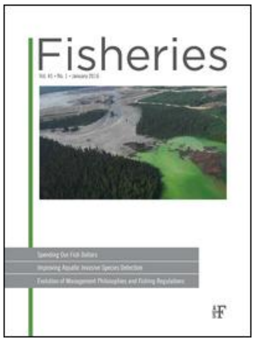

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AFS Position Paper and Policy on Mining and Fossil Fuel Extraction

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Following a four-year period of writing, member comment, and multiple revisions, the AFS Position Paper and Policy on Mining and Fossil Fuel Extraction was approved unanimously by the membership at the Society's annual business meeting August 19, 2015, in Portland, Oregon. The entire document can be read at fisheries.org/policy_statements; a brief summary follows.

TECHNICAL BACKGROUND

Mining (hard-rock, aggregate, deep, and surface) and fossil fuel (coal, oil, gas) extraction have the potential to significantly alter aquatic ecosystem structure and function. Adverse impacts on water quality, hydrology, physical habitat structure, aquatic biota, and fisheries include elimination and contamination of receiving waters (USEPA 2011; USEPA 2014); significantly altered algal, macroinvertebrate, and fish assemblages (e.g., Pond et al. 2008; Lavoie et al. 2012; Daniel et al. 2014; Figure 1); impairments of aquatic-dependent wildlife (USEPA 2011; USEPA 2014); and climate change (Hansen et al. 2013).

For example, even at low concentrations, mining-associated contaminants, such as copper, impair salmonid olfactory function (McIntyre et al. 2008), thereby increasing predation susceptibility (McIntyre et al. 2012); alter salmonid migratory behavior (Sprague et al. 1965; Lorz and McPherson 1976); increase disease susceptibility (Baker et al. 1983); and reduce growth (Marr et al. 1996).

Despite predicted compliance of permit conditions, many operating metal mines have violated water quality criteria (Kuipers et al. 2006). Those permit conditions, or applicable regulations, are minimum requirements and typically do not represent best management practices. Also, the applicable regulations rarely account for the cumulative effects of pollution from multiple mines.

Under the General Mining Act of 1872 in the United Sates, federal law transfers metal wealth from the public to mining companies, and shifts clean-up liability from those companies to taxpayers. The half-million abandoned hard-rock mines in the United States could cost US$72-240 billion to rehabilitate (USEPA 2000; NRC 2005), and the over 100 abandoned metal mines in Quebec are estimated to cost over US$600 million to remediate (Hamilton et al. 2015). In both cases, the majority of those costs will fall on taxpayers (Woody et al. 2010; Chambers et al. 2012; Hamilton et al. 2015). In addition, those estimates do not include rehabilitation of the newer, larger mines being

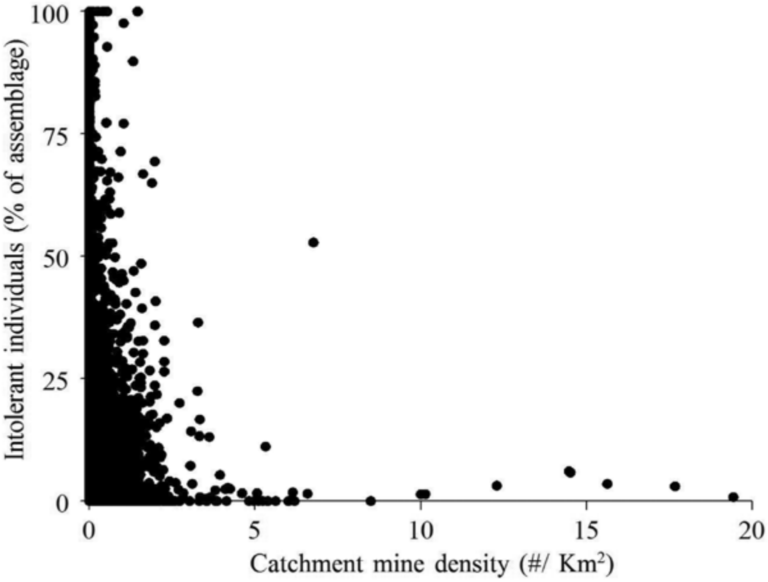

Figure 1. Percent generally intolerant fish individuals as a function of mine density for the conterminous USA (*n* = 33,538). Mines include coal, hard rock, uranium, and aggregate mines.

developed in more inhospitable environments, nor the costs of spills, failures, and accidents. Such a spill into the Animas River occurred on August 5, 2015, when U.S. Environmental Protection Agency contractors were assessing leaks of toxic metals in the vicinity of the abandoned Red, Bonita, and Gold King mines near Silverton, Colorado, and broke the debris dam of a holding pond (Vox 2015). That spill sent 12 million liters of contaminated water downstream and into the states of New Mexico and Utah via the San Juan River; the costs of fish kills, water monitoring, clean-up, and loss of water use by recreationalists, irrigators, and other users have been estimated in the tens of millions of dollars. The Mt. Polley tailings pond failure on August 4, 2014, which spilled 14 million m^3 of metals-contaminated water and sediments into Hazeltine Creek and Polley and Quesnel Lakes in central British Columbia, has been estimated to cost at least $500 million (US) to rehabilitate (Uechi 2014). Because of various economic factors, the numbers of serious and very serious tailings dam failures such as these have increased since 1960 (Bowker and Chambers 2015).

Surface mining temporarily eliminates surface vegetation and permanently changes topography and hydrology, as with mountain-top-removal-valley-fill (MTRVF) coal mines (Fritz et al. 2010; USEPA 2011). Reclaimed surface mines create a leach bed for ions producing toxic conductivity concentrations (Pond et al. 2008), whereas altered hydrology produces flashy flows similar to those in urban areas (Ferrari et al. 2009; USEPA 2011). Underground mines produce acid mine drainage that can eliminate most aquatic life across extensive regions or alkaline mine drainage that alters ionic balance of freshwater ecosystems (USEPA 1995; USEPA 2000). Instream and gravel bar aggregate mining and dredging can alter channel morphology and increase bed and bank erosion, which can reduce riparian vegetation and impair downstream aquatic habitats (Kondolf 1994).

Oil and gas wells and product transport can cause devastating spills in freshwater and marine ecosystems (e.g., AP 2012; Amezcua-Linares 2013; Keller 2015). Hydraulic fracturing to extract residual oil and gas can contaminate groundwater and alter surface water ecosystems (Entrekin et al. 2011; Weltman-Fahs and Taylor 2013). Fish biodiversity and macroinvertebrate taxa richness were negatively correlated with the number of well pads per catchment and total mercury concentrations in crayfish, and Brook Trout *Salvelinus fontinalis* were positively correlated with well pads per catchment (Grant et al. 2015). Smith et al. (2012) concluded that fewer than one well pad per 3 km^2 and 3 ha per pad were needed to minimize damage to Brook Trout populations. Bamberger and Oswald (2012) and Webb et al. (2014) documented a wide range of health effects as a result of exposure to fracking fluids and gases. McKenzie et al. (2012) reported cumulative cancer risks of 10 per million for residents living <800 m from a gas well. Stacey et al. (2015) and Cil (2015) associated lowered infant health with proximity of drinking water wells to gas wells. The casings and grouting of abandoned oil and gas wells should be expected to eventually leak and contaminate surface and ground water (Dusseault et al. 2000). In addition, fossil fuel combustion is fundamentally altering the global climate, sea levels, and ocean chemistry (e.g., Orr et al. 2005; Dai 2013; Hansen et al. 2013).

Catastrophic mine tailings failures have killed hundreds of thousands of fish and hundreds of people, and contaminated tens to thousands of river kilometers (USEPA 1995; Chambers and Higman 2011; WISE 2011). Oil and gas wells are exempted from regulation by several U.S. laws, despite considerable evidence of their detrimental effects on surface and ground water (Allen et al. 2011; Amezcua-Lineares 2013; Keller 2015).

PROPOSED AFS POLICY

Mines and wells should only be developed where, after weighing multiple costs, benefits, beneficiaries, and liabilities, they are considered the most appropriate use of land and water by affected publics, can be developed in an environmentally responsible manner, benefit workers and affected communities, and are appropriately regulated. Because of substantial widespread adverse effects of mining and wells on aquatic ecosystems and related human communities, fossil fuel combustion effects on global climate, and enormous unfunded reclamation costs for abandoned extraction sites, the American Fisheries Society (AFS) recommends substantive changes in how North American governments conduct environmental assessments and permit, monitor, and regulate mine and fossil fuel development. In particular, AFS recommends that:

1. Following a formal environmental impact assessment, the affected public should be involved in deciding whether a mine or well is the most appropriate use of land and water, particularly relative to the need to preserve ecologically and culturally significant areas.
2. Mine or well development should be environmentally responsible with regulation, treatment, monitoring, and sureties sufficient for protecting the environment in perpetuity.
3. Baseline ecological and environmental research and monitoring should be conducted in areas slated for mining and fossil fuel extraction before, during, and after development so that the effects of those industries can be assessed in an ecologically and statistically rigorous manner, and the resulting data should be made publicly available.
4. This policy and related research should help inform the process of responsible resource development for mining and fossil fuel extraction, and should guide the implementation of the precautionary principle for those sectors.
5. A formal risk assessment of the cumulative atmospheric, aquatic, and oceanic effects of continued fossil fuel extraction and combustion should be conducted and reported to the public.
6. A formal risk assessment of the cumulative aquatic and oceanic effects of continued hard rock and aggregate extraction and metals smelting should be conducted and reported to the public.

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