Mining Impacts
in the
Siskiyou Wild Rivers Area
Southwest Oregon

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Summary

The Siskiyou Wild Rivers area (SWRA) in southwestern Oregon encompasses 6 major watersheds: Illinois River, Chetco River, Winchuck River, Pistol River, Elk River, and lower Rogue River (Figure 1). About 75% percent of these watersheds are public lands managed by the Rogue River-Siskiyou National Forest (RRSNF), Medford District Bureau of Land Management (BLM) and Coos Bay District BLM. The Illinois River Basin was heavily mined for gold and other minerals from the 1850s through the 1940s. Many Illinois Valley streams and rivers were severely damaged from hydraulic mining during this period. In 1989 the Siskiyou National Forest Plan stated that "Mineral development on the Forest in 10 years will increase. The most active mining activity will probably continue to be for gold, although interest in nickel-laterites and chromite areas may be increasing. Physical and biological impacts will have been minimized; however, short-term effects on water quality will continue to be a concern. New discoveries of minerals will bring additional demands for access into the unroaded portions of the Forest" (USDA Forest Service 1989: IV-3). These predictions have proved essentially correct through 2009 and can be expected to continue.

An additional and unforeseen impact is the increased recreational motorized vehicle use of legacy mining routes in serpentine areas where rare plants are vulnerable to destruction and Port Orford-cedar is susceptible to a fatal root disease. Motorized use increases erosion and sedimentation of streams, destroys significant areas of native vegetation including rare plants, introduces invasive weed species, and spreads Port Orford-cedar root disease. Desirable wilderness characteristics such as pristine landscapes, natural vegetation, and solitude in unroaded areas is degraded by the cumulative effect of legacy mining routes and increasing recreational motorized use. The Kalmiopsis Wilderness is degraded by commercial mining facilities on private inholdings. Besides noisy helicopter shuttles, these inholdings create the potential for motorized land travel by miners and equipment through a large portion of the Kalmiopsis Wilderness.

The most serious and ongoing impact is destabilization of streambeds from suction dredge mining. Spawning gravel stability is already a known threat to fall-spawning coho and chinook salmon in southwest Oregon streams because of logging. Researchers have found that chinook and coho salmon have reduced egg-to-fry survival when they spawn in suction dredge mine tailings. Studies of suction dredging found that streambanks are made vulnerable to erosion because the dredging occurs at or too close to the streambank. Sediment eroded at suction dredge mining sites is deposited at downstream locations where it harms aquatic animals. Visible turbidity plumes extend 150-500 ft downstream from dredges. Long term mining camps, noise, odor and the presence of dredges in streams displaces traditional recreationists or reduces the quality of the outdoor experience.

A 2009 legislated ban on suction dredging in California and record high gold prices through 2010 can be expected to increase suction dredge mining and placer mining impacts in the Siskiyou Wild Rivers area. In addition to suction dredging, placer mining operations excavate pits on floodplains and terraces that destroys areas of mature riparian forests and often releases sediment into streams. Placer mining on terraces and floodplains, in-stream suction dredging, and construction/use of mining roads will retard recovery of SWRA streams to former biological productivity and diversity, essentially disrupting desired biological function. Cumulative impacts to formerly pristine streams and impacts to streams recovering from previous mining are increasing. Mineral withdrawal is the only proven remedy to reduce mining impacts and allow streams to fully recover.

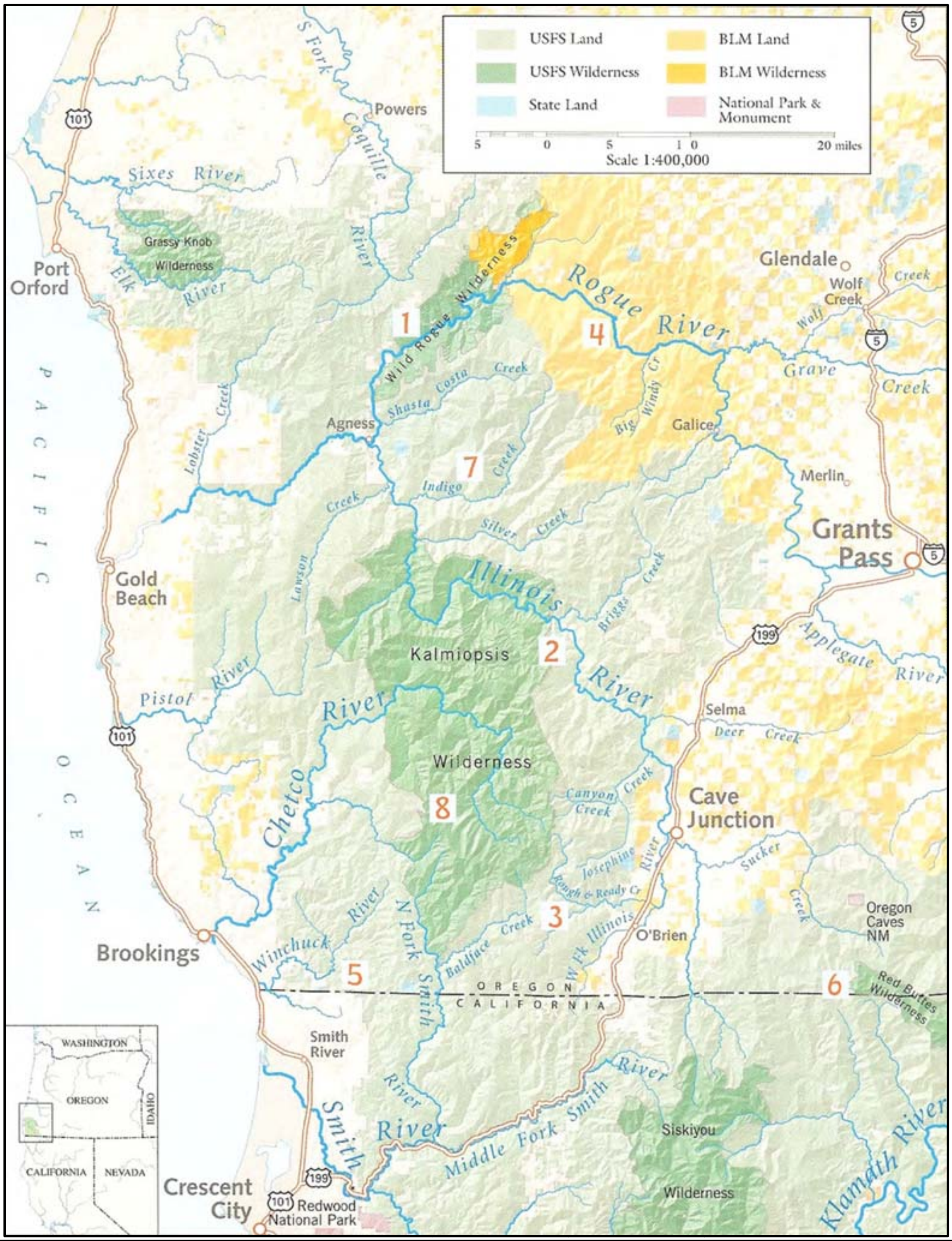

Figure 1. Siskiyou Wild Rivers area of southwest Oregon

Introduction

Despite requirements of the National Environmental Policy Act, no comprehensive description of mining impacts exists for the Siskiyou Wild Rivers Area (SWRA) in southwest Oregon (Siskiyou Project 2009). The purpose of this report is to fill that void and describe impacts associated with all types of mining in the SWRA in southwest Oregon. The best previous attempt to describe mining impacts was a draft programmatic impact statement published by the Forest Service for suction dredging (USDA 2001a). I used unpublished and published information. Bold type highlights the most serious impacts and the best available science for implementing the Endangered Species Act. I primarily relied on my personal observations, government publications, and unpublished reports to demonstrate that impacts described in published literature are indeed occurring in the SWA (i.e. mining impacts are not merely hypothetical). This report will be updated periodically to include the best available science and site specific examples of impacts.

In 1872, the General Mining Act authorized the prospecting and mining for economic materials such as gold on federal public lands. The Siskiyou National Forest Plan (USDA Forest Service 1989: IV-18) states that proposals for mineral exploration and development are negotiated on a case-by-case basis. Impacts are largely determined by the specifics of the actual plans of operations. Some recent examples are the Nicore Mining Plan of Operations (USDA Forest Service 1999) and Tracy Placer Mining Project (USDA Forest Service 2009). Mineral exploration and surface disturbance that do not require a plan of operation have more generic impacts that are less site specific. For example, suction dredge mining impacts are similar because the equipment (usually a 4 inch or smaller dredge operated within salmonid spawning streams) are similar for most suction dredging (USDA Forest Service 2001). Bulk sampling generally involves a small trench less than 0.1 acres. Impacts from mining are lessened by restrictions to protect water quality, riparian vegetation, soils, and rare plants (i.e. surface resources). For example, congressionally designated Wilderness in the SWRA has been withdrawn from new prospecting, mineral entry, and mineral location since December 31, 1984. Similarly, congressionally designated Wild and Scenic or Recreation Rivers have been withdrawn from mineral entry or have access restrictions. The Illinois, Rogue, Chetco, North Smith and Elk Rivers are partially withdrawn within ¼ mile from each bank. Pre-existing mining claims in withdrawn areas may be valid but mining plans of operations in these withdrawn areas are subject to a very high level of restrictions consistent with the intent of Congress for the designated area. The Siskiyou National Forest Plan as amended by the Northwest Forest Plan (USDI/USDA 1994) places minor restrictions on surface mining disturbance in Riparian Reserves, restricts motorized access, and restricts locations of processing facilities. Despite adoption of mining standards and guidelines in the Northwest Forest Plan, annual mining in Riparian Reserves has continued to be a chronic cause of stream degradation and retards recovery to former (pre-mining) aquatic productivity and ecologic integrity (Nawa 2002).

Types of Mining in the Siskiyou Wild Rivers Area and the 1872 Mining Law

Gold and other valuable minerals occur in lode or placer deposits. Mining claims on federal lands are either lode claims or placer claims. Originally, all gold and other valuable minerals are located within solid rock, often as veins in quartz. Lode mining is also called hard rock mining to differentiate it from soft rock mining which is excavation of softer minerals such as salt, coal or oil sands. Lode deposits of gold were primarily mined from the 1850s to 1940s by underground methods. The process of lode mining generally involves the labor of many miners working together to extract gold or other valuable minerals with tunnels in a mountain or large open pits (Nevada). Lode mining has not been recently attempted in the SWRA because of high start-up costs requiring considerable capital investment.

Placer deposits are formed when lode deposits are disintegrated by natural erosion, such as water flowing over the rock. Placer deposits can be unconsolidated surface sediment or much older buried sediments. Placer deposit of loose surface soil or gravel contains gold or other valuable mineral such as nickel laterite or chrome. Dredging recovers gold from sediments within the wetted stream channel. Historically, large instream dredges were used but these have been replaced by small portable suction dredges (Agee 2007). Usually one miner or a small group of miners separate out the gold with placer mining. Placer mining can also recover gold from floodplains and terraces with large earth moving equipment and processing machines. Placer mining for nickel laterite and chrome recovers ore from shallow deposits in upland serpentine areas where these minerals are concentrated.

Gravel mining extracts commercially valuable rounded rock from riverine areas on private lands, generally for road construction and concrete applications. Quarries on hillsides extract rock suitable for road construction. Some quarries in the area (e.g. Marble Mountain near Wilderville) once provided granite or marble for specialized construction purposes. Gravel and other non-hardrock mining activities are not subject to the 1872 mining law.

Suction Dredge Gold Mining in Streams and Rivers

The commonest mining activity in the SWRA with significant impact is suction dredging for gold in streams. The Siskiyou National Forest (SNF) reports 577 placer claims within streams (USDA Forest Service 2001:37; Figs 1). The Illinois River Basin has the highest concentration of suction dredge mining operations in Oregon (USDA Forest Service 2001:37; Fig 7). Site specific physical impacts to three heavily mined streams in the Illinois Basin were reported by Nawa (2002). California banned suction dredging in 2009. Horizon (2009) has produced a comprehensive literature review of impacts associated with suction dredging for the California Department of Fish and Game. **The most important biological impacts are reduced egg-to-fry survival for Chinook and coho salmon when salmon spawn in suction dredge mine tailings (Harvey and Lisle 1999).** Damage to streambanks and riparian vegetation are important because recovery is slow (Harvey and Lisle 1998). **Introduction of Port Orford-cedar root disease via mining roads is an irreversible impact to the ecological integrity of riparian forests, especially in serpentine areas of the SWRA (Nawa 1997; Hansen et al. 2000).**

Streambank Effects

Although state regulations in both Oregon and California prohibit dredging that results in streambank erosion, streambank excavation and erosion is the most frequent long term visible impact observed with suction dredge mining (Hassler et al 1986; Horizon 2009:4.1-5).**"Dredging that excavates streambanks may have long-lasting effects because streambanks are commonly slow to rebuild naturally"** (Harvey and Lisle 1998; Wolman and Gerson 1978). Similar to these published reports, Nawa (2002:18) found 30 streambank excavations associated with suction dredging along 9.5 miles of stream in the Siskiyou National Forest. Streambank excavations are particularly harmful because nearly all material excavated from streambanks is deposited directly into the stream channel which increases sediment load and greatly increases turbidity (Nawa 2002:20). Some miners also remove protective boulders and cobble that once armored streambanks from erosion (Nawa 2002: 22). An unknown amount of additional sediment beyond what was excavated from streambanks will be added to the stream each year as denuded streambanks continue to erode during winter floods (Fig 2). Streambanks denuded of vegetation have increased erosion of 80% or more (Micheli et al. 2004; Horizon 2009: 4.3-20).

Figure 2. Nearly all protective armoring and riparian vegetation has been removed from this streambank by suction dredge operators, making the streambank vulnerable to increased erosion from winter floods. Briggs Creek, Rogue River-Siskiyou National Forest, 5 September 2001. Photo by Rich Nawa.

Streambed Effects

Undisturbed streambeds are armored with coarse rock that requires relatively high (bankfull) flows to activate bedload movement of underlying fine sediment (Jackson and Bestcha 1982). **Direct effects of dredging include the creation of unnatural pits averaging 1.2-1.5 m in depth and tailings piles that destabilize the streambed through the removal of coarse textured streambed armoring (Stern 1988; Hassler et al. 1986; Sommer and Hassler 1992; Harvey and Lisle 1998; Harvey and Lisle 1999; Horizon 2009-4.14).** Streambed dredging remove the coarse protective armoring and allow the underlying finer sediments to be mobilized by modest (less than bankfull) flows (Nawa 2001:23). Streambed dredging makes the streambed more susceptible to streambed erosion, turbidity, and increased fine sediment deposition. Increased sediment, unstable eroding streambanks, loss of coarse textured armoring, and creation of mid-channel bars combine to destabilize streambeds.

During summer low flows, suction dredge operators sometimes move coarse streambed sediment to channelize flow towards streambanks that causes undercutting and erosion (Horizon 2009:4.1-6; Harvey and Lisle 1998:11). Similar to published reports, Nawa (2002:18) documented flow channelization by suction dredge miners in Briggs Creek on the Rogue River-Siskiyou National Forest.

Turbidity/Total Suspended Solids (TSS)

Visible plumes of sediment (15-50 NTUs; 160-340 mg/L) can be seen between 50 and 160 m (164 ft and 525 ft) below suction dredges but can extend up to 320 m (1,050 ft). These sediment plumes are 2-3 times dirtier than background levels above the dredge (Harvey 1986; Somer and Hassler 1992; Thomas 1985; Griffith and Andrews 1981; Stern 1988; Prussian et al. 1999; ODEQ 2010; Horizon 2001: 4.2-1, 2). Elevated suspended sediment in discharge plumes suppresses algal production which reduces invertebrate and fish production (Lloyd et al. 1987). Based on data from Newcomb and Jensen (1996), Horizon (2009: 4.3-12) calculated that juvenile salmonids may be slightly affected by typical increases in turbidity resulting from a single suction dredge. Multiple dredges, even if plumes did not mix, would have significant impacts because all or a large portion of a stream could be affected and beneficial uses by fish and humans would be impaired.

Size (flow) of receiving water is important and often overlooked. Althouse Creek is a typical low gradient coho salmon stream with elevated fine sediment due to logging, roads, and historic mining. Dredging with a 4 inch dredge created a turbid plume that extended beyond 300ft. (ODEQ 2010:10). Similarly, R. Nawa had to discontinue snorkel counting of juvenile coho salmon when turbid water from a single suction dredge muddied an estimated 1,000 ft of a very small unnamed tributary to Middle Fork Sixes River. The entire water column was muddied and the juvenile coho salmon had no place to escape the turbidity. Dredges in very small coho streams may have disproportionately higher impacts than those commonly reported in the literature (i.e. the smaller the stream the greater the fish impact for a given size of dredge). Conversely, large streams such as the mainstem Illinois River and Applegate River have comparatively small turbidity effects from a 4 inch dredge (ODEQ 2010:10).

Downstream Fine Sediment Deposition Effects to Fishes and Amphibians

Coarse sediments are found immediately adjacent the dredge as tailings. Fine sediment harmful to aquatic organisms is carried by the current and settles out, generally unseen below the dredge site. Thomas (1985) measured a 10-20 fold increase in fine sediment deposited in the first 15 m below the dredge site (Horizon 2009: 4.1-7). Similar significant increases in fine sediment were measured by Harvey et al. 1982, Somer and Hassler 1992, Stern 1988, Prussian et al. 1999, and summarized by Horizon 2009:4.1-7, 8. Sediment impacts are believed to be short-term because sediment flushing flows during the winter obliterates dredge tailings and holes (Horizon 2009:4.1-9,10), however, the sediment impact would affect the critical reproductive period of fall spawning salmon, lamprey, and some amphibians (Harvey and Lisle 1999).

Fine sediments redistributed into streambeds downstream of mining sites reduce the infiltration capacity of the streambed gravels, which can result in isolation of surface and interstitial (subsurface) flows. This hindering of interstitial flow exchange can increase temperature extremes in surface water (higher for longer periods in summer, lower in winter) and contribute to oxygen depletion in interstitial habitat, and may eliminate critical thermal refugia (Bjerklie and LaPerrie 1985). For example, fine sediment fills interstices used by tailed frogs and yellow legged frogs lead to population declines (Welsh and Olivier 1998; Horizon 2009:4.3-19). Sedimentation of habitat downstream of dredging activity can negatively impact the microhabitats of bottom-oriented stream fish such as dace, sculpin, and juvenile salmonids because these fishes rely on cover that can become embedded with fine sediment during dredging operations (Harvey 1986, Baltz et al. 1982; Suttle et al. 2004; and summarized in Horizon 2009: 4.3-8).

Mercury and Other Heavy Metals

The EPA (2010b:15) reports that "[m]ercury was used in historic placer mining operations to amalgamate gold fines. Elemental mercury may be present in stream beds and banks and if remobilized can result in impacts to fish and other aquatic life." Mercury bio-accumulates to top predator fish in areas with historic placer mining (Stewart et al. 2008; May et al 2000; Kuwabara et. al 2002). Mercury residues in fish tissue and fish eggs are harmful to fish reproductive success (Beckvar et al. 2005). The flux of mercury from sediments at the bottom of a reservoir in the Sierras was apparently a "lesser pathway" and resulted in lower mercury concentrations in fish tissue compared to the pelagic (upper water column) food web. The higher rate of mercury enrichment in the pelagic food web was related to mercury in the water column that was continuously being resupplied from mercury in the watershed deposited during historic gold mining. Mercury has concentrated in historic dredge tailings along the Sacramento River (Prokopovich (1984). Similar mining tailings are found along streams in the Illinois Valley (see USGS Quadrangle Maps;Nawa 2002).

The Forest Service conducted a controlled experiment to recover elemental mercury with a small suction dredge from a mercury "hot spot" in the South Fork American River, California (Humphreys 2005). Although the dredge recovered 98% of the elemental mercury, the mercury concentration of the sediment lost by the dredge was ten times higher than the minimum concentration necessary for classification as a California hazardous waste. **Humphreys (2005) concludes that "lost sediment [from suction dredging] with high mercury levels is, in effect, mercury recycled to the environment. Floured mercury in fine sediment and mercury attached to clay particles in suspended sediment may be carried by the river to environments where mercury methylation occurs and where fish have high mercury concentrations."**

Placer mining and suction dredging increases arsenic, lead, zinc, and copper by mobilizing sediments (LaPerriere et al. 1985;Prussian 1999).

Loss of Large Wood and Large Boulders

Harvey and Lisle (1998:12) report that "[d]redge operators may remove coarse woody debris (CWD) and large boulders from stream channels or reduce the stability of these elements by removing surrounding material." Similar to published studies, Nawa (2002:6-24 observed that large instream wood was cut into smaller pieces and boulders winched or removed. **Loss of boulders and large wood reduces the potential for the stream to form pools and thus reduces habitat for aquatic organisms such as salmonids (Horizon 2009:4.3-8, 9; Harvey and Lisle 1998:12).**

Destruction of Riparian Vegetation/Increased Stream Temperatures

Nawa (2002:26) observed that most tree felling and cutting of fallen trees adjacent suction dredge mining operations was done in conjunction with stream bank excavations. Dredgers apparently remove streamside trees and cut roots while excavating stream banks (Fig 1). Removal of streamside trees and shrubs with subsequent streambank excavation makes streambanks vulnerable to accelerated erosion and channel widening. Channel widening and shifting thalweg destabilizes the streambed. Cumulative effects of tree removal would eventually reduce shade, cause stream temperature increases, and retard progress towards cooler, pre-mining conditions (Nawa 2002:26; Spence et al. 1996).

Pool Formation/Loss

Fish may benefit from using abandoned dredge holes (Harvey 1986; Stern 1988; Horizon 2009:4.3-7) but sediment from dredging can fill in pools downstream from dredges resulting in decreased fish use (Harvey 1986; Thomas 1985).

Decreased Fish and Amphibian Reproductive Success

Winter scour of suction dredge deposits is probably the largest impact on fishes, especially for fall-spawning salmonids that spawn in the dredged tailings.

Harvey and Lisle **(1999: 616-617) state the following:**

- **"[M]any more preemergent Chinook salmon were lost from redds on dredge tailings compared with redds on natural substrates."**
- **"[W]here natural spawning substrate is in short supply, large proportions of redds may be located on dredge tailings."**
- **"Our results show that fisheries managers should consider the potential negative effects of dredge tailings on the spawning success of fall-spawning fish, such as Chinook salmon and coho salmon."**

Increased fines sediment in spawning areas due to suction dredging would also be expected to have adverse effects on developing fish embryos and alevins (Merz et al. 2006; Spence et al. 2006; Shumway et al. 1964; Silver et al. 1963; Horizon 2009:4.3-4). Similarly, siltation reduces reproductive success of amphibians (USFWS 2002; Welsh and Ollivier 1998; Horizon 2009: 4.3-18).

Steelhead eggs and developing alevins are harmed or killed when they are prematurely aborted from the streambed by suction dredging as early as June 15 in the Siskiyou Wild Rivers Area (USDA Forest Service 2001; Nawa 2002: 20; Griffith and Andrews 1981; Horizon 2009: 4.3-5). Eleven steelhead redds were found at five sites on Briggs Creek in the Rogue River-Siskiyou National Forest that were either recently dredged or adjacent to mining camps (Nawa 2002:20).

Harvey and Lisle **(1998:9) make the following statements about entrainment:**

- **Griffith and Andrews (1981) found that "sac fry of hatchery rainbow trout suffered >80% mortality following entrainment, compared to 9% mortality of a control group."**
- **"Entrainment in a dredge also would likely kill larvae of other fishes. Sculpins (*Cottidae*), suckers (*Catostomidae*) and minnows (*Cyprinidae*) all produce small larvae (commonly 5mm-7mm at hatching) easily damaged by mechanical disturbance."**
- **"Fish eggs, larvae, and fry removed from the streambed by entrainment that survived passage through a dredge would probably suffer high mortality form subsequent predation and unfavorable physicochemical conditions."**

Eggs of non-salmonid fishes [e.g., lamprey species] that adhere to rocks in the substrate are unlikely to survive entrainment. Lampreys have only a 3%-26% survival rate when passed through a dredge (Beamish and Youson 1987; Kostow 2002:41). **The U.S. Fish and Wildlife Service (2008a:3; 2008b:7; 2009:10;) report that many age classes of Pacific Lamprey ammocoetes can be impacted by mining or dredging activities. As an example, suction-dredge mining is thought to be one of the reasons for the loss of lamprey in the upper John Day River basin in Oregon.**

Entrainment of amphibian eggs, tadpoles, and recently metamorphosed amphibians would likely result in harm or mortality (Horizon 2009:43.3-18). Incubating eggs of amphibians such as the tailed frog (*Ascaphus truei*) would suffer direct mortalities because they breed during the summer when dredging occurs (Corkran and Thoms 1996:81). Dredging displaces and increases mortality of foothill yellow-legged frog tadpoles (Kupferberg et al. 2007 in Horizon 2009:4.3-19). The **USDA Forest Service (2001:107) states that "[w]hen substrate is sucked through a dredge, many aquatic organisms (such as eggs and larva of Pacific giant salamander and tailed frog) can be entrained, resulting in mortality or injury of some individuals."**

Loss and Restoration of Benthic Insects and Invertebrates

Although dredging may destroy all benthic animals within 10 m of the dredge, the areas are re-colonized about 4-6 weeks after dredging ceases (Bernell et al.2003; Thomas 1985; Mackay 1992; Horizon 2009: 4.3-14). While locally severe, the potential loss of invertebrate food sources for salmonids is temporary. Ironically, some of the invertebrates excavated by dredging are made more available as fish are commonly observed feeding below active dredges (Stern 1988; Thomas 1985; Hassler et al. 1986; Harvey 1986; and summarized in Horizon 2009: 4.3-5)

Loss of Bivalves (Mussels)

About 50% of mussels buried by 10 cm-17.5 cm of sand or silt die. Mussels are unable to escape from burial by typical dredge tailings (Krueger et al. 2007; Horizon 2009:4.3-15)

Air quality

Exhaust from suction dredge may cause short term air pollution in a confined canyon with little air movement, but when considered at the state (California) level, impacts were less than significant (CDFG 1994; CDFG 1997; summarized in Horizon 2009: 4.9-2). Emissions from suction dredge engines in Clearwater National Forest would have negligible impacts due to remote location in unpopulated areas and 150 ft spacing between dredges (USDA Forest Service 2009b).

Noise

Noise levels with the operation of an 18 horsepower Briggs and Stratton gasoline powered engine (Table 1) were reported by the Clearwater National Forest (USDA Forest Service 2006) and reproduced in Horizon 2009: 4.10-1)

Based on the assumption that ambient noise level of a quiet wetland is 25 decibels, the Clearwater National Forest concluded that suction dredging noise would result in only slightly-elevated noise levels above ambient (USDA Forest Service 2006 in Horizon 2009: 4.10-1).

Distance (Meters)	Decibel level
4	85
50	63
100	57
150	53
300	47

Table 1. General noise levels of 18hp engines

Noise from helicopters accessing remote suction dredge mining locations within Kalmiopsis Wilderness (Daily Courier 2009) would degrade wilderness experience of hikers, equestrians, and others who seek solitude in the Wilderness.

Economics

The number of permits for suction dredging increases with the price of gold (Horizon 2009: 4.5-3). May 2010 gold prices were at record highs ($1,240 per ounce) and will likely result in increased numbers of suction dredgers and increased impacts to streams during 2010 and into the foreseeable future. Suction dredgers in California's Klamath River Area spend $45-$59 per day (Horizon 2009; 4.6-2). The New 49ers, a mining club in Happy Camp, California, report average yield of 3.5 grams to 1.0 ounce of gold per miner week for groups ranging up to 22 individuals, some of whom were inexperienced (Horizon 2009: 4.6-4). Yields for more experienced miners could be higher. Costs to clean up suction dredge camps and rehabilitate damaged fish habitat are not available but restoration of fish habitat is expensive because of equipment costs. Clean up and removal of waste in remote areas can be very expensive when helicopters are needed (Fig 5).

Placer Mining on Floodplains, Terraces and Uplands

Placer mining for gold commonly occurs on terraces and high floodplains along streams and rivers (Fig 3). Significant impacts are deforestation of the site, loss of stream shade, and loss of wildlife habitat. Ponds used for gold processing sometimes discharge sediment into adjacent streams or breach during high water events resulting in severe sedimentation of downstream habitats and loss of incubating salmon eggs. Access roads and associated dust cause sedimentation of adjacent streams. Some existing examples within the Siskiyou Wild Rivers area are the Defiance Mine on Josephine Creek (ceased operation ca 2006), Tracy Placer adjacent Sucker Creek (ceased operation September 2009) and the Carlin gold mine operating on private land at the confluence of Caves Creek and Sucker Creek. The BLM is likely to approve plans of operation for two more placer mining location on Sucker Creek (USDI 2010).

Figure 3. The Tracy Placer mine destroyed a mature Douglas Fir Forest and caused turbid water to enter Sucker Creek. Rogue River-Siskiyou National Forest, September 2009. The Medford BLM has announced that Mr. Tracy plans to deforest a similar placer mining site 2 miles below this one on BLM lands (USDI 2010). Photo by Shane Jimerfied, Siskiyou Project.

The proposed Nicore Nickel Mine would strip mined 3.1 acres of uplands in the Rough and Ready Creek watershed each year for a period of ten years. Haul routes totaling about 14 miles would have 16 crossings over perennial streams. Roads, mining excavations, and wet stream crossings would increase stream sedimentation harmful to fish and increase pollution of the stream with petroleum products and nickel. About 14 rare plants would be adversely affected. Visually the area would be degraded as viewed from Highway 199 due to roads, truck hauling, and stock piles of mine ore. The wilderness character of South Kalmiopsis Roadless Area would be degraded due to widened roads and heavy use by haul trucks. A recent plan of operation (Freeman 2010) has been submitted to BLM to mine undisclosed minerals within the French Flat Area of Environmental Concern south of Cave Junction, Oregon. This mining operation is likely to adversely impact rare and endangered plants on BLM lands.

Roads, Off Highway Vehicle Use, Encampments and Occupancy

Miners use motorized vehicles to access camps and streams via roads, unmaintained routes, and cross country travel. Impacts associated with mining roads and unmaintained routes are increasing. New roads are being constructed or reconstructed by miners with no notification or oversight by federal land managers or private land owners. In September 2009, a miner reconstructed an abandoned mining road along and across Sucker Creek to excavate a placer mine (Oregonlive 2009). At another location on Sucker Creek at least 2 miles of roads were found in a Riparian Reserves that appear to have been illegally constructed or reconstructed during the 1990s (Nawa 2002:25). During summer 2009, a suction dredger created road ruts and damaged a spring by repeatedly driving an all terrain vehicle from Eight Dollar Mountain Road to the Illinois River in the Eight Dollar Mt. Botanical Area (Nawa 2002:25).

Miners construct dwellings and facilities on SWRA public lands (Nawa 2002:14, 27) and also on remote private inholdings (Daily Courier 2009). Long term camping, trailers, cabins, out houses, road construction, and off highway vehicle use cause soil compaction, soil contamination, chemical and bacterial pollution, litter, vegetation damage, spread of Port Orford-cedar root disease, loss of rare plants, increased fire ignitions, decreased wildlife, increased stream bank erosion, and increased sedimentation (Moyle et al.1996; Harvey and Lisle 1998; USFWS 2002a; Mahrdt et al. 2002; Brodie 2001; Knight and Skagen 1986; Horizon 2009:4.3-21; Nawa 2002:27).

Fish and Wildlife

Gold miners and suction dredgers generally camp adjacent streams in Riparian Reserves where wildlife use is the highest. Occupancy of these sites adversely affects fish and wildlife use in the area due to noise, soil disturbance and destruction of vegetation. Mining cabins in remote areas are often used to support fishing and hunting which reduces local populations of fish and wildlife (Daily Courier 2009; Nawa 2002:27). All fishing is generally illegal in these remote areas. Declining western pond turtles are vulnerable to off highway vehicle use by miners. Soil compaction degrades turtle nesting habitat and eggs incubating in shallow nests may be crushed (Brodie 2001; Horizon 2009 4.3-21). Encampments and off-road vehicles may adversely affect raptors and declining neo-tropical migrants by altering behavior, altering movements, altering distribution, reducing nesting success, and causing unnecessary expenditure of critical energy reserves (Knight 1986; Horizon 2009:4.3-21).

Sediment, Sanitation, Water Quality

High road density within the Briggs Creek Riparian Reserve (7.5 mi/mi^2) is a significant source of sediment because roads leading to mining camps in Riparian Reserves usually lack water bars and culverts (Nawa 2002:23). These poorly designed roads divert hill slope runoff onto the road surface which creates gullies. Five stream crossings along Briggs Creek delivered roadbed sediment directly into the stream and increased the risk of petroleum contamination of pristine steelhead spawning streams (Nawa 2002:24). In September 2009, a miner re-constructed an abandoned mining road along and through Sucker Creek that caused sediment to enter the stream. Mining roads reduce shade to streams and increase stream temperatures by directly destroying riparian vegetation or retards temperature recovery by preventing trees from growing due to motorized vehicle use and compaction.

Remote cabins used by miners usually lack septic systems and long term campsites lack facilities for adequate treatment of human feces (Nawa 2002; Curry Pilot 2009). Dean Swickert (BLM, California) has observed that the mining encampments often pose hazards to the surrounding area due to unsanitary conditions (Horizon 4.7-7). Water quality can be affected because of inadequate treatment of human feces, discharge of contaminants into streams, and contamination of ground water. Trailers and motorhomes used by miners are often parked along streams and the potential exists for waste water to be discharged onto the ground or into streams. Horizon (2009: 4.2.1) speculates that mercury and nitric acid could be spilled while processing gold on site and cause contamination of streams.

Vegetation and Rare Plants

Soil compaction, soil contamination and loss of shade could eliminate or reduce populations of rare plants, especially along streams (Shevock 1996;Horizon 2009:3-21). Riparian vegetation including old growth conifers were cut to reconstruct a mining access road along Sucker Creek (Oregonlive

2009). Motorized vehicle use of mining routes into Botanical Areas and serpentine areas destroys rare plants and contributes to the need to federally list plant species (Nawa 2009:23).

Port Orford-cedar Root Disease and Invasive Weeds

Motorized use of mining access roads and cross country routes increases the risk of spreading Port-Orford root disease and unwanted invasive weeds. Port Orford-cedar is an important component of riparian areas in the Siskiyou Wild Rivers area because it provides shade, streambank stability, and stable instream wood needed for complex habitats used by salmonids and other aquatic creatures (Nawa 1997). The cedar's roots are susceptible to the fatal Port Orford-cedar root disease (*Phytophthora lateralis*) (Hansen et al. 2000). Roads and ATV trails used or created by miners are likely pathways for infestation by the root disease. Infectious spores from dead and dying trees are found in muddy areas along infested streams and roads. Mud infested with spores attaches to vehicle tires, frames and mining equipment. Vehicles transport the infested mud to uninfested areas. Port Orford-cedars along Briggs Creek and Left Fork Sucker Creek are currently uninfected by the fatal disease. Briggs Creek is at high risk for infestation because of high road densities and numerous stream crossings created by miners for access (Nawa 2002). Wet season road closures of mining roads in upper Briggs Creek to reduce risk of disease spread are ineffective because of a vandalized gate at Forest Road 2512-017. Even when gates are locked, recreational motorized users have accessed the unnumbered mining routes along Briggs Creek by driving down a steep embankment from Road 2512-017 and into a mining camp (Nawa 2002). All terrain vehicle access to mining claims along Left Fork Sucker Creek could easily infect that drainage (Nawa 2002). Mining related activities are likely to have contributed to Port Orford-cedar disease infestation of the Little Chetco River in the Kalmiopsis Wilderness.

Vandalism Associated with Mining Access Roads, Mining Sites, and Mining Camps

Mining access roads and camps attract vandals and recreationists who cause additional resource damage (i.e. cumulative effects). Vandals create motorized routes around locked gates and around boulder blocks which destroys vegetation through compaction. Vandals destroy gates or remove boulders to gain access to mining roads that lead to ecologically sensitive Riparian Reserves and roadless areas (Nawa 2002; Nawa 2009). A field visit to the Ray Wolf mining site south of Cave Junction with BLM personnel on February 21, 2006 revealed severe degradation of meadow soils, plants, and hydrology (Nawa 2007). At least an acre of former meadow and riparian vegetation had been churned into mudded ruts by motorized vehicles (Fig 4). All riparian vegetation had been destroyed along a perennial stream for 150 ft. by motorized vehicles. The mine site was used for illegal dumping of solid waste such as televisions, refrigerators, and household garbage.

Figure 4. Off road vehicles used mining roads in Waldo area near Obrien, Oregon to destroy riparian vegetation along a stream. Medford District Bureau of Land Management, February 2006. Photo by Rich Nawa..

Recreation Conflicts

As previously discussed, off-road-vehicle users often use mining routes to vandalize public lands by destroying vegetation, creating road ruts, and damaging streambeds. A few miners reside in remote cabins on public lands in the SWRA where conflicts between miners and off road vehicle users may occur. For example, a miner residing on a mining claim northwest of Cave Junction shot and seriously injured a man operating a off road motor vehicle on a mining claim site (Daily Courier 2009b). Dean Swickert (BLM California) observed that miners are territorial and intimidate others including other miners (Horizon 2009: 4.7-7). For example, in 1994 a miner residing in a cabin along Josephine Creek near Kirby, Oregon shot and killed another miner residing in a nearby cabin on federal lands. Mr. Swickert's observations were corroborated by R. Nawa (Siskiyou Project), who was confronted by miners with firearms while leading a public hike on BLM lands adjacent Althouse Creek near Cave Junction, Oregon. Although illegal, federal mining claims are sometimes posted with "No Trespassing" signs or "Keep Out" signs warning others to stay away from the federal claim areas. Overt violence with firearms, intimidation with firearms, and exclusionary signs discourages legitimate recreational use on public lands occupied or claimed by miners. Miners displace hikers, campers, bird watchers, photographers, botanists, and swimmers.

Bernell et al. (2003) analyzed recreational conflicts related to suction dredging activities conducted in Oregon. Conflict attributed to the presence and actions of miners was fairly common where mining and quiet recreation occurred together. Complaints about suction dredgers from other recreation users cite issues related to access barriers, intimidation, noise, aesthetics, level of development, degraded ecological conditions and safety hazards. The main conflict recreationist have with suction dredging is that they find suction dredgers to be annoying and a nuisance (Bernell et al. 2003). Studies in California also found that suction dredgers and their associated campsites may conflict with other recreation user's expectations and enjoyment of quiet settings and natural areas as a result of aesthetics, sanitation, noise, garbage and air pollution concerns (CDFG 1994; CDFG 1997; summarized in Horizon 2009: 4.7-7). Nawa (2002) reports that his recreational hiking experience with several friends along the Briggs Creek Trail was sullied by the gasoline stench and noise of a suction dredge operating in Briggs Creek.

Mining Trespass on Private Lands

Mr. Dean Swicket (California BLM) "notes that mining trespass and health and safety violations are the primary issues of concern when BLM staff are summoned to suction dredge sites." (Horizon 2009: 4.7-7) Mr. Swickert further stated that "he has observed territorial disputes between miners and landowners citing that miners trespass on private lands." During June 2009, suction dredge miners trespassed across private land with tractor trailers loaded with mining equipment and 5th wheel trailers to establish a large mining camp on BLM lands along Deer Creek near Selma, Oregon (Nawa 2009b).

Roadless Areas/Wilderness Areas

Inventoried Roadless Areas and unroaded areas adjacent the Kalmiopsis Wilderness have hundreds of miles of unmaintained mining routes. For example, the Canyon Creek watershed within the South Kalmiopsis Roadless Area has an estimated 97 miles of unmaintained mining routes (USDA Forest Service 1992:3-10). Use and reconstruction of these routes degrade wilderness qualities. Motorized use of these unroaded areas creates chronic sources of sediment into pristine steelhead spawning streams. During summer 1993, a miner bulldozed a route through a Port Orford-cedar wetland along Silver Creek in the North Kalmiopsis Roadless Area (Nawa 2002:25). Similarly, during summer 2000 a miner constructed or reconstructed roads accessing a claim on Fall Creek, also in the North Kalmiopsis Roadless Area (Nawa 2002:25). Suction dredge miners use helicopters to access claims along Silver Creek in the North Kalmiopsis Roadless Area and to access a mining camp on private land along the Little Chetco River within the Kalmiopsis Wilderness Area (Daily Courier, 2009; Nawa 2002). In 1997, R. Nawa discovered that miners accessing claims in the North Kalmiopsis Roadless Area had discarded several 55 gallon drums that were leaking gasoline (Fig 5). In 1997 and more recently in 2009, miners owning a private inholding along the Little Chetco River have pursued motorized access through the Kalmiopsis Wilderness on 11 miles of long abandoned mining routes. Motorized use on these hiking trails would significantly damage wilderness character of the Kalmiopsis Wilderness and degrade the current high quality wilderness experience (USDA Forest Service 1997).

Figure 5. Suction dredge miners using helicopters abandoned these leaking barrels of gasoline on a terrace above Silver Creek in the North Kalmiopsis Roadless Area. August 1997. Photo by Rich Nawa.

Lode Mining

Tunneling into mountains can produce toxic mine wastes that seriously degrades water quality, kill fish, and prevent restoration of native vegetation. The Siskiyou Wild Rivers area has numerous perhaps hundreds of abandoned mine shafts. Abandoned mine shafts are safety hazards to people entering mine shafts or falling into mine shafts that were excavated vertically. Only the Almeda Mine is known to discharges toxic and highly acidic acid mine drainage into the Rogue River. Susan Lee (BLM project leader) says the polluted water discharged from the Almeda Mine is being remediated with a federal project costing $250,000 (Daily Courier 2009c). The Benton Mine located on a private inholding at the confluence of Whisky Creek and Drain Creek north of Galice, Oregon is the largest underground gold mine in Oregon. Drain Creek, a tributary to Whisky Creek, has been heavily impacted with settling ponds and loss of riparian vegetation. No new lode mines have been excavated on public lands in the SWRA since at least the 1940s and none have been known to be in operation since the 1970s. Due to the remoteness of the SWR A, lode mines could be worked by miners without the knowledge of government regulators. For example, R. Nawa found a mine shaft near Snailback Creek along the Illinois River that appears to have been worked as recently as the 1980s and hikers discovered a miner illegally working a lode claim on Fall Creek.

Stream Diversions and Hydraulic Mining

Historically, streams in the Illinois Valley were hydraulically mined by capturing water in mid-slope ditches and running the water through high pressure nozzles to erode hillsides into sluice boxes to recover gold. Large scale hydraulic mining caused severe sedimentation of streams and destruction of riparian forests (Agee 2007). Hydraulic mining was banned because the increased turbidity in streams from mining would violate state water quality standards and increased sediment would reduce reproductive success of salmonids. In addition, miners usually lack water rights to implement stream diversions needed for hydraulic mining. Mining ditches excavated over 100 years ago remain as visible features on hill slopes in the Illinois Valley and continue to alter local hydrology by capturing surface flows and releasing concentrated flows on hill slopes. Severe gully erosion and chronic turbidity regularly impacts coho salmon spawning in Scotch Gulch, a tributary to the upper East Fork Illinois River (Nawa 2009d). Other small streams in the Illinois Valley are similarly affected. Hydraulic mine tailings of cobbles and boulders persist along Althouse Creek, Sucker Creek, Briggs Creek, Josephine Creek, East Fork Illinois River, main stem Illinois River, and others. Mature forests have established on most of these once barren tailings but some tailings continue to lack forest cover.

Unregulated small scale hydraulic mining continues in the Illinois Valley in remote areas. Nawa (2002) found one small stream diversion where less than 1% of the flow from Sucker Creek was diverted into a 1 inch plastic pipe for 500 ft to service a small 8ft diameter settling pond about 40 ft above the stream. Sediment laden water from the settling pond appears to have overflowed into Sucker Creek. Diverting clean water from a stream and returning turbid water is harmful to aquatic animals. Nawa (2002) reports that Siskiyou National Forest Service stream surveyors have found stream diversions that operated during winter months on Bolan Creek and Canyon Creek in the Illinois Valley. During the late 1980s, water was diverted through a series of ditches and into a pipe to hydraulically mine terraces adjacent to Canyon Creek east of Carpenter Gulch in the Josephine Creek watershed. All vegetation covering about 20 acres was destroyed. Sediment laden water from hydraulic mining flowed directly into Canyon Creek for several winters because there were no holding ponds (USDA 1992:3-10). Similarly, during 1987 a 900 ft long ditch diverted most of the flow from Bolan Creek to service hydraulic mining of hill slopes adjacent to Bolan Creek (Nawa 2002). In April 2000, harmful hydraulic mining of hill slopes and terraces was discovered by the Forest Service in Josephine Creek. Due to the remoteness of streams in the SWRA and lack of effective monitoring, harmful hydraulic mining activities can go undetected for years.

Exploration, Prospecting and Bulk Sampling

Prospecting generally involves excavating shallow pits with hand tools or deeper trenches with backhoes. While individual sites generally have negligible impacts because the area disturbed is small and usually less than 0.1 acre, cumulative impacts are significant because the number of sites and total area impacted continues to increase. The destruction of native plant cover is especially severe in serpentine areas that have been heavily prospected in the past with nearly no reclamation (Fig 6). A compounding factor is that once serpentine soils are disturbed they are very slow to recover former plant species and vegetative cover. The visual impact of soil disturbance and trenches degrades the wilderness character of unroaded areas, especially the South Kalmiopsis Roadless Area which is dominated by serpentine soils.

Figure 6. Exploratory mining trench excavated in serpentine geology with no reclamation and little vegetative recovery. The abandoned trench and many similar ones are located in Rogue River-Siskiyou National Forest southeast of Gold Beach Oregon. June 2008. Photo by Rich Nawa.

Gravel Mining

Gravel mining within or adjacent streams may result in channel erosion, incision, coarsening of streambed material, and loss of spawning gravels for salmonids (Kondolf 1997). Gravel mining occurs in the IllinoisValley and lower reaches of the Chetco River and Rogue River where streambeds are under the jurisdiction of Oregon Department of State Lands and Army Corps of Engineers. Extensive bar scalping in the lower Chetco River has caused the river to widen and become very shallow. Reduced stream depth impedes upstream migration of fall Chinook salmon. Riparian vegetation is unable to establish on floodplains because of annual bar scalping. Gravel pits have been excavated on private agricultural lands along the East Fork Illinois River and main stem Illinois River near Kerby. During winter floods the pits on the East Fork Illinois River have trapped adult and juvenile salmonids during downstream migrations. Capture and removal these stranded fish resulted in severe turbidity to East Fork Illinois River and the water intake for Cave Junction. During most years some or all of the stranded salmonids die, since none are moved back to the river.

Quarries

Quarries are located in upland sites where mined rock is used for local roads. Quarries have adverse visual impacts and reduce wildlife habitat due to permanent loss of forest cover. A quarry on Oregon Mountain in the Oregon Mountain Botanical Area is suspected of spreading Port Orford-cedar root disease and has become a staging area for off road vehicle use in the botanical area.

Cumulative Impacts

The Forest Service (2009a:3) reports that most Illinois Valley streams were being placer mined in the 1850s and the mining continued periodically for much of the later 1800s and early 1900s. Tailing piles from early hydraulic mining are periodically reworked which prevents full recovery. Fish habitat restoration is retarded because miners remove wood habitat structures placed in the stream by fisheries biologists. Recovery of streams and associated riparian areas is also prevented because of clear-cutting to allow excavations associated with placer mining (Fig 3). At least two areas along Sucker Creek and one on Josephine Creek have been deforested since 1980 to provide for placer mining operations. New plans of operation that require forest clearing are being submitted every year (USDI 2010).

Most salmonid spawning streams in the Illinois River basin have high concentrations of mining claims (Fig 7). Each year significant portions of these streams are suction dredged (Nawa 2002) and the potential exists for severe cumulative impacts due to the near continuous series of mining claims along Briggs Creek, Althouse Creek, Sucker Creek, Rough and Ready Creek, and Josephine Creek (Fig 7). Destabilization of streambeds from suction dredge mining is being added to instability caused increased sediment from logging. Cumulative watershed impacts are adversely affecting fall spawning salmon (Frissell 1992).

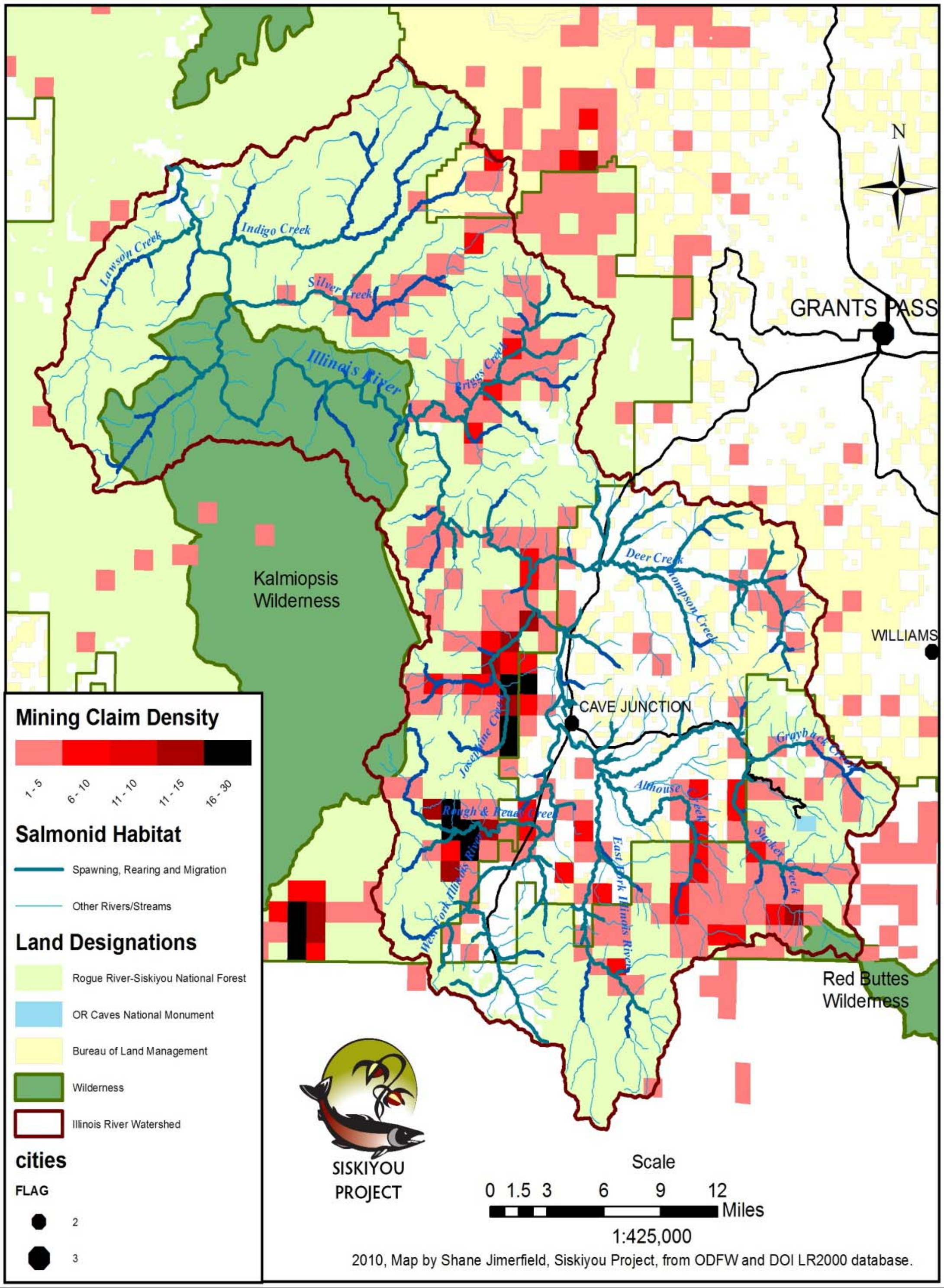

Fig 7. Mining claim densities in relation to salmon, steelhead and Pacific Lamprey spawning, rearing and migration habitat in the Illinois River Basin, Oregon.

Conclusion

Scientific findings compiled in this report demonstrate that mining is harmful, especially in Riparian Reserves. Destabilization of streambeds is inimical to suction dredge mining. Oregon Department of Environmental Quality and Department of State Lands requirements for suction dredging completely fail to address the harm to salmon spawning bed stability demonstrated by Harvey and Lisle (1999). Seasonal dredging restrictions, turbidity plume limits, and prohibitions on bank excavation fail to address the root cause of destabilization of spawning beds, a primary reason for the California ban. Allowing dredging in streams impacted by logging increases reduced egg-to-fry survival. Repeated planer mining pits on terraces and floodplains prevents riparain forest recovery. Collective mining impacts over space and time retards recovery of streams to their pre-mining conditions. Effective monitoring and effective enforcement of mining prohibitions in Riparian Reserves is not likely to occur with current staffing levels of responsible state and federal agencies. Federal Aquatic Conservation Strategy Objectives 3, 5, 8 and 9 cannot be met due to mining- related impacts in Riparian Reserves (USDI/USDA 1994).

My observations and findings reported by numerous other scientists lead me to conclude that the only long-term solution for protection and recovery of Riparian Reserves is mineral withdrawal. Mineral withdrawal of the Smith River National Recreation Area on the Six Rivers National Forest and mineral withdrawal of the Steamboat Creek watershed on the Umpqua National Forest provides certainty that mining related impacts in Riparian Reserves will decrease over time and allow for effective restoration efforts. Much of the upper Chetco River watershed and lower Illinois River in the RRSNF was withdrawn from mineral entry with designation of the Kalmiopsis Wilderness. Mineral withdrawal is long overdue for remaining Siskiyou Wild Rivers' streams threatened by mining.

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