WINTER STEELHEAD AND CHINOOK AND COHO SALMON LIFE CYCLES AND HABITAT REQUIREMENTS

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I. Upstream Migration of Adults

A. **Timing:** Fall Chinook – September through November
Coho – late November through mid-February
Steelhead – late December through April

B. **Requirements:** Sufficient streamflow to provide passage over shallow riffles, log jams, falls, etc.

C. **Potential Problems**

1. Shallow, broad, "critical riffles"
2. Other natural barriers – falls, logjams, sandbars
3. Man-made barriers – culverts, dams, streamflow alterations
4. Seasonal streamflows
5. Altered amount and timing of streamflows, due to reservoirs and diversions
6. Fishing pressure by sportsmen and poachers
7. Failure or delay in sandbar breaching in dry years (including due to diversions or coastal modifications)

D. **Potential Solutions**

1. Minimum streamflow requirements (bypasses, reservoir releases)
2. Barrier modification or removal (most logs should be left in the stream)
3. Fishing regulations and their enforcement
4. Sandbar management plans which allow artificial breaching under rare severe drought conditions (for access by coho salmon)

II. Spawning (Reproduction)

A. **Timing:** Fall Chinook – September through December
Coho – late December through February
Steelhead – late December through April
Early spawning means potentially early emergence, longer growing season and larger first-year size (coho). Later spawning reduces risk of nest ("redd") destruction by storms.

B. **Requirements:** Sufficient cool streamflow over good, clean pea- to apple-sized gravels, good streambed hydraulic configuration (usually at head of riffles) of sufficient depth, and with escape cover (usually a deep pool with cover) nearby.

C. **Potential Problems**

1. Siltation of gravels due to logging, development and/or road building, resulting in smothered eggs or easily washed away nests.
2. Low winter streamflows, resulting in poor aeration of eggs (or rarely, stranding of nests.
3. High winter streamflows, resulting in washing away of earlier nests (this is especially likely for chinook and coho, which spawn near the beginning of the winter storm season). Large funnel-shaped watersheds generate higher floodpeaks than smaller, narrower watersheds (which may serve as flood year spawning refuges).
4. Reservoirs may alter winter flows, increasing or decreasing flood risks.
5. Weak year classes or gaps from 3-year cycle of female coho; the ghost of bad years past.

D. **Potential Solutions**

1. Land use plans to reduce erosion from logging, road building and/or development, and their enforcement.
2. Hatchery incubation? (with concern for genetic problems of hatcheries)
3. Hatchery manipulation for 2-year-old (precocial) female coho
4. Addition of gravels or structures which can trap gravels (expensive, requires continuous effort)

III. **Rearing**

A. **Timing:** Fall Chinook – November through January through April to May (3-6 months in fresh water)
Coho – April through April to May of the following year (1 year in fresh water)
Steelhead – April through April to June of the following year (spring, summer, winter or spring – 1 year in fresh water) or two spring-through-spring periods (2 years in fresh water)

B. **Requirements:** Escape or hiding cover (undercut banks, logs, pools, surface turbulence, unburied cobbles), suitable water quality (temperature, oxygen, clarity), and minimal rations for Maintenance. Steelhead: fast-water feeding areas and/or high food abundance for Growth. Coho: productive pools and glides with cover and good food availability. Enough light for algal and insect production and for sight feeding.

1. Small, low flow tributary streams (Little Sur, Scott, Corralitos, Redwood creeks) tend to provide less food and produce small fish after one year, resulting in poorer survival of salmon going to the ocean and usually

requiring steelhead to spend two years in the stream. Growth occurs primarily in the spring, when fast water is available (and possibly when light is more available). Steeper streams lack abundant, good pools for coho. Small streams mostly provide maintenance habitat. Water quality (temperature, oxygen, turbidity (muddiness)) is usually not a problem.

2. Larger, warmer streams (Carmel and San Lorenzo rivers, Uvas Creek, Russian River?) cannot provide enough food in summer to maintain coho or steelhead in pools. Only fast-water riffles, and pools immediately downstream of them, can support steelhead. However, these riffles often provide steelhead with enough food for summer growth; many fish grow large enough to go to the ocean after one year in the stream. Augmented streamflows from reservoirs (for conveyance or groundwater percolation) can produce good steelhead habitat by providing fast-water feeding areas, despite higher water temperatures (and increased steelhead food demands); unless water temperature is too high, warmer water primarily produces a food problem, rather than a direct physiological threat.
3. Small, productive seasonal ponds (such as Sprig Lake at Mt. Madonna County Park) can sometimes provide excellent rearing conditions for steelhead, if they are not too warm and if food is abundant. However, the value can be lost if the ponds are drawn down too low in the fall or emptied into dry or warm streambeds downstream before the winter rains.
4. Lagoons (Carmel River, Waddell, Soquel, and Pescadero creeks) form at the mouth of most streams in summer due to sandbar development, creating freshwater or brackish lakes. If water quality (high temperature, low oxygen) is not a problem and conditions for food production are good (adjacent marshes, algae and aquatic plant production), lagoons can rear large numbers of fast-growing steelhead. Lagoons are usually too warm for coho salmon rearing in summer.

C. **Potential Problems**

1. Loss of escape cover and pool depth due to sedimentation and channel alteration, due to development, roads or timber harvest (reducing the number of fish and possibly their growth, by reducing food)
2. Loss of large woody debris (LWD) due to timber harvest and clearing for flood control. Shift from durable streamside conifers as wood source to small, brittle, short-lived alders.
3. Reduction of streamflow due to spring and summer water diversion (reducing fish abundance and/or growth).
4. Turbid water, which reduces feeding efficiency, due to watershed clearing and development or to turbid reservoir releases.
5. Large reductions in streamside vegetation, resulting in high water temperatures and fish food demands.
6. Drawdown or early draining of seasonal ponds.
7. Draining of summer lagoons for recreation, urbanization or agriculture. Lack of sufficient freshwater inflow resulting in brackish, layered, warm conditions.

D. **Potential Solutions**

1. Regulation of development to reduce erosion and streamside modifications.
2. Strict timber harvest regulations that reduce sedimentation and maintain sufficient canopy (temperature) and LWD recruitment, especially of large conifers.
3. Restrictions on LWD removal for flood control or "barrier" removal. Wood is good!
4. Minimizing onstream spring and summer water diversions.
5. Redesign of outlet works and altered regulations on draining of seasonal ponds.
6. Maintaining and enhancing summer lagoons.

IV. Overwintering

A. **Timing**: December through April

B. **Requirements:** Deep pools and backwater habitats with good escape cover, especially undercut banks, logs and rootwads, to protect fish from high streamflows. (Similar to the pools and escape cover which provide summer maintenance habitats.) Logjams may be extremely valuable refuges during floods. Clear water between major storms to allow for feeding and growth.

C. **Potential Problems**

1. Filling of pools with sediment accompanying development, road building and/or timber harvest.
2. Removal of logs from streams as a flood control measure or modification of the riparian forest.
3. Development, road building, logging and other watershed modifications, including reservoirs, which prolong turbid runoff associated with storms.

D. **Potential Solutions**

1. Regulation of development and streamside vegetation removal to prevent erosion and sedimentation.
2. Careful and limited log removal for flood control.
3. Maintenance and creation of complex woody pools, including logjams and backwaters.

V. Migration of Juvenile Fish (Smolts) to the Ocean

A. **Timing:** Late March through early June

B. **Requirements:** Sufficient flow to allow safe passage (and protection from predators) during the migration season. Flows prolonged enough to allow fish to feed and grow quickly in spring in either the stream or the estuary before

migrating to the ocean. Clear late winter and spring streamflows, to allow for rapid growth prior to and during the migration. Larger fish adjust more easily to ocean water and are better at avoiding predators; they are much more likely to return as adults.

C. **Potential Problems**

1. Reduced streamflow, due to diversions, forcing fish to migrate out as small fish early in the spring or remain in the stream to feed and risk being trapped ("Go or grow conflict").
2. Prolonged turbid streamflows in spring, due to development or due to turbid releases from reservoirs. Turbid water stops or reduces feeding and growth.
3. Channel modifications for flood control or other purposes (San Lorenzo River), resulting in difficult downstream passage.
4. Loss of good estuaries that allow gradual adjustment for the saltwater transition.
5. Early sandbar closure, due to reduced streamflows or modification of coastline conditions.

D. **Potential Solutions**

1. Streamflow protections which allow spring migration.
2. Restrictions on developments that produce turbid spring flows.
3. Restrictions on channel modifications or their redesign to allow passage.
4. Reduction in watershed erosion to reduce sedimentation of the estuary.
5. Restoration and maintenance of estuaries.
6. Management plan to allow artificial breaching of sandbars under unusual drought conditions to allow outmigration of coho smolts.

VI. Ocean Residence

A. **Timing:** Chinook – Two or more summers for males, three or four years for females (die after spawning)
Coho – One or two years for males, two years for wild females (die after spawning)
Steelhead – One to four years (may spawn many times)

B. **Requirements:** Food is usually abundant in the ocean and once the young salmon or steelhead survive the transition to salt water they usually have very high survival rates and grow very quickly (8 to 12 inches during their first year in the ocean). Fish range the ocean for hundreds or thousands of miles and find their way back to their home stream by magnetic navigation (long range) and stream odor (short range).

C. **Potential Problems**

1. Heavy coastal and open ocean sport and commercial fishing.
2. Large increases in marine mammals.

3. Long-term shifts back and forth in productive ocean zone between north (Alaska) and south, which reduce ocean survival and growth.
4. El Niño years, when upwelling is reduced, reducing ocean productivity and fish growth and survival.

D. **Potential Solutions**
1. Regulation of ocean fishing, including cutbacks in harvest during periods of poor ocean survival and growth.
2. Emergency control of marine mammals at stream mouths when predation threatens weak salmonid stocks?

VII. Other Salmonids or Changes in Steelhead and Coho Biology North of Central California

A. **Coho Salmon**
1. Progressively earlier adult migration and spawning further north.
2. Often two years of freshwater residence due to slower growth in cool, shaded northern habitats and higher survival or 2 year old smolts.

B. **Steelhead**
1. Earlier adult migration and spawning for winter steelhead further north.
2. Often three years' fresh water growth further north.
3. "Summer steelhead" enter streams in late spring, spend summer in deep pools of cooler streams and spawn in fall/ early winter (Eel River).

C. **Chinook Salmon**
1. Stream type fish spend one year in fresh water and then migrate to use near-shore ocean
2. Ocean type fish migrate to ocean in spring and summer of first year and use offshore ocean habitats
3. Juvenile chinook tend to feed in faster water (like steelhead) rather than use pools (like coho).
4. Migration/spawning times differ for various chinook stocks – i.e., Spring run, Fall run, Late-fall run, Winter run (Sacramento River only).

D. **Sockeye Salmon**
1. Associated with Washington, Canadian and Alaskan watersheds that have accessible lakes for rearing by plankton-feeding juvenile sockeye (1 – 3 years).
2. Land-locked sockeye (**Kokanee**) have been stocked in many reservoirs and lakes (Tahoe) to provide a plankton-feeding sport fish.

E. **Chum** (Dog) and **Pink** (Humpback) **Salmon**
1. Spawn in the lower reaches of large rivers.
2. Migrate to the ocean within weeks of emerging from the nest.

F. **Coastal Cutthroat Trout**
1. Usually a headwater/ small stream spawner.
2. Two to three years in fresh water, with requirements similar to those of steelhead.
3. Juveniles migrate to the estuary for "ocean phase" of rearing.