

Fish and Fish-Eating Birds at the Salton Sea: Successes and Slumps
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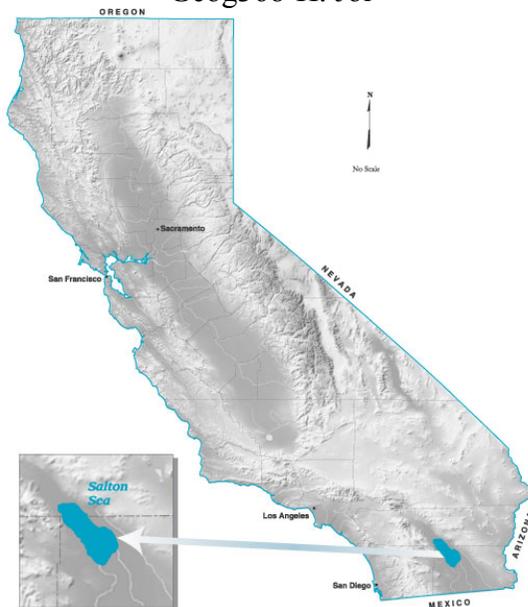


Figure 1: Location of the Salton Sea in southern California, United States of America. The Enlarged area shows the Salton Sea and inlet streams of the Salton Sea (California Department of Water Resources, 2010).

Abstract: The Salton Sea is a human made body of water located in the former Salton Sink, located in southern California. The Salton Sea was created by an uncontrolled flooding event of Colorado River in 1905. Once thought by investors to be a new “French Riviera” in the middle of California, this thought steadily decreased in popularity among investors as problems with the Sea began to emerge. Over the past 100 years the Salton Sea has undergone changes to its’ water quality. This salinity change then affects the wildlife population. As salinity levels in the Sea rose, the fish population rose as well. The fish increase also resulted in a greater avian population at and around the Sea. In the second half of the 21st century, a Botulism outbreak traced back to the Salton Sea has become an issue for both the fish and avian population and is the source of much debate today.

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Introduction

The Salton Sea was created by a large flooding event in 1907 when farmers diverted the Colorado River. The farmers were attempting to irrigate dry land in the area to make it useable for agriculture. The Colorado River broke the flood barriers and began to fill in the Salton Sink, a low-lying area located in southern California, and created the Salton Sea. Over time, the Salton Sea changed from a freshwater body of water to a Sea with salinity levels surpassing Ocean levels (35g/L). A sign of the high salinity levels are the frequent fish die-offs, on any given mid-summer morning millions of fish can die, with their remains lining the shore. During events like this, citizens living in the Los Angeles metro area, 250 kilometers away, can smell the dead fish (Metzler and Springer 2004).



Figure 2: Map of the location of Salton Sea within Southern California, United states of America. Approximately 250km Southwest of the city of Los Angeles. (ESRI Database, 2012).

The Salton Sea is home to a complex ecosystem full of birds and fish who interact cohesively at times, and other times, in a destructive manner. The destruction of wetland habitats in California over the past century has forced migratory Birds to use the Salton Sea as their main roosting and migratory area. The Salton Sea is the only major body of water for

these migratory birds to use in the area, and thus is overused. This continued overuse detracts from the quality of habitat through bird waste, and the consumption of poisoned fish, and eventually the Salton Sea became a hazardous environment for the avian population. The fish population and diversity within the Salton Sea fluctuates as the salinity level has increased over the past 100 years. Moving from a freshwater lake to a Sea with a higher salt content than the ocean has not been a smooth transition and the health of the wildlife that relies on the Salton Sea reflects that (Boyle, 1996). In the past fifty years, humans have tried spend millions of dollars in attempts to create an attractive environment at the Salton Sea and nearby Salton City. However, all that is left is a few stores and low-income housing. This paper will outline a brief history of the Salton Sea, then provide an explanation of the fish population, the bird population, and the relationships between the two populations.

The Salton Sea Explained

History

The history of the Salton Sea has been one of periods of prosperity and periods of disaster (Boyle, 1996). The body of water was created through an accidental flooding event. In 1905 farmers were attempting to divert the Colorado River for agricultural purposes when one of their dams broke and created a flood (Boyle, 1996). The Colorado River flowed into what was then the Salton Sink, a low-lying area in the Imperial and Coachella valleys located in Southern California. The flooding was eventually blockaded, and the river resumed its original course south, along the California Arizona border, before flowing into the Gulf of California. At the time the Salton Sea was created, it was approximately 72.5 km long, 30 km wide and 24 meters deep (Boyle, 1996).

The Salton Sea has no outlet rivers or tributaries and receives less than 6 centimeters of rainfall per year, meaning it should have slowly evaporated over time; however it has persisted into present day due to the agricultural runoff it continuously received (Boyle, 1996). A few small streams and irrigation runoff from the local farms are what feeds the Salton Sea. Irrigation runoff full of nutrients, pesticides, and salt, brings in four million tons of salt annually and has kept the Salton Sea in existence (Metzler and Springer, 2004). Over the past century, the giant freshwater lake that the Colorado River created, has transformed into what is now an inland Sea with higher salt contents than the Pacific Ocean. Over this time, the ever-increasing salinity level has dictated the ecology of the Salton Sea and human activity surrounding the Salton Sea (Metzler and Springer, 2004).

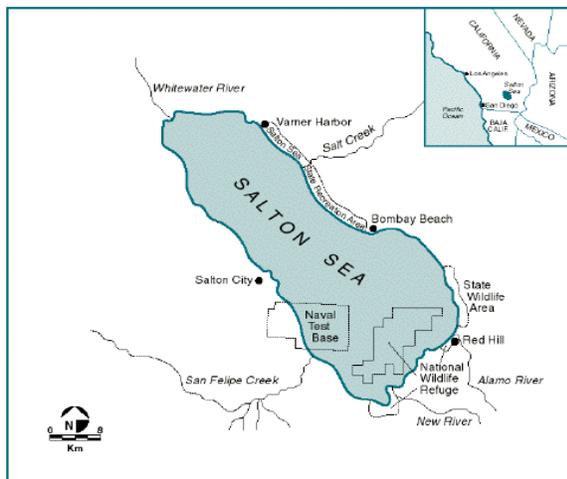


Figure 3: A Map of the Salton Sea showing dimension of approximately 72.5 km long and 30 km wide. Map also outlines nearby human settlements and small river inflows near the Salton Sea (California Department of Water Resources, 2010).

Recreational and development by humans in the Salton Sea has been up and down since the creation of the Sea. From the 1950s to 1970s, wealthy individuals from Southern California desired to create a second “Palm Springs” resort town with the Salton Sea at the center (Metzler

and Springer, 2004). Through the 1980s and into the present, hope of the resort boom ever coming to fruition has disappeared due to the salinity levels rising. The wildlife associated with the Sea, mostly fish and fish-eating birds, has also been in ever changing periods of success and decline, which mirror the changing salinity levels in the Sea and seasonality (Metzler and Springer, 2004).

Necessary Wetlands

The Salton Sea has taken on important status as a necessary wetland in California. The land that Los Angeles was founded on was formerly a marshy area. As the Los Angeles area developed, the marshes were drained and transformed into drier, more suitable land for city infrastructure (Shuford et al., 2002). As wetlands were removed, the wildlife that resided there had to find new wetland locations; The Salton Sea provided that necessary wetland area. The Salton Sea is located along the Pacific Flyway, an essential migratory route for birds in western North America, and has always been used at a regional stop over area. However, the fact that the Sea is located along such an important migratory route has further implications than simply providing a place for the avian population to stop on their way (Shuford et al., 2002).

The Salton Sea connects many bird populations from a wide area in a relatively small body of water, and the health of many species of birds from all over North America can be traced back to the health of the Salton Sea (Shuford et al., 2002). As with any water ecosystem, the Salton Sea demonstrates a complicated relationship between water and wildlife, specifically centered on the fish and bird populations, both of which, are illustrated further in the following paragraphs.

Wildlife: Fish

Just as the Salton Sea's water composition has changed since its formation, so has the fish population living in it. The Salton Sea not only received its original water from the Colorado River, but also its original fish population. The Colorado River washed in populations of carp, trout, bonytail, catfish, striped mullet and humpback sucker (Hurlbert et al., 2007). This population thrived while the water remained mostly fresh. However, it was short-lived, salinity increased, and as early as 1920, salinity levels in the water reached near-ocean levels. During those early years it was estimated that the population of fish grew enormously and thrived under low salinity, then crashed as salinity increased and freshwater fish could no longer survive.

As salinity increased over time, the fish population continually changed (Hurlbert et al., 2007). In the 1940s and 1950s humans introduced desert pupfish, striped mullet, mosquitofish, and longjaw mudsuckers to the sea, these species became the dominant species in the Sea (Hurlbert et al., 2007).

Then in 1960s, 1970s, and 1980s, salinity reached ocean-like levels and populations of bairdeilla, sargo, corvine, and tilapia came to dominate the Salton Sea (Hurlbert et al., 2007). Humans, with the hope to provide a sport fishing environment in the Salton Sea, first introduced these species into the Sea. People saw the Salton Sea as an opportunity for game fishing, so they began to release corvina and tilapia, into the Salton Sea (Metzler and Springer, 2004).

During the 1970s and 1980s, the Salton Sea supported a game fishing industry, which was a major selling point for people who thought about visiting the Salton Sea. However, in the 1980s, 1990s and into present day, many freshwater and even salt water species failed, while others, like tilapia, thrived in the Salton Sea (Metzler and Springer, 2004).

As the Salton Sea moves into present day, Tilapia continues to dominate the current population, with estimated numbers around 100 million. The Salton Sea was believed to be the

most productive Tilapia producing body of water in the world in the early 2000s and into present day. (Metzler and Springer 2004).

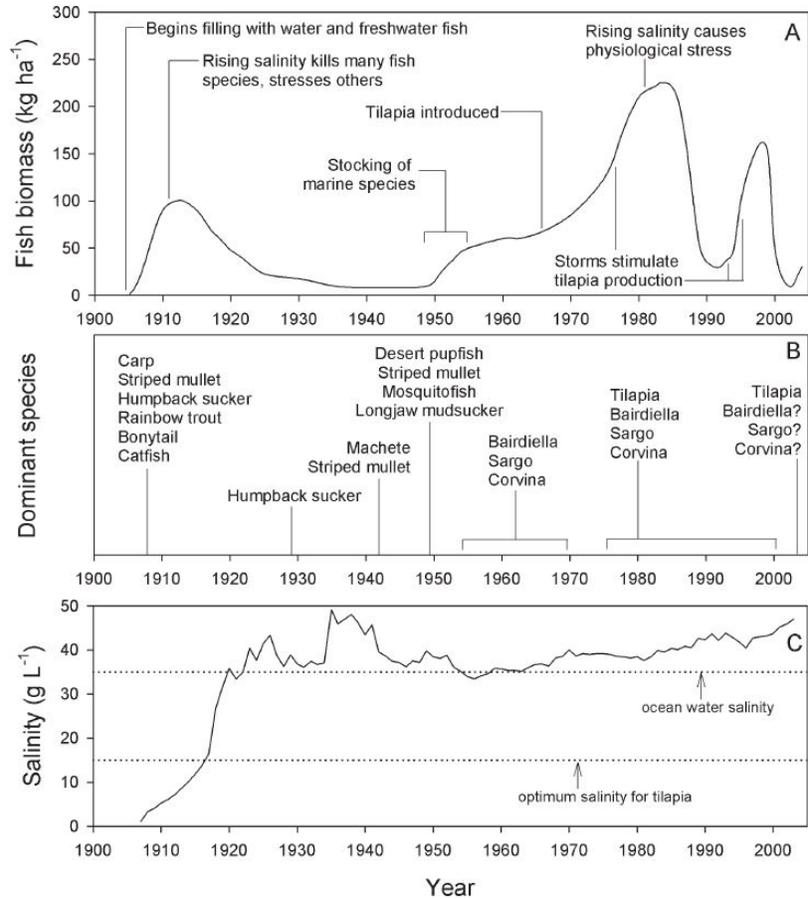


Figure 4: Graphs depicting Fish Biomass(A), Dominant Species(B), and Ocean Salinity (C), over the time period 1900-2000. (Hurlbert et al., 2007).

The temperatures and salinity of the Sea continually changes, both annually and seasonally. As the Salton Seas conditions changed, so did the populations of the tilapia. There are two main variables that play a role in the tilapia reproduction; salinity levels and water temperature. During the cooler winter months at the Salton Sea, water temperatures drop to the lower end of tilapia tolerance and are responsible for winter tilapia die offs (Hurlbert et al., 2007). However, it is during the summer season where the major die offs occur. In the summer heat, the water temperature rises and algae blooms become present on the water surface. The

algae blooms block the sunlight and air from mixing with the water, and the amount of dissolved oxygen that can reach the fish decreases (Metzler and Springer, 2004). Without the necessary oxygen, the fish die from a lack of oxygen in the water. That absence of oxygen in the water caused die offs numbering in the millions during the summer months in the past ten years. In one particular event, 7.6 million fish died at one time in the Salton Sea.

During the summer of 1996, the Salton Sea experienced events where the shores filled with dead fish stretching a kilometer into the Sea itself (Metzler and Springer 2004). The die-off of fish can cause a decay smell that permeates the air near the Salton Sea, and even drifts into the Los Angeles area (Metzler and Springer, 2004). Even as recently as 2011, and 2012, there have been multiple instances where Los Angeles was filled with an awful smell that can be traced back to the Salton Sea. While the smell and fish kill are a problem, byproducts of the fish die off are the biggest concern, specifically Botulism. The high temperatures and salinity levels that are so prevalent during the summer months set the stage for Botulism in the fish (Metzler and Springer, 2004). The contaminated fish then become food for the fish-eating birds in the Sea, and pass on botulism to the bird population. When botulism spreads to the avian population is what has ecologists concerned (Friend, 2002).

Wildlife: Birds

Birds are another piece of the ecosystem at the Salton Sea. Over time the avian population has shifted towards using the Salton Sea as a necessary wetland, population numbers are constantly fluctuating as migratory birds flock to, and depart from the Salton Sea constantly. Birds began arriving shortly after the Colorado River brought an unknown amount of fish into the Sea in 1907, as it presented an attractive feeding ground where fish were available in high numbers (Hurlbert et al., 2007).

Wetland habitat in southern California decreased over time, and as urbanization grew, more and more birds began using the Salton Sea as a stopover spot, simply for the reason that it was the only wetland spot left. The Salton Sea is an important stopover area for birds migrating along the Pacific flyway, This results in overuse of the Salton Sea by the avian population and this overuse increases the exposure of the avian population to any diseases that may be present (Friend, 2002).



Figure 5: Overview of the Pacific Flyway routes used by avian population of North America. Routes follow along the western coastline of North America stretching from Alaska down to Central America.

Avian disease, and subsequent die offs are an annual problem at the sea. Similar, to the fish population, the summer months and onset of high temperatures, lead to birds getting sick and dying. When the temperatures are high, and salinity is rising, botulism in fish thrive, and when the birds unknowing consume infected fish, the botulism is then spread to the birds (Metzler and Springer, 2004).

Botulism is not a recent phenomenon at the Sea as the Salton Sea has been reporting avian botulism since 1938, but in the 1990s and 2000s it has become far more severe (Friend,

2002). In the 1990s the Salton Sea experienced large-scale loss of fish-eating birds from Botulism poisoning, and is the only place in the world to experience an event like that; no other place has reported losses to the same magnitude (Friend, 2002). During the summer of 1996 approximately 15-20 percent of the population of white pelicans in the Western United States died from botulism poisoning that traced back to the Salton Sea (Friend, 2002).

The Salton Sea Wildlife Refuge was set up to be a waterfowl wintering area, however the use for the wildlife refuge changed in recent years (Metzler and Springer, 2004). After the massive die-offs of 1996 the wildlife refuge employees became a rescue effort for infected endangered wildlife. Each summer when the botulism die-off happens, the wildlife refuge employees go and pick up the dead birds. It is important to remove the bird carcasses so they do not become carriers to further the botulism disease, and kill more birds (Metzler and Springer, 2004).

The effort to keep the bird die offs to a minimum is primarily to keep the Salton Sea a healthy environment for the migratory birds that stop there. As mentioned, the Salton Sea is an essential stopover area for both migratory and non-migratory birds (Friend, 2002.) If the Sea is unhealthy, the bird populations suffer. (Friend, 2002). This becomes an issue in the instance of the Brown Pelican, which is an endangered species in California, and most of the population visits the Salton Sea at one time or another during the year. If the Brown Pelican population at the Salton Sea were to die off, it would further endanger the species (Metzler and Springer, 2004).

If the dead birds are allowed to further contaminate the Sea, it is possible that diseases could become widespread as birds leave the Sea for their seasonal destinations, having an unknown effect on the avian population in these places. Although it is an ecological disaster to

have such high bird and fish die-offs in the sea, it would be an even greater disaster to have this spread outward to other ecosystems in North America (Friend, 2002).

Conclusion

The Salton Sea has had a history full of fluctuations, which are not stopping as we move into the future. When it comes to maintaining the health of the Salton Sea's complex ecosystem, human interaction is currently simply providing damage control (Friend, 2002). In order to preserve the quality of the avian population in Western North America, the Salton Sea needs to provide a healthy environment for the birds that frequent it (Metzler and Springer, 2004).

The needs of the fish and birds will continue to be unmet unless higher regulation of water inflow occurs. Overall the Salton Sea needs cleaning up, or the populations of fish in the Salton Sea, and avian populations throughout North America could suffer further unforeseen consequences. (Friend, 2002).

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