



ENCYCLOPEDIA OF

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Editors in Chief

# *Encyclopedia of Environmental Ethics and Philosophy*

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these areas, homes are often situated within fire-prone ecosystems and are at a significant risk of damage from fires. Much like areas prone to flooding, the often infrequent occurrence of wildfires promotes a feeling of safety and a belief that fires are out of the ordinary, especially when fire frequency goes beyond twenty-year cycles. The location of homes and communities within ecosystems prone to fire has renewed efforts at fire suppression on public land, particularly when it occurs in areas where there is valuable private property at risk.

#### ETHICAL ISSUES

There are a wide range of ethical issues surrounding wildfires and prescribed fires. For those who feel that human involvement with wilderness areas is unnatural, suppressing lightning-caused fires and setting prescribed fires are seen as attempts to domesticate the wilderness and control wild nature. Increasingly, however, it seems unavoidable that human decisions will affect these areas in some way. The fragmentation of habitats and the suppression of fires throughout much of the United States reduces fire frequency in wilderness areas. Lightning within those relatively small wilderness areas will not be enough to maintain a fire frequency similar to that of historical conditions. Focusing only on lightning-caused fires also ignores the prevalent use of fire as a landscape-shaping tool by cultures around the world over the last 10,000 to 400,000 years, a period during which many systems were shaped by those fires and have come to depend on them. Human-initiated prescribed fires may restore fire frequency, but are often set under conditions when these fires can best be controlled. Such conditions are not likely to be similar to historical conditions when lightning might have begun such fires.

In many ways the ethical concerns surrounding fire come down to the most basic question in environmental ethics: To what extent are human actions natural or justified in the environment? On the one hand, to the extent that humans are perceived as interlopers in nature, there are few fire regimes that can be considered natural. If, on the other hand, humans and their actions, or at least a subset of them, can be considered natural, then the challenge is to identify the level of interaction that will result in desired results stemming from a specific set of philosophical assumptions. In any case, fire is neither good nor bad, but is instead a complex occurrence that must be evaluated on a case-by-case basis.

Anthropocentric value systems will focus on the needs and desires of humans. Under such a value system, fire or fire suppression should be used primarily to protect humans and their property rights, but could also extend to humans' desires to have access to healthy ecosystems for recreation, wildlife habitat, and the production of ecosystem services.

Zoocentric and biocentric ethical systems will focus on the effects of fire on individual animals, plants, and their habitats, but can reach conflicting results in cases where, in any one area, both fire and fire suppression will kill some individuals and promote others. Ecocentric ethics will focus on the role of fire in promoting healthy ecosystems and stable biotic communities, but this goal is invested with other challenges. Differences in fire frequency, fire intensity, and fire season can result in changes in community composition and ecosystem functions, and many alternatives can be considered healthy. Selecting the most appropriate way to use or suppress fire in the landscape remains a subjective value judgment that cannot be reduced to objectively verifiable criteria. It is this complexity that makes fire worth studying scientifically, politically, and philosophically.

SEE ALSO *Ecology: III. Ecosystems; Environmental Philosophy: V. Contemporary Philosophy; Environmental Policy; Forests; Habitat Loss; Native Americans; U.S. Forest Service; U.S. National Park Service.*

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Steve Windhager

## FISH FARMING

Aquaculture is the cultivation of aquatic populations of freshwater and saltwater organisms (e.g., fish, shrimp, bivalves) under controlled conditions. Aquaculture accounts for more

than 30 percent of all fish consumed by humans (U.N. Food and Agriculture Organization 2003). During the second half of the twentieth century, the Green Revolution promoted the practice of intensively managed monocultures, or the practice of producing a single species over a wide area in controlled environments. In the 1960s monocultures covering vast areas of land and coastal ecosystems began to prevail also in large-scale forestry and aquaculture. Monocultures usually involve introducing and growing an alien species at the expense of native flora and fauna. Consequently, monocultures have been identified as a major driver of biodiversity losses (Primack et al. 2001).

Defenders of monoculture argue that these intensive farming practices are necessary for providing food for a growing human population, at a time when only a small proportion (approximately 15%) of the remaining land on the planet is available for agriculture and when fishery stocks have declined dramatically (Millennium Ecosystem Assessment 2005). In the early 1980s, aquaculture was presented as the coming Blue Revolution that would alleviate world hunger, provide jobs, and fight poverty (Primavera 2005). Yet ecologists and other scholars began to question the effectiveness of some widespread large-scale monoculture practices that had negative environmental, social, or economic impacts.

The explosive expansion of salmon and shrimp farming since the late 1980s has created an intensive debate on associated issues of environmental and social justice, scientific-technological and indigenous ecological knowledge, ecosystems and human health, and biotechnology and animal rights (Rozzi 2003). Contrasting large-scale industrial aquaculture with small-scale sustainable practices in Asia, the Philippine ecologist Jurgenne Primavera since the 1980s has led tireless efforts to replace unsustainable aquaculture practices with sustainable ones. Primavera (2005) has pointed out that fish farming has boomed during the last three decades, and that although farmed fish are produced mainly in developing countries, most of the production is exported for markets in industrialized nations.

Shrimp and salmon are not only the most controversial aquatic monocultures but also among the most lucrative and widely traded aquaculture products (Naylor et al. 1998, U.N. Food and Agriculture Organization 2003). Shrimp are widely farmed in tropical coastal areas of Asia and Latin America, while salmon are raised in temperate and higher-latitude coastal and inland waters of the Northern and Southern Hemispheres.

#### THE ECOLOGICAL AND SOCIAL CONSEQUENCES OF SALMON FARMING

It is commonly assumed that aquaculture relieves pressure on wild fisheries and adds to the world's food supply. This assumption is generally valid for herbivorous species, but

not for carnivorous fish such as salmon (Beveridge et al. 1997). Farmed salmon spend their first year in freshwater ponds, and then for another one to two years of growth, they are transferred to floating cages anchored in coastal bays, where they are fed nutrient-rich diets containing large amounts of fishmeal and fish oil extracted from caught wild fish. Paradoxically, the required input of wild-fish products is up to four times the volume of salmon-fish output. This imbalance exerts pressure on native fish consumed by humans and on trophic chains in marine ecosystems. Therefore, salmon aquaculture depletes rather than augments fisheries resources (Naylor et al. 1998).

Because salmon depend on a diet that is 45 percent fishmeal and 25 percent fish oil, European salmon farming requires stocks of wild fish imported from South America. Initiated in Norway in the 1960s, salmon farming rapidly expanded toward equivalent high-latitude environments in southern Chile in the 1980s. Chile's southern regions offer ideal water temperatures and salinity conditions in sheltered fjords and in channels of the subantarctic Magellan Archipelagoes, one of the most pristine ecoregions of the world (Bjorndal and Aarland 1999, Robles Gil 2002). The aesthetic of these austral landscapes is transformed by the presence of salmon cages along the coast, and marine biodiversity is affected by voracious feral salmon that escape from the cages. In addition, local fishermen are losing access to use rights of coastal areas because concessions of bays are given to the salmon-farming industry.

Salmon farming uses a dilution approach to water pollution. Salmon cages allow feces and uneaten feed to flow directly into coastal waters, which results in substantial discharges of nutrients. The Nordic salmon-farming industry discharges quantities of nitrogen and phosphorous equivalent to the amounts in untreated sewage from populations of 3.9 million and 1.7 million people, respectively (Folke et al. 1994). High stocking densities of caged salmon have facilitated outbreaks of diseases and parasites, which require the use of antibiotics and pesticides that spread chemicals into coastal waters. High concentrations of salmon in cages also raise questions about animal treatment. The living conditions of farmed fish are even worse than those of industrially raised poultry and mammals (Rozzi 2003). Stress hormones and chemicals can build up in the meat of farmed fish, and these may have health effects on people. For human-health, ecological, and ethical reasons, free-living salmon represent a better option. A healthier alternative is provided by Irish organic salmon produced off-shore, 6 kilometers away from the coast in areas exposed to marine currents, where fish must constantly swim against the current. These conditions not only have a positive influence on muscle development and fat content, in addition, fecal and feed wastes are flushed away.

### SHRIMP FARMS IN PLACE OF MANGROVES

The white-gold boom of shrimp production in such Asian and Latin American countries as Thailand, Indonesia, and Ecuador has involved extensive deforestation of mangroves for farming pools during the last three decades. Mangrove deforestation attracted worldwide attention when a tsunami crashed into the coastal regions of Asia in 2004. The lifespan of intensive shrimp pools in Asia rarely exceeds five to ten years, but their ecological and social impacts are long-lasting (Naylor et al. 1998).

A notorious example from Ecuador illustrates the main social and ecological problems associated with shrimp farming (Rozzi 2003). Ecuadorian shrimp is famous in international cuisine. Commercial cultivation of shrimp began in Ecuador in 1968, and this country became the world's principal producer of shrimp in 1983. This boom had such a large environmental impact that in 2008 the extent of shrimp pools surpasses that of mangroves along the Ecuadorian coast. Mangroves act as "ecosystem membranes" between tropical terrestrial and marine ecosystems, recycling nutrients and regulating hydrological flows. Their massive conversion to shrimp pools dramatically increased the levels of sedimentation in coastal waters and losses of soil nutrients. Shrimp industries also discharge contaminated waters and divert the course of streams and rivers. These processes drastically affect population levels of algae, fish, crustaceans, and mollusks that depend on mangroves at some phase of their lifecycles.

In addition, the shrimp industry causes serious social problems by limiting the access of local communities to coastal natural resources. The rights of local communities are ignored or easily violated to favor shrimp industries, which limit or forbid access to traditional users of mangroves by means of government concessions. Furthermore, the conversion of mangroves and the pollution of estuarine ecosystems diminish the quality of life for fisher communities by reducing the populations and diversity of species of shellfish, fish, algae, crabs, and oysters traditionally gathered by women in these ecosystems. Consequently, this export boom in Ecuadorian shrimp leads to hunger in local people inhabiting the coastal region of this country. Local communities have opposed this model of development since the 1970s. As a result of such local opposition, the government established a biological reserve of mangrove ecosystems in the province of Esmeraldas in 1995, and in 1999 it issued a presidential decree that forbids cutting mangroves in Ecuador. This decree created hope in coastal communities of Ecuador, Colombia, and other tropical Latin American countries, as well as in Asian nations also affected by losses of

mangroves and displacement of local communities associated with large-scale shrimp farming (Primavera 2005).

The protection of mangroves in Ecuador represented a shift in ecological and social values and national policy at the end of the twentieth century. During the first decade of the twenty-first century, protected mangroves have contributed to the regional economy by providing suitable nursery habitats for shrimp larvae and attractive sites for ecotourist activities.

SEE ALSO *Agricultural Ethics; Hunting and Fishing: IV. Angling; Hunting and Fishing: V. Commercial Fishing; Pesticides.*

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