Changes and Processes in the Salton Sea Ecosystem

The following is a running narrative that represents the general flow of the Biological Ecosystem section of the Atlas story. This narrative serves as a framework for the individual sub-stories that are being developed by topical teams. It is expected that this framework will evolve as the sub-stories are developed, integrated, and progress.

Chapter Overview

The Salton Sea is a significant part of both regional and local ecosystems. This chapter outlines the nature and significance of the Sea, from an international scale down to the microscopic organisms that comprise the foundation of the food chain. The story begins with a description of climate change over the last 500 years and its effects on the natural ecology of the American Southwest and the Northern Gulf, including the remnant habitats and species that make the area so special today. The significance of the Sea to the Pacific Flyway and the overall biodiversity and environmental health of the region is described next. Finally, the complex web of biological systems, interrelationships, and dependencies within the Sea itself are characterized, and ultimately tied back to the health of the region.

1. Climate Change and Transition of the Last 500 Years

The climate and ecology of the American Southwest and Northern Gulf have changed significantly over the past 500 years, with the Salton Sea alternately filling and drying as an element of that transition, resulting in dramatic shifts in plant and animal life over such time. These factors, as well as the persistence of some remnants of past ecosystems in isolated and fragile niches, exemplify another dynamic element in an already complex and highly variable regional ecology and contribute to the unique and special character of this locale.

2. A Link in an International Chain

The location of the Salton Sea as a large body of water in the desert, in close proximity to the biologically rich Gulf of California and situated fortuitously along the route of the migrating birds of the Pacific Flyway, support its significance as an important link in a regional and international ecological chain.

The importance of the Salton Sea to migrating birds is a central issue surrounding the sea. Nearly 95% of the wetlands in California alone have been lost to human landscape alteration over the past century. The network of wetland "rest stops" that once supported migrating birds along the Pacific Flyway has been reduced to critical levels. Footprints of these dramatic changes include the damming up and canalization of the Colorado

River, resulting in the severe modification or elimination of a vast amount of wildlife habitat. These grave alterations of wetland patterns throughout California have reinforced the role of the Salton Sea as one of the critical remaining links in what was once an interwoven chain of wildlife habitat. Today, the Salton Sea is famous for the number and variety of bird life that can be observed there.

3. Biodiversity and Protected Species in the Salton Region S/T

Section Overview:

This section will overview conservation biology principles and how they are reflected in the regional context of the Salton Sea. Another segment in this section will focus on the threatened and endangered flora and fauna found at and around the Salton Sea.

The area around the Salton Sea contains a unique diversity of habitat and species, ranging from frigid alpine forest to low desert scrub. Together with the Salton Sea, these interrelationships form an intricate and delicate web, making the Salton Basin the unique and biologically diverse environment that it is today.

The Salton Sea also represents a vital stopover for several federally protected species, as well as a unique habitat area for several local inhabitants. The Desert Pupfish, Yuma Clapper Rail, Desert Tortoise, Fringe-Toed Lizard, and Big Horn Sheep represent only few examples of the vast variety of species sighted, and will be described in more detail. Each creature plays a unique role in the ecosystem, and is dependent on the remaining niches of habitat that are linked or related in some way or another to the Salton Sea ecosystem.

4. Life in the Salton Sea S/T

Section Overview:

This section presents the evolutionary process of the lake during the past century, how it evolved from a fresh water lake to a highly saline lake, the range of fish species introduced, leading up to the current status where we have a highly productive system with millions of fish, algae blooms, etc.

This section also clearly portrays the biological cycles and interrelationships involved in the Salton Sea with diagrams showing relationships among the Sea's biological components, beginning with the algae as the basis of the food chain, and continuing through to fish and birds as the end of the food chain. The chain of relationships will be clearly described with illustrative renderings. Care will be taken to point out information gaps with regards to what we know and do not know about the Sea's ecosystem.

This section ends with the description of the eutrophication process which illustrates how all of these different trophic levels are related to one-another and what their effects on each other are. It also ties back to the human influence and the accelerated processes associated with the latter over the past century, and its consequences for the migratory birds and the value of the Pacific Flyway in general.

Cultural Eutrophication

When the Salton Sea was created at the beginning of this century, it represented a huge body of fresh water, devoid of any life, save perhaps for that of the diverse microscopic variety. It was soon to become a watering hole for various avian and terrestrial animals, as well as some of the local human populace. By the early Twentieth century, the lake was being stocked with a variety of fish species and used as a recreation area by the public, changing the dynamics of the Sea and its immediate surroundings. As western industry and agriculture expanded in the early Twenties, the Sea began to receive increased amounts of municipal and industrial effluents mainly originating from Mexicali, Mexico, as well as agricultural discharges from the Imperial, Coachella, and Mexicali Valleys. As a result, nutrients were introduced into the Sea where they have since accumulated and fuelled biological productivity. This situation represented the beginning of a greatly accelerated pattern of physical, chemical, and biological reactions that have caused the Sea to shift from a relatively unproductive, fresh-water body to a highly nutrient-rich and productive yet very unbalanced ecosystem in less than a century — a most unnatural rate of change.

Hence, in its latest incarnation, the Sea represents a highly eutrophic system characterized by a unique blend of naturally occurring and introduced elements. Typically, it takes hundreds and thousands of years to reach nutrient and productivity levels of this magnitude, but in the case of the Salton Sea, the effects of human activities have dramatically accelerated it. This human acceleration of the lake's metamorphosis is known as "cultural eutrophication" and has severely limited recreational use in the area. Though the Salton Sea is dependent on outside sources for its life-maintaining nutrients, these same influxes have brought with them an overabundance of nutrients. The latter have typically generated massive algal blooms, which subsequently deplete the oxygen level in the water column and often result in extensive fish kills. If unchecked, increasing salinity and eutrophication will reduce or even eradicate the capacity of the Sea to support game fish and other life forms, including the substantial bird populations that have come to rely on the Sea as a bountiful oasis along their migratory journey.

Curiosum of the Salton Sea

It is interesting to note that the general eutrophic state of the Salton Sea has remained virtually unaltered over time in spite of both the change in the types and abundance of fish as well as algae, and the increase in influxes (note the doubling of the inflow of Phosphorous) since the 1960's. Why this is so remains a mystery, though it implies that the total incoming Phosphorous — the main nutrient stimulating biological production —

must be absorbed and sequestered by the bottom sediments via a yet unexplained mechanism. One theory proposes that a mineral combination could possibly be occurring between the Phosphorous and some form of calcium found in fish bones. Whatever the cause, Phosphorous is not being released from the sediments back into the water to provide food for algae, as is the usual case.

Thus today, the Salton Sea represents a very fragile and tenuously stable system that is highly dependent on its external environment. It is comparable to a big aquarium in which food is introduced, accelerating bio-productivity beyond stable levels and leading finally to environmental conditions hazardous to both human and wildlife health.

Avian Disease

Since the 1990's, losses of migratory birds from disease at the Salton Sea has become an increasingly important problem due to the major environmental changes described above. Minimizing future losses represents a challenge that must be adequately met in order to achieve the restoration goal; which is to "Provide a safe, productive environment at the Sea for resident and migratory birds and endangered species." Neither this challenge, nor the outbreak of disease are occurrences new to or unique to the Salton Sea. Large–scale die-offs of birds at the Salton Sea have occurred since at least the 1920's, but during recent years the types and frequency of disease outbreaks have increased to a disconcerting level. The complexity of this situation poses a major challenge for the Salton Sea Restoration Project.

One of the major goals is to reduce the occurrence of avian disease at the Salton Sea by improving the environmental quality of this ecosystem in a manner that minimizes the potential for disease outbreaks. In this context, it is vital that causes rather than symptoms be addressed if avian losses from disease are to be minimized, and within this perspective, to view disease as the resultant outcome of factors facilitating disease occurrence. It is widely recognized that environmental changes can be the basic cause for disease emergence. Thus, once the complex interplay of physical and biological processes is understood, environmental management can be a powerful means for minimizing both disease occurrence and the number of cases of disease that occur in association with such outbreaks.

Conclusions

The following represents a first try at summarizing ideas and issues that will have to be refined and completed in the actual Conclusion section.

After all which has been said of the Salton Sea, this dynamic tale leads us to a single juncture from which two possible avenues lie ahead: one in which the Sea is left alone to follow its present course towards collapse. Or the path in which humans, almost entirely responsible for its present condition, decide to take on the responsibility of maintaining, and perhaps even improving the state of this fragile oasis. Either decision will have long-term impacts both on the general environment of the region as well as on how we as a culture will view the importance and the significance of our impact on the environment and its resulting effect on our life-quality.

No Action

Should it be decided that it is best to allow the present situation confronting the Salton Sea to run its course, unmitigated and unaltered, then the results may be both acute and far-reaching, both physically and socially. With the influx of sediments, pollutants, and nutrients continuing unabated, the salinity and eutrophication of the Sea will critically reduce its capacity to support life other than algae and bacteria, including the substantial bird populations that have come to rely on the Sea as a bountiful oasis along their migratory route. The first trophic level in the food chain to be threatened by these changes will most likely be the fish, imperiled by depleted oxygen levels and critically high salinity values. Once the water becomes uninhabitable to fish, it could progress to a disease-ridden cesspool, populated only by a thick soup of algae and bacteria. Migratory birds in search of water could run an increased risk of acquiring illnesses due to these hazardous environmental conditions favoring the emergence of disease. This situation could result in the transmission and environmental perpetuation of the disease agents across and beyond the boundaries of the Salton Sea, possibly severing the link for other migratory birds and animals in the North and the South.

Maintaining the Ecosystem

If it is decided that the wisest course of action is to maintain a balanced and healthy ecosystem by conscientious intervention and maintenance of the Salton Sea and its surrounding habitat, then certainly one or more of several actions can be undertaken:

This is where we could list several of the proposed alternatives (?)

There are sure to be many other feasible solutions yet unnamed and unimagined, though whatever the solution, the critical point is for us to realize both our connection to the environment, as well as our responsibility of balancing-out the effects wrought by our

culture. When do we realize that we are, part of and reliant upon the condition of our natural surroundings, and what price do we put on our survival? At some point, when we realize that we are, by nature, within, and reliant upon the sphere of Nature, we must become aware of the price we have put on our survival.