



Salton Sea Aquatic Food Webs

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Abstract

The Salton Sea hosts a diverse array of species, including fish, birds, algae, and arthropods, whose interactions form dynamic food webs. Tilapia, desert pupfish, and other fish species once dominated the aquatic environment, but are now facing challenges such as fluctuating oxygen levels and predation pressures. Avian diversity is equally remarkable, with hundreds of migratory species categorized into insectivorous (insect-eating) and piscivorous (fish-eating) groups. Ecosystem modeling suggests that reduced freshwater inputs, stemming from water management agreements, pose significant threats to bird populations at the Salton Sea. Understanding these complex food web dynamics is crucial for effective conservation strategies in the face of environmental changes and human impacts on this unique ecosystem.

Introduction

Maybe you've heard how out in nature, the small fish gets eaten by a bigger fish, which then gets eaten by an even bigger fish, which then gets eaten by a larger animal, and this continues all the way up the "food chain." Well, in the realm of ecology, it is often quite a bit more complicated than that. In the ecological community, a food web describes who eats whom. In

addition, food chain is incredibly interconnected, so each organism within the food web is a part of multiple food chains. Understanding how relationships between species are connected helps us understand how changes to ecosystems affect different species, both directly and indirectly.

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Animals supported by the Salton Sea's ecosystems include fish and birds, supported by algae and arthropods. Fish in the sea today are restricted to tilapia (*Oreochromis mossambicus* x *O. urolepis*), which was once the dominant species in the sea but are now rare if not entirely gone from the Salton Sea; desert pupfish (*Cyprinodon macularius*), an endangered species that is highly tolerant of saline water; sailfin mollies (*Poecilia latipinna*); and western mosquitofish (*Gambusia affinis*); other introduced species of fish were unable to cope with increasing salinity and appear to have died

out in recent years. Tilapia were likely introduced by the escaping fish farms and through introduction by the California Department of Fish and Wildlife for control of noxious weeds and insects, while desert pupfish are a native species to the American southwest. The primary constraints on the survival of these species include the temperature and salinity of the sea, both of which fluctuate wildly around the Salton Sea due to seasonality associated with freshwater inflows. In general, annual average salinity is increasing beyond the physiological limits of these animals.



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Tilapia venture to the bottom sediments to lay their eggs and are found in all parts of the sea in the winter. They migrate to nearshore and shallow waters in the spring and as oxygen levels decrease and sulfide levels increase, return to the open, deeper waters in the winter as dissolved oxygen levels increase. Tilapia feed both on algae and other small animals, including small arthropods and smaller fish. In recent years the lower oxygen content has become too low for tilapia to survive resulting in massive fish die-offs. Desert pupfish are less commonly found in the Sea, as their primary habitats are in the fresher waters of the riparian zones and wetlands, though they travel through the sea between various breeding habitats. Tilapia and other non-native fish likely predate upon pupfish eggs, though the extent to which tilapia impact pupfish is unknown. Desert pupfish populations find refuge in channels and creeks around the sea, though can travel through the sea connecting populations. However, pupfish ultimately survive in agricultural drainage systems rather than the sea itself, partly due to predation pressures and ideal habitat and breeding space.

The Salton Sea can support as many as 350 different species of birds. Most bird species are migratory, occupying the sea in the winter months. The birds of the Salton Sea fall into two categories: invertebrate-eating birds (insectivorous) and fish-eating birds (piscivorous). Insectivorous birds benefit more readily from the wetland habitat managed by the Fish and Wildlife Service in Sonny Bono Salton Sea National Wildlife Refuge. The insectivores feed largely in the wetlands and riparian zones while piscivores are largely subsisting on the

tilapia in the littoral zone of the lake where their prey congregate. With the decline in fish populations, visits by piscivorous birds have also declined, as they found other places to stop during their migration. Piscivores include pelicans, gulls, cormorants, terns, and many others, typically migrating from coastal marine areas and other saline lakes. Caspian terns (*Hydroprogne caspia*) congregate near the margins of freshwater inputs to the Salton Sea in the north and the south, including the Whitewater, Alamo and New River deltas where fish are likely to congregate due to lower salinities and water temperatures.

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