reduced or elimination of water deliveries down the stream channels in the fall. This reduction in flow greatly reduces the amount of water present to facilitate fish passage. Water depths are inadequate to provide fish passage until fall rains increase the natural runoff sufficiently to provide adequate water depth for migration.</p> <p>FRN2.2. Low fall flows push the aquatic community through an ecological bottleneck each year by reducing the amount of habitat available, exposing stream bottom that has been wetted for months, and generally decreasing the complexity of aquatic habitats available for a variety of fish species.</p> | <p>FRP2.1. Water suppliers operate fully within their water rights and operational procedures.</p> <p>FRP2.2. Reducing or eliminating fall water imports to the stream channels increases the overwinter storage at upstream reservoirs, and may in some years result in an increased water supply for the following summer.</p> |
| <p>FRM3. Sediment concentrations and accumulations are adversely impacting spawning success and overall stream productivity.</p> | <p>FRN3.1. Excessive concentrations of sediment in anadromous fish and resident fish spawning gravels is reducing the spawning success of certain fish species.</p> <p>FRN3.2. Excessive concentrations of sediment in the stream channel reduces</p> | <p>FRP3.1. None identified.</p> |

Table 8-2. Resource Issues and Impacts Related to Fishery Resources

| Management Issue | Negative Ecological and Social Impacts | Positive Ecological and Social Impacts |
|--|--|---|
| | overall stream productivity by limiting aquatic invertebrate production, reducing the quality and quantity of aquatic habitats, and reducing overall habitat complexity and diversity. | |
| FRM4. Mortality of juvenile salmonids at diversion locations without fish exclusion devices. | FRN4.1. Unknown numbers of juvenile salmonids (and other species) are removed from the overall population along with diverted water. The impacts of this source of mortality on the overall population is unknown. | FRP4.1. Diversion operations do not have additional operations and maintenance costs associated with fish exclusion devices. |
| FRM5. The degraded condition of the riparian zone has a negative impact on stream stability and overall productivity. | FRN5.1. Degraded or missing riparian vegetation reduces stream bank stability; increases the amount of solar radiation to reach the water surface, thus increasing water temperatures; decreases the amount of woody debris in the channel, thus reducing overall habitat diversity and complexity; and reduces the amount of vegetative (leaf fall) and biological input (terrestrial insect fall) to the water surface, thus reducing overall stream productivity. | FRP.1. Allows landowners maximum use of lands adjacent to riparian areas. |
| FRM6. Water temperatures in the summer are adequate to support salmonids throughout the summer in about half of the channel lengths of the three | FRN6.1. Current water management practices have negative impacts on water temperatures by not allowing flow over the lowermost diversion structure and in | FRP6.1. The current practice of using the stream channels to deliver large quantities of cold irrigation water to western area customers provides |

Table 8-2. Resource Issues and Impacts Related to Fishery Resources

| Management Issue | Negative Ecological and Social Impacts | Positive Ecological and Social Impacts |
|--|--|---|
| streams that support fish populations. | certain years in the fall when water deliveries are curtailed. | water temperatures that are suitable for salmonids over about half of these channels total length. Without these deliveries, the amount of habitat for salmonids would be greatly reduced or completely eliminated. |
| FRM7. Removal of water flows by SMD-1 and/or City of Auburn’s WWTP through construction of a regional wastewater and reclamation facility near Lincoln. | <p>FRN7.1. In the fall, these water sources constitute a significant percentage of the volume of water in the upstream reaches of Auburn Ravine and Coon Creek. Removal of these water sources would increase water temperatures at critical biological times, reduce the amount, diversity and complexity of aquatic habitats.</p> <p>FRN7.2. Removal of these flow sources would reduce the overall productivity of the streams by reducing the nutrient inputs.</p> | FRP7.1. Removal of these flow sources would improve overall water quality by reducing the input of nutrients. Too many nutrients increases biological productivity to undesirable levels as seen in Coon Creek. However, a steady supply of nutrients at the right levels can optimize stream productivity for a given set of water chemistry values. |
| FRM8. Management of discharge from the proposed regional wastewater treatment and reclamation facility near Lincoln could have a major positive or negative influences on Auburn Ravine. | <p>FRN8.1. Discharges from this facility could have a negative impact on Auburn Ravine by increasing the overall nutrient loading in the stream.</p> <p>FRN8.2. The volume and timing of discharges could create false attraction for</p> | FRP8.1. If discharges from this facility were adequately treated, Auburn Ravine downstream from the discharge point could have a daily flow of 50 cfs at plant capacity. However, this conclusion is based on the assumptions that this |

Table 8-2. Resource Issues and Impacts Related to Fishery Resources

| Management Issue | Negative Ecological and Social Impacts | Positive Ecological and Social Impacts |
|---|--|---|
| | <p>adult salmonids and bring them into the stream up to the point of discharge in the fall, where the fish would find insufficient water depth to proceed upstream. These fish would be trapped in an area with no spawning gravel.</p> <p>FRN8.3. If discharges to the stream channel are episodic because of other demands for the water or if this water is captured by downstream users, then impacts to the stream would be negative.</p> | <p>discharge would reach the Sacramento River.</p> |
| <p>FRM9. Introduction of salmonids from outside these watersheds.</p> | <p>FRN9.1. Introduction of chinook salmon by the Department of Fish and Game has a negative ecological impact on the existing populations. In addition, this practice is contrary to good genetics management practices.</p> | <p>FRP9.1. None identified.</p> |
| <p>FRM10. Beaver dams in the watersheds.</p> | <p>FRN10.1. Beaver dams may block upstream migration of salmonids, depending on their configuration, volume of water flow, and stream channel morphology.</p> | <p>FRP10.1. Ponds created by beaver dams may increase the juvenile rearing capacity of the streams and provide complexity and diversity of aquatic habitat types.</p> |

Summary of Findings

- Current water management practices have both a positive and negative impact on salmonid populations in the watersheds.
- Sediment levels in the stream channels have an extremely negative impact on aquatic habitats in the watersheds.
- Overall stream productivity and habitat complexity and diversity are reduced because of the condition of the riparian vegetative community.