# 9. Mussel Creek Population

Northern Coastal Stratum

Dependent Population

Recovery criteria: 80% of IP habitat must be occupied in years following spawning of brood years with high marine survival

Habitat likely available to support all life stages

14 $mi^2$ watershed (2% Federal ownership)

6 IP-km (4 IP-mi) (50% High)

Dominant Land Uses are Timber Harvest and Recreation

Key Limiting Stresses are 'Lack of Floodplain and Channel Structure' and 'Degraded Riparian Forest Conditions'

Key Limiting Threats are 'Timber Harvest' and 'Channelization/Diking'

*Highest Priority Recovery Actions*

| | |
|---|---|
| • Increase large woody debris (LWD), boulders, or other instream structure<br>• Construct off-channel habitats, alcoves, backwater habitat, and old stream oxbows<br>• Improve timber harvest practices by revising Oregon Forest Practices Act | • Increase beaver abundance<br>• Improve grazing practices<br>• Reduce pollutants, minimize impervious surfaces |

## 9.1 History of Habitat and Land Use

Mussel Creek empties into the Pacific Ocean just south of Port Orford between Brush and Euchre creeks. Historically, a trail likely passed through the lower basin, and became a road for automobiles in the 1920s prior to eventually becoming Highway 101 (Maguire 2001b). The roadway has caused the South Fork of Mussel Creek to be realigned, which resulted in a loss of habitat suitability for coho salmon. Tourist attractions, such as the Prehistoric Gardens and the Arizona Beach campground, are in the floodplain of lower Mussel Creek and Myrtle Creek.

Data for timber harvest on private lands are not available for the Mussel Creek basin, but aerial photos indicate timber has been harvested from most of the basin except for a small patch below Highway 101, adjacent to Prehistoric Gardens. Active timber harvest continues and road densities are high in this basin. In addition, Mussel Creek has very steep slopes, which likely facilitated sediment transport to the creeks during and after land disturbing activities. Myrtle Creek serves as an example of these channel changes; it loses surface flow in late summer and early fall possibly due to excessive fine sediment loads from steep, managed land near the headwaters. Additionally, the stream channel has been straightened and channelized to maximize space for camping and recreation. These impacts have made approximately 50 percent of the area with high intrinsic potential for coho salmon habitat currently uninhabitable and difficult to restore.

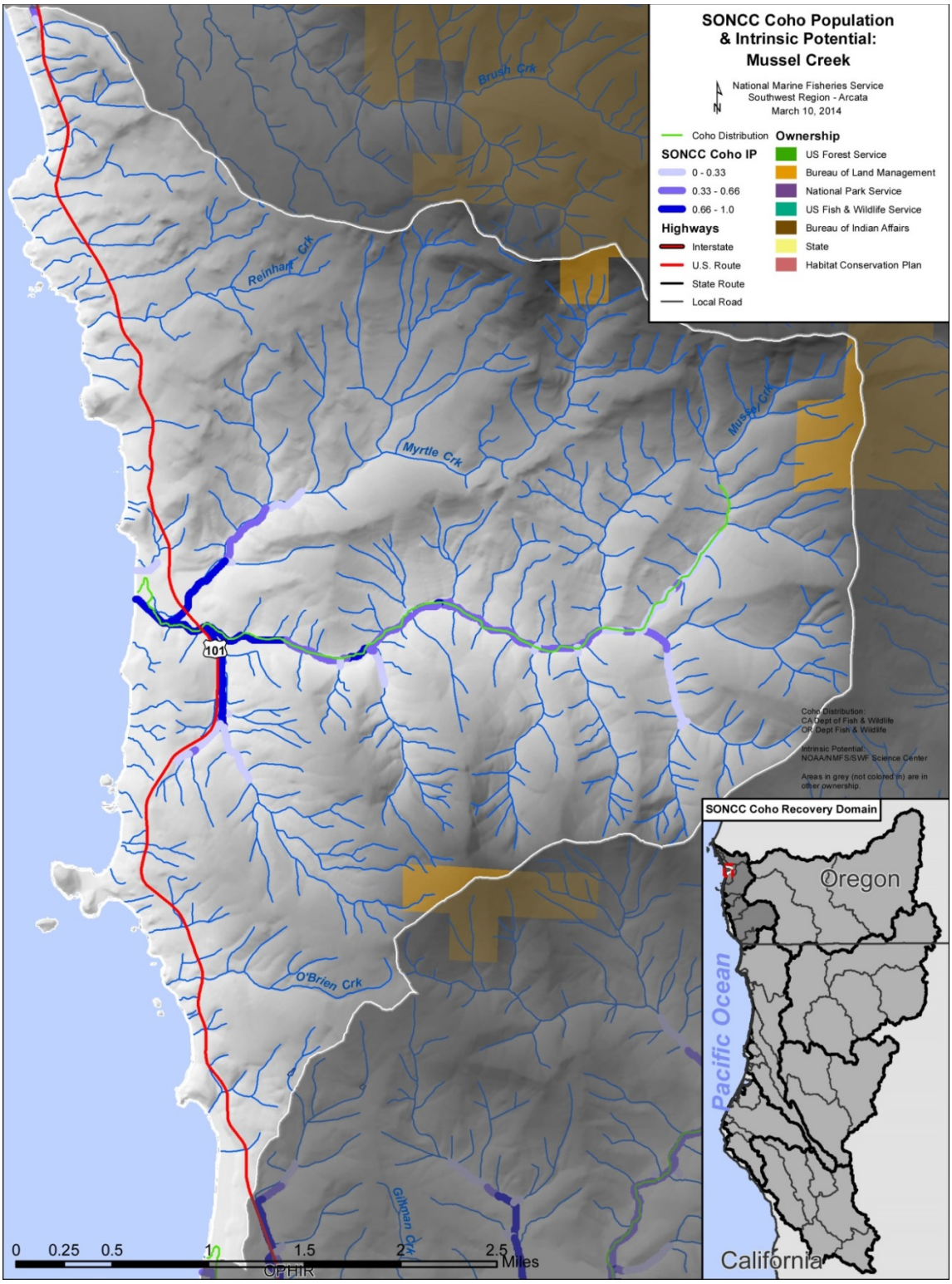


Figure 9-1. The geographic boundaries of the Mussel Creek coho salmon population. Figure shows modeled Intrinsic Potential of habitat (Williams et al. 2006), land ownership, coho salmon distribution (ODFW 2013a), and location within the Southern-Oregon/Northern California Coast Coho Salmon ESU and the Northern Coastal diversity stratum (Williams et al. 2006). Grey areas indicate private ownership.

## 9.2 Historic Fish Distribution and Abundance

No information is available about the historic distribution and abundance of coho salmon in Mussel Creek.

Table 9-1. Tributaries with high IP reaches (IP > 0.66) (Williams et al. 2006).

| Stream Name | Stream Name | Stream Name |
|---|---|---|
| Lower Mussel Creek | Myrtle Creek | South Fork Mussel Creek |

## 9.3 Status of Mussel Creek Coho Salmon

### Spatial Structure and Diversity

Much of the high IP in Mussel Creek is not currently suitable because the South Fork is channelized and re-routed by Highway 101. The major tributary, Myrtle Creek, is also channelized and loses surface flows during the summer and fall. Approximately 50 percent of high IP in the basin has been degraded due to channelization and straightening. Additionally, mainstem Mussel Creek lacks sufficient depth and other channel features necessary to be fully functional for coho salmon rearing. Available data show coho salmon are restricted to mainstem Mussel Creek when present, and that no coho salmon were observed during recent juvenile surveys in 2002 and 2003 (Oregon Department of Fish and Wildlife [ODFW] 2005a). The small population size in Mussel Creek suggests restricted genetic diversity.

### Population Size and Productivity

The Mussel Creek population is presumed to be nearly extirpated based on recent juvenile surveys, impaired habitat conditions, and the lack of any other information to indicate that coho salmon currently spawn or rear in the basin. The productivity and size of this population is driven not only by the dynamics of the Mussel Creek population, but by those of nearby populations as well, which contribute spawners as strays. However, the supply of strays to Mussel Creek is not expected to be substantial or consistent in the near term because most adjacent populations in the SONCC coho salmon ESU are at low levels.

### Extinction Risk

Not applicable because Mussel Creek is not an independent population.

### Role in SONCC Coho Salmon ESU Viability

The Mussel Creek population is considered dependent because it does not have a high likelihood of sustaining itself over a 100-year time period in isolation and would likely receive sufficient immigration to alter its dynamics and extinction risk (Williams et al. 2006). Although such populations are not viable on their own, they do increase connectivity by allowing dispersal among independent populations and provide areas of refugia for other populations, acting as a source of colonists in some cases. Historically the Mussel Creek population would have interacted with other Northern Coastal dependent populations of coho salmon, such as those in

Brush Creek, as well as larger independent populations such as those in the Elk and Rogue Rivers. Any restored habitat in Mussel Creek provides potential connectivity that assists metapopulation function in the ESU.

## 9.4 Plans and Assessments

### State of Oregon

*Oregon Plan for Salmon and Watersheds*
http://www.oregon.gov/OPSW/about_us.shtml

The State of Oregon developed a conservation and recovery strategy for coho salmon in the SONCC and Oregon Coast ESUs (State of Oregon 1997). The Oregon Plan for coho salmon is a comprehensive plan that includes voluntary actions to address all of the threats currently facing coho salmon in these ESUs and involves all relevant state agencies. Reforms to fishery harvest and hatchery programs described in the Oregon Plan were implemented by ODFW in the late 1990s. Many habitat restoration projects have occurred across the landscape in headwater habitat, lowlands, and the estuary.

*Report of the Oregon Expert Panel on Limiting Factors*

ODFW (2008b) convened a panel of fisheries and watershed science experts as an initial step in their development of a recovery plan for Oregon's SONCC coho salmon populations. Deliberations of the expert panel provided ODFW with initial, strategic guidance on limiting factors and threats to recovery. Based on the input of panel members, ODFW (2008b) summarized the concerns for the Mussel Creek population as follows:

> Key concerns in Mussel Creek were primarily loss of over-winter tributary habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally very limited in these systems and have been impacted by past and current urban, rural residential, and forestry development and practices. Secondary concerns were related to a loss of over-winter, lowland habitat complexity due to past and current agricultural practices. In addition, high water temperatures exist for summer parr due to a loss of riparian function and channel straightening.

*Cumulative Effects of Southwest Oregon Coastal Land Use on Salmon Habitat*

Oregon State University (OSU) Oak Creek Labs conducted a study funded by ODFW and the Oregon Department of Forestry (ODF) to determine relationships between forest harvest and Pacific salmon productivity (Frissell 1992). The study assessed basins along the Oregon coast extending from the Sixes River to the southern border during the period from 1986 to 1992.

## 9.5 Stresses

Table 9-2. Severity of stresses affecting each life stage of coho salmon in Mussel Creek. Stress rank categories, assessment methods, and data used to assess stresses are described in Appendix B.

| | Stresses[2] | Egg | Fry | Juvenile[1] | Smolt | Adult | Overall Stress Rank |
|---|---|---|---|---|---|---|---|
| 1 | Lack of Floodplain and Channel Structure[1] | Low | Very High | Very High[1] | Very High | Very High | Very High |
| 2 | Degraded Riparian Forest Conditions[1] | - | Very High | Very High[1] | Very High | Very High | Very High |
| 3 | Altered Sediment Supply | High | High | High | High | High | High |
| 4 | Impaired Estuary/Mainstem Function | - | Medium | High | High | Medium | High |
| 5 | Impaired Water Quality | Medium | Medium | Medium | Low | Low | Medium |
| 6 | Barriers | - | Low | Low | Low | Low | Low |
| 7 | Altered Hydrologic Function | Low | Medium | High | High | Low | High |
| 8 | Adverse Fishery- and Collection- Related Effects | - | - | Low | Low | Low | Low |
| 9 | Adverse Hatchery-Related Effects | Low | Low | Low | Low | Low | Low |

[1] Key limiting stresses and limited life stage.
[2] Increased Disease/Predation/Competition is not considered a stress for this population.

### Key Limiting Stresses, Life Stages, and Habitat

The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking as vital habitat for the population. The key limiting stresses for this population are lack of floodplain and channel structure and degraded riparian forest condition. Winter rearing habitat is often formed by instream large wood, but is also found in estuaries and floodplain wetlands. Timber removal has decreased the source of large wood, and much of the historically available habitat in the estuary and floodplain wetlands has been altered by development and channelization. The IP habitat in the Mussel Creek basin is concentrated in the flattest parts of the basin, near the ocean, which is where the development occurs. Off-channel juvenile rearing habitat with suitable temperature is vital to coho salmon recovery in this creek, but is very impaired. These findings are consistent with those of the Oregon Expert Panel (Section 9.4).

### Lack of Floodplain and Channel Structure

In many areas, the creek and its tributaries are disconnected from the floodplain. Channelization of Myrtle Creek and the South Fork Mussel Creek eliminated meanders and side channels that would have provided summer and winter coho salmon rearing habitat. Coho salmon juveniles prefer pools formed by large wood, but habitat surveys show less than one key piece per 100 meters in the middle reach of Mussel Creek upstream of the highest IP habitat, which rates as

poor according to ODFW standards. The upper reach of Mussel Creek had 1 to 2 key pieces of large wood per 1000 feet, which rates as fair.

Figure 9-2. Photo of the Myrtle Creek channel. View is looking downstream just above its convergence with Mussel Creek. Surface flow has been lost, and the stream has been channelized. Photo taken on 9/18/2008.

Pool frequency in the upper reach of Mussel Creek was rated as (10 to 20 percent) according to ODFW standards. The good rating (20 to 35 percent) in the middle reach of Mussel Creek likely represents a substantial reduction in pool frequency from historic conditions, given the level of disturbance in the basin. Pool depth is poor (average less than 2 feet) in the entire sampled area.

### Degraded Riparian Forest Conditions

Without proper riparian forests, Mussel Creek has no mechanism for recruitment of large wood, which would trap fine sediment and enhance habitat complexity (Chapter 3). Lack of riparian cover also decreases shade and thermal buffering, and reduces formation of undercut banks. Habitat surveys of riparian conditions in the middle reaches of Mussel Creek found the area to be devoid of large conifers (>36” diameter at breast height), which translates to a poor riparian condition score using the ODFW criteria (<75 large conifers per 1000 feet of stream). Lack of large conifers in the riparian zone of much of the lower creek is also apparent. One short reach of Mussel Creek downstream Highway 101 contains a patch of late seral forest with a mature riparian canopy (Figure 9-3).

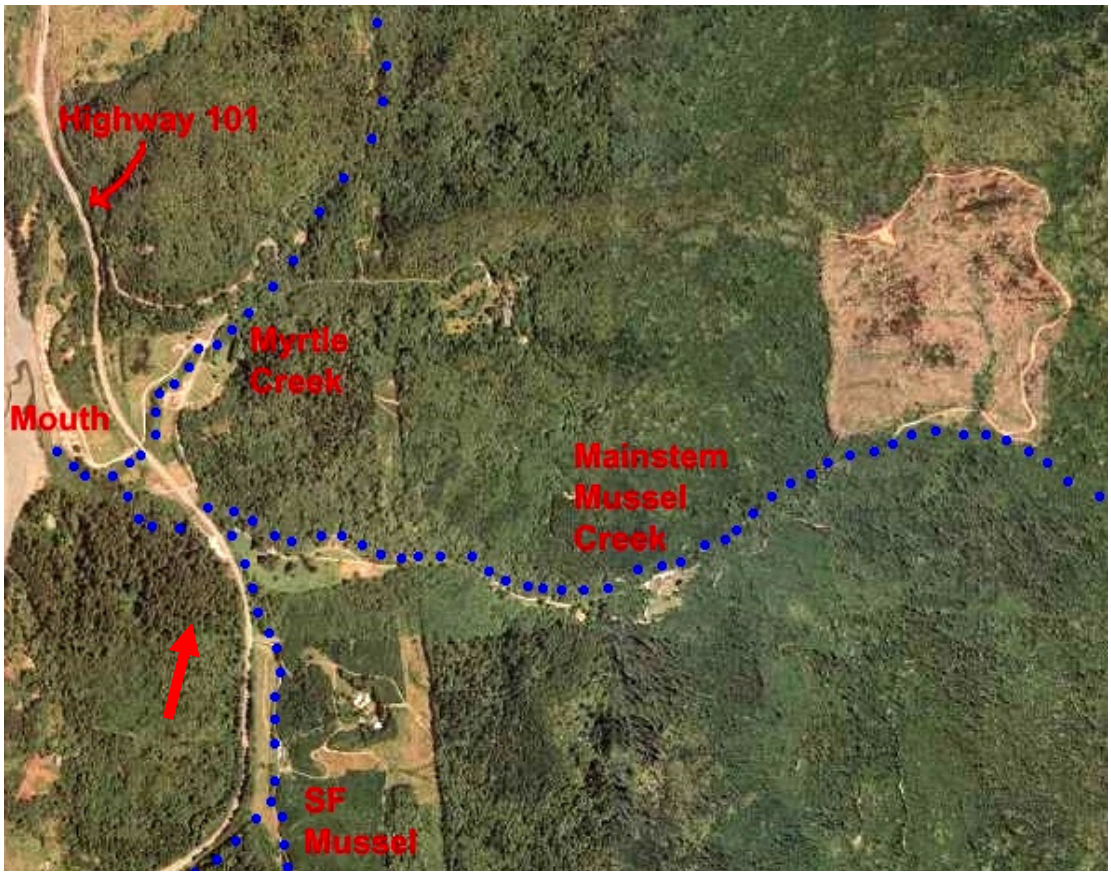


Figure 9-3. The lower reaches of Mussel, South Fork Mussel and Myrtle creeks in June 2005. Note the power line corridor in upper Myrtle riparian, Highway 101 confining South Fork, and a clearcut upper mainstem Mussel Creek. Arrow at lower-left points to patch of large trees, possibly old growth.

### Altered Sediment Supply

Sediment contribution from landslides and erosion occurs naturally in the Mussel Creek basin. However, roads, timber harvest, and bank erosion following removal of riparian vegetation have elevated fine sediment input. While the steeper reach further upstream rated good for surface fines (<12 percent), habitat surveys in the middle reaches of Mussel Creek found poor (>17 percent surface fines) silt/sand surface conditions. These middle reaches are where the high IP is located. The high percentage of industrial timberlands, high harvest rates and associated roads has increased the amount of fine sediment delivered to the streams. Excess fine sediment directly impacts coho salmon egg viability and can reduce food for fry, juveniles and smolts. Poor pool frequency and depth throughout the Mussel Creek basin is likely due to elevated levels of fine sediment partially filling pools, a lack of scour-forcing obstructions such as large wood, and in some reaches diminished scour due to channel widening.

### Impaired Estuary/Mainstem Function

Little is known about the historic extent of estuarine area in Mussel Creek, but it is likely that development adjacent to the current estuary has reduced habitat. Currently the estuarine portion of Mussel Creek is confined to less than 10 acres of tidal sand and mudflat, and a few acres of tidal wetland habitat west of Highway 101 (Figure 9-4). Based on the natural drainage pattern

and elevations in the area, much of the historical estuarine tidal area that once existed has likely been diked and filled to accommodate the highway, other small roads, and residential and agricultural development. Remaining habitat is largely degraded and provides little cover and foraging habitat.

Figure 9-4. Lagoon at the mouth of Mussel Creek. View is looking north. A sand bar blocks exchange of salt and fresh waters during periods of low flow. The lagoon is shallow, lacks cover, and likely provides limited habitat for juvenile salmonid rearing. (9/18/2008).

### Impaired Water Quality

There are no water quality data available for Mussel Creek. Temperature problems are unlikely in Mussel Creek due to the proximity to the coast, topographic shading, short transit time, and likely contributions of groundwater from hollows throughout this steep basin. Turbidity is likely high during winter due to high road density and timber harvest in the basin. Potential sources of chemical water pollutants would be use of herbicides on industrial timberlands and leakage from septic systems at the campground, resorts, or the small number of rural residences in the basin.

### Barriers

There are no known structural barriers to coho salmon passage in Mussel Creek. The dry reach of lower Myrtle Creek poses a potential seasonal impediment to passage.

### Altered Hydrologic Function

The complex hydrology of Mussel Creek has been severely disrupted by Highway 101, debris torrents down Myrtle Creek, and development on the floodplain. Increased peak discharge is likely in the Mussel Creek basin, due to high road densities and widespread timber harvest. These peak flows can scour eggs and flush fry, juveniles, and smolts from the river system.

### Adverse Fishery- and Collection-Related Effects

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

### Adverse Hatchery-Related Effects

Hatchery-origin coho salmon may stray into Mussel Creek; however, the proportion of adults that are of hatchery origin is likely less than five percent and there are no hatcheries in the basin. Therefore, adverse hatchery-related effects pose a low risk to all life stages (Appendix B).

## 9.6 Threats

Table 9-3. Severity of threats affecting each life stage of coho salmon in Mussel Creek. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

| Threats[2] | | Egg | Fry | Juvenile[1] | Smolt | Adult | Overall Threat Rank |
|---|---|---|---|---|---|---|---|
| 1 | Timber Harvest[1] | Very High | Very High | Very High[1] | Very High | Medium | Very High |
| 2 | Channelization/Diking[1] | High | Very High | Very High[1] | Very High | Very High | Very High |
| 3 | Roads | High | Very High | Very High | Very High | Very High | Very High |
| 4 | Urban/Residential/Industrial Dev. | High | High | High | High | High | High |
| 5 | Agricultural Practices | Medium | Medium | Medium | Medium | Medium | Medium |
| 6 | Dams/Diversion | Low | Low | Medium | Low | Low | Low |
| 7 | Climate Change | Low | Low | Low | Low | Medium | Low |
| 8 | High Severity Fire | Low | Low | Low | Low | Low | Low |
| 9 | Road-Stream Crossing Barriers | - | Low | Low | Low | Low | Low |
| 10 | Fishing and Collecting | - | - | Low | Low | Low | Low |
| 11 | Hatcheries | Low | Low | Low | Low | Low | Low |

[1]Key limiting threats and limited life stage.
[2]Invasive Non Native/Alien Species and Mining/Gravel Extraction are not considered threats to this population.

### Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are timber harvest and channelization/diking.

### Timber Harvest

Recent private timber harvest data are not readily available. However, Mussel Creek has the highest percentage of industrial timberlands managed under the Oregon Forest Practices Act. Active timber harvest on private lands within the Mussel Creek basin is widespread and occurring rapidly with the expectation it will continue. The high harvest rates and associated roads impact multiple aspects of coho salmon habitat. Studies of adjacent southwest Oregon basins found that "downstream, cumulative impacts of human activity are pervasive in southwest Oregon, wherever logging has occurred over an extensive portion of a drainage basin or has involved operations on steep, unstable slopes. The downstream effects of channel sedimentation and aggradation can severely damage streams even where buffer zones of riparian vegetation have been retained, and such effects persist more than 20-30 years after logging activities have ceased (Frissell 1992)."

### Channelization/Diking

Highway 101 caused the relocation and straightening of most of the South Fork Mussel Creek channel, which altered more than 20 percent of the high IP in the Mussel Creek basin. The highway is not likely to be relocated and is a major impediment to restoring habitat in South Fork Mussel Creek; however, there is a meadow east of the creek that could potentially provide space for creation of a more complex channel. Myrtle Creek has also been channelized through the lower reach near the campground. A parking lot for beach access was constructed by rearranging deposited materials, which created a functional dike along the eastern lagoon border and reduced the lagoon area. While the number of developed properties is low (Prehistoric Gardens and a few rural residences), they overlap with the highest IP habitat. These most important reaches of Myrtle Creek, Mussel Creek and South Fork Mussel Creek have been pushed to the sides of their floodplains, channelized and diked.

### Roads

Road densities in the Mussel Creek basin are over thresholds recognized as contributing to increased fine sediment yield and elevated peak flows. Roads are expected to cause fine sediment delivery into Mussel Creek because the basin is very steep and the geology is relatively unstable. The construction of Highway 101 has resulted in the channelization and realignment of the South Fork Mussel Creek, as well as parts of the mainstem Mussel Creek and Myrtle Creek. These impacts, along with excessive sedimentation from upslope activities, have altered the hydrology of these creeks and made them less suitable for coho salmon spawning and rearing. In addition, because of the small size of the Mussel Creek basin and the significant impacts of Highway 101 to high IP habitat in the basin, the highway continues to be a major threat to coho salmon in this basin.

### Urban/Residential/Industrial Development

A resort (Prehistoric Gardens), a campground, and a day use recreation area (Arizona Beach) are operated in the floodplain of Mussel Creek. Additionally, an electrical power transmission line runs north-south across the South Fork and lower mainstem Mussel Creek and parallels the riparian zone of upper Myrtle Creek (Figure 9-3). Periodically, along this corridor all vegetation is removed. Other than the power lines, the existing developments are relatively small and are

not expected to expand significantly. The recent acquisition and conversion of Arizona Beach from a privately operated campground facility to a state park should improve conditions in the basin.

### Agricultural Practices

Cattle grazing occurs in the lower Mussel Creek floodplain adjacent to high IP. In the rest of the basin, agriculture is not a significant activity.

### Dams/Diversions

No dams are known to exist in the valley and few water diversions are presently active.

### Climate Change

There is low risk of average temperature increase, or change in average precipitation, over the next 50 years (Appendix B). The risk of sea level rise is moderate (Appendix B, Thieler and Hammer-Klose 2000). Adults may be negatively impacted by climate-related ocean acidification, changes in ocean conditions, and prey availability (see Independent Science Advisory Board 2007, Feely et al. 2008, Portner and Knust 2007).

### High Severity Fire

The proximity of the Mussel Creek basin to the coast is a strong moderating factor on fire risk.

### Road-Stream Crossing Barriers

Road-stream crossing barriers are not a significant threat to coho salmon in Mussel Creek based on the lack of known barriers that exist in the basin. Given the amount of timber harvest that has occurred in the basin and the density of roads in the lower basin, there are likely many partial or total barriers that have yet to be identified on private land. Based on the projected population growth in this area, an increase in road-stream crossings is not likely unless significant timber harvest resumes in roadless areas.

### Fishing and Collecting

Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any scientific collection (Appendix B), these activities pose a low stress to juveniles, smolts, and adults.

### Hatcheries

Hatcheries pose a low threat to all life stages of coho salmon in the Mussel Creek population area. The rationale for these ratings is described under the “Adverse Hatchery-Related Effects” stress.

## 9.7 Recovery Strategy

Restoration efforts should be focused on lower Mussel Creek, South Fork Mussel Creek, and Myrtle Creek, which all have high IP (Figure 9-1).

The Mussel Creek population is considered dependent and therefore cannot be viable on its own; however, restoring habitat within the basin is necessary so that the basin can support all life stages of coho salmon and provide connectivity between other populations in the ESU. The recovery criterion for this population is that 80% of available IP habitat must be occupied in years following spawning of brood years with high marine survival. The most important factor limiting recovery of coho salmon in Mussel Creek is a deficiency in the amount of suitable rearing habitat for juveniles. The processes that create and maintain such habitat must be restored by increasing habitat complexity within the channel, re-establishing off-channel rearing areas, restoring riparian forests, increasing summer flow, and reducing threats to instream habitat. The effects of fishing on this population's ability to meet its viability criteria should be evaluated.

Table 9-4 on the following page lists the recovery actions for the Mussel Creek population.

Table 9-4. Recovery action implementation schedule for the Mussel Creek population. Recovery actions for monitoring and research are listed in tables at the end of Chapter 5.

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MusC.19.3.3 | Timber Harvest | Yes | Improve wood recruitment, bank stability, shading, and food subsidies | Improve timber harvest practices | Population wide | 2b |
| *SONCC-MusC.19.3.3.2* | *Determine how to revise Oregon Forest Practice Rules so that they do not limit recovery of SONCC coho salmon and make appropriate revisions* | | | | | |
| *SONCC-MusC.19.3.3.3* | *Adopt rules for fish-bearing streams sufficient to protect both water quality and fish habitat* | | | | | |
| *SONCC-MusC.19.3.3.4* | *Adopt rules to increase protection of non-fish-bearing streams that address practices that adversely impact water quality and fish habitat* | | | | | |
| *SONCC-MusC.19.3.3.5* | *Ensure management measures for landslide prone areas include protection of water quality and fisheries habitat* | | | | | |
| *SONCC-MusC.19.3.3.6* | *Until more permanent regulatory mechanisms can be put in place, immediately adopt interim rules that increase protection for salmon habitat in forested areas, including increased natural recruitment of large wood on perennial and intermittent streams likely to deliver wood downstream, increased shade on all perennials, and protective buffers on small intermittent streams.* | | | | | |
| SONCC-MusC.2.1.6 | Floodplain and Channel Structure | Yes | Increase channel complexity | Increase LWD, boulders, or other instream structure | State park in lower mainstem and streams where coho salmon would benefit immediately | 2b |
| *SONCC-MusC.2.1.6.1* | *Assess habitat to determine beneficial location and amount of instream structure needed* | | | | | |
| *SONCC-MusC.2.1.6.2* | *Place instream structures, guided by assessment results* | | | | | |
| SONCC-MusC.2.1.35 | Floodplain and Channel Structure | Yes | Increase channel complexity | Increase LWD, boulders, or other instream structure | Population wide | 2c |
| *SONCC-MusC.2.1.35.1* | *Assess habitat to determine beneficial location and amount of instream structure needed* | | | | | |
| *SONCC-MusC.2.1.35.2* | *Place instream structures, guided by assessment results* | | | | | |
| SONCC-MusC.2.2.4 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows | Lower mainstem and estuary, and streams where coho salmon would benefit immediately | 2b |
| *SONCC-MusC.2.2.4.1* | *Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat* | | | | | |
| *SONCC-MusC.2.2.4.2* | *Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results* | | | | | |
| SONCC-MusC.2.2.36 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Construct off channel habitats, alcoves, backwater habitat, and old stream oxbows | Population wide | 2c |
| *SONCC-MusC.2.2.36.1* | *Identify potential sites to create refugia habitats. Prioritize sites and determine best means to create rearing habitat* | | | | | |
| *SONCC-MusC.2.2.36.2* | *Implement restoration projects that improve off channel habitats to create refugia habitat, as guided by assessment results* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MusC.2.2.5 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Increase beaver abundance | Lower Mainstem and streams where coho salmon would benefit immediately | 2b |
| *SONCC-MusC.2.2.5.1* | *Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort* | | | | | |
| *SONCC-MusC.2.2.5.2* | *Implement education and technical assistance programs for landowners, guided by the plan* | | | | | |
| *SONCC-MusC.2.2.5.3* | *Reintroduce or relocate beaver if appropriate, guided by the plan* | | | | | |
| SONCC-MusC.2.2.37 | Floodplain and Channel Structure | Yes | Reconnect the channel to the floodplain | Increase beaver abundance | Population wide | 2c |
| *SONCC-MusC.2.2.37.1* | *Develop a beaver conservation plan that includes education and outreach, technical assistance for land owners, and methods for reintroduction and/or relocation of beaver as a last resort* | | | | | |
| *SONCC-MusC.2.2.37.2* | *Implement education and technical assistance programs for landowners, guided by the plan* | | | | | |
| *SONCC-MusC.2.2.37.3* | *Reintroduce or relocate beaver if appropriate, guided by the plan* | | | | | |
| SONCC-MusC.7.1.1 | Riparian | Yes | Improve wood recruitment, bank stability, shading, and food subsidies | Improve long-range planning | Lower mainstem and estuary | 2c |
| *SONCC-MusC.7.1.1.1* | *Review General Plan or County Ordinances to ensure coho salmon habitat needs are accounted for. Revise if necessary* | | | | | |
| *SONCC-MusC.7.1.1.2* | *Develop watershed-specific guidance for managing riparian vegetation. Consider larger riparian buffers in coho occupied habitat* | | | | | |
| SONCC-MusC.2.2.31 | Floodplain and Channel Structure | No | Reconnect the channel to the floodplain | Improve regulatory mechanisms | Population wide | 2c |
| *SONCC-MusC.2.2.31.1* | *Improve protective regulations for beaver and develop guidelines for relocation that are practical for restoration groups* | | | | | |
| SONCC-MusC.7.1.19 | Riparian | No | Improve wood recruitment, bank stability, shading, and food subsidies | Improve grazing practices | Private lands and all areas where coho salmon would benefit immediately | 3b |
| *SONCC-MusC.7.1.19.1* | *Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions* | | | | | |
| *SONCC-MusC.7.1.19.2* | *If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition* | | | | | |
| *SONCC-MusC.7.1.19.3* | *Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MusC.7.1.40 | Riparian | No | Improve wood recruitment, bank stability, shading, and food subsidies | Improve grazing practices | Population wide | 3d |
| *SONCC-MusC.7.1.40.1* | *Assess grazing contribution to sediment delivery, pollutants, and impaired riparian conditions* | | | | | |
| *SONCC-MusC.7.1.40.2* | *If problems are identified, develop and implement grazing management strategy that decreases delivery of sediment and pollutants to streams and improves riparian condition* | | | | | |
| *SONCC-MusC.7.1.40.3* | *Monitor effectiveness of grazing management to ensure grazing does not limit recovery of SONCC coho salmon* | | | | | |
| SONCC-MusC.7.1.20 | Riparian | No | Improve wood recruitment, bank stability, shading, and food subsidies | Increase regulatory oversight | All coho salmon bearing streams | 3b |
| *SONCC-MusC.7.1.20.1* | *Strengthen city and county ordinances to limit development within the 100 year channel migration zone* | | | | | |
| *SONCC-MusC.7.1.20.2* | *Strengthen city and county ordinances to limit development within the 50 year flood elevation* | | | | | |
| SONCC-MusC.22.1.21 | Urban, Residential, Industrial Development | No | Reduce pollutants | Increase regulatory oversight | Population wide | 3b |
| *SONCC-MusC.22.1.21.1* | *Strengthen city and county ordinances to minimize new impervious surfaces and require treatment to current standards* | | | | | |
| *SONCC-MusC.22.1.21.2* | *Strengthen city and county ordinances to require treatment to current standards when existing impervious surfaces are expanded, reconditioned, reconstructed or replaced* | | | | | |
| *SONCC-MusC.22.1.21.3* | *Develop local regulatory mechanisms that limits development and reduces amount of total impervious area through incentives* | | | | | |
| SONCC-MusC.5.1.8 | Passage | No | Improve access | Remove barriers | All streams where coho salmon would benefit immediately | 3c |
| *SONCC-MusC.5.1.8.1* | *Use ODFW and SCWC fish passage barrier database to remove barriers based on known coho use or data identifying suitable habitat conditions above barriers* | | | | | |
| SONCC-MusC.5.1.39 | Passage | No | Improve access | Remove barriers | Population wide | 3d |
| *SONCC-MusC.5.1.39.1* | *Use ODFW and SCWC fish passage barrier database to remove barriers based on known coho use or data identifying suitable habitat conditions above barriers* | | | | | |
| SONCC-MusC.3.1.18 | Hydrology | No | Improve flow timing or volume | Increase instream flows | All streams with ODFW water rights for fish, and all streams where coho salmon would benefit immediately | 3c |
| *SONCC-MusC.3.1.18.1* | *Secure adequate instream flows to fulfill ODFW water rights for fish* | | | | | |
| SONCC-MusC.3.1.38 | Hydrology | No | Improve flow timing or volume | Increase instream flows | Population wide | 3d |
| *SONCC-MusC.3.1.38.1* | *Secure adequate instream flows to fulfill ODFW water rights for fish* | | | | | |

| Action ID | Target | KLS/T | Strategy | Action Description | Area | Priority |
|---|---|---|---|---|---|---|
| *Step ID* | *Step Description* | | | | | |
| SONCC-MusC.8.1.11 | Sediment | No | Reduce delivery of sediment to streams | Reduce road-stream hydrologic connection | All areas where coho salmon would benefit immediately | 3c |
| *SONCC-MusC.8.1.11.1* | *Assess and prioritize road-stream connection, and identify appropriate treatments* | | | | | |
| *SONCC-MusC.8.1.11.2* | *Decommission roads, guided by assessment* | | | | | |
| *SONCC-MusC.8.1.11.3* | *Upgrade roads, guided by assessment* | | | | | |
| *SONCC-MusC.8.1.11.4* | *Maintain roads, guided by assessment* | | | | | |
| SONCC-MusC.8.1.41 | Sediment | No | Reduce delivery of sediment to streams | Reduce road-stream hydrologic connection | Population wide | 3d |
| *SONCC-MusC.8.1.41.1* | *Assess and prioritize road-stream connection, and identify appropriate treatments* | | | | | |
| *SONCC-MusC.8.1.41.2* | *Decommission roads, guided by assessment* | | | | | |
| *SONCC-MusC.8.1.41.3* | *Upgrade roads, guided by assessment* | | | | | |
| *SONCC-MusC.8.1.41.4* | *Maintain roads, guided by assessment* | | | | | |
| SONCC-MusC.10.7.33 | Water Quality | No | Restore nutrients | Add marine-derived nutrients to streams | All streams where coho salmon would benefit immediately | 3c |
| *SONCC-MusC.10.7.33.1* | *Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)* | | | | | |
| *SONCC-MusC.10.7.33.2* | *Supply marine-derived nutrients to streams guided by the plan* | | | | | |
| SONCC-MusC.10.7.34 | Water Quality | No | Restore nutrients | Add marine-derived nutrients to streams | Population wide | 3d |
| *SONCC-MusC.10.7.34.1* | *Develop a plan to supply appropriate amounts of marine-derived nutrients to streams (e.g. carcass placement, pellet dispersal)* | | | | | |
| *SONCC-MusC.10.7.34.2* | *Supply marine-derived nutrients to streams guided by the plan* | | | | | |
| SONCC-MusC.22.1.7 | Urban, Residential, Industrial Development | No | Reduce pollutants | Educate stakeholders | Population wide | 3d |
| *SONCC-MusC.22.1.7.1* | *Develop an educational program that teaches landowners about avoiding pollution from septic systems, backyard pesticides, fuels, and nutrients* | | | | | |
| SONCC-MusC.22.1.17 | Urban, Residential, Industrial Development | No | Reduce pollutants | Increase regulatory oversight | Population wide | 3d |
| *SONCC-MusC.22.1.17.1* | *Increase application of Low Impact Development (LID) techniques through education and incentives* | | | | | |
| *SONCC-MusC.22.1.17.2* | *Incorporate LID in Clean Water Act permits for projects that result in stormwater discharge* | | | | | |

This page intentionally left blank.