

RESTORATION

West of the West: Tales from California's Channel Islands

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Lesson Plans 1 & 2

Lesson Plan 1 – Introduction and Overview

- At 96 sq. miles (or roughly 4x the size of Manhattan), Santa Cruz Island (SCI) is the largest and most biologically diverse of California's 8 Channel Islands (40km long x 12km wide).
- In the last 30+ years, significant efforts have been made to restore and protect the unique biodiversity of the Channel Islands, and of Santa Cruz Island in particular.
- Santa Cruz Island lies between 19 and 33 miles off the Central Coast of California, just a stone's throw away from the mainland, and yet it is like being a world away from anywhere.
- It is located in the northern Channel Islands, and is part of the Channel Islands National Park, along with the islands of Anacapa, Santa Rosa and San Miguel. SCI and the other northern Channel Islands lie within the Channel Islands National Marine Sanctuary.
- Santa Cruz Island is co-owned and managed by The Nature Conservancy, which owns 76 percent of the 62,000-acre island, and the National Park Service, which owns the remaining 24 percent. The Conservancy gifted 14% (8,5000 acres) of the Island to NPS in 2000.
- The Conservancy purchased the Island in 1978, and since that time has worked to reverse the loss of native habitats and recover rare species that were negatively impacted by unmanaged overgrazing by feral sheep and by feral pigs.
- For decades, SCI was intensively ranched with pigs, sheep and cattle, leaving much of the island as a barren landscape.
- At the height of ranching operations on the Island, there were more than 150,000 sheep, and thousands of cattle and pigs.
- As the post-war demand for meat and wool diminished, these sheep were largely unmanaged, and formed large feral populations that ravaged the Island.
- The Nature Conservancy removed over 35,000 feral sheep from its portion of the Island in the 1980s (1982-1988).
- The tens of thousands of unmanaged populations of sheep, pigs and cattle had a devastating impact on the Island.

The Importance of Islands

- Islands are important for the conservation of the richness of life on earth. They are hotspots for biological diversity. Isolation and lack of connection to the mainland typically leads to higher rates of endemism – unique species found nowhere else.
- Approximately 20% of all terrestrial species (land animals) are island endemics.
- Islands are also extremely important for marine species. Islands provide critical habitat for seabirds, pinnipeds (seals and sea lions), and to a lesser extent sea turtles. These marine creatures forage over thousands of kilometers of ocean and often play a significant role in regulating these marine systems. They are also highly dependent on small islands for breeding and nesting sites.
- Despite their importance, islands have been decimated by humans. Most extinctions don't happen in rainforests or the oceans, but on islands: 95% of bird extinctions, 90% of reptile extinctions, 69% of all mammal extinctions, and 68% of plant extinctions.
- Well over half of all recorded extinctions have been on islands (if freshwater fishes and mollusks are also included). *Based on analysis of IUCN data for about 800 species listed as extinct.*
- The stakes are much higher on islands. The potential to lose species forever from an island is very high. One of the biggest challenges we face today is the global extinction crisis. The tragedy of needless extinction is perhaps greatest on islands. One of the things that drives much of that extinction are introduced invasive/non-native species. The story of California's Channel Islands is a great example of tackling this challenge, removing invasive species and reversing a legacy of habitat degradation and loss of biodiversity.

Biodiversity of Santa Cruz Island and the Northern Channel Islands

- Not only is Santa Cruz Island the largest and most biodiverse of southern California's 8 Channel Islands, it is also the most geographically diverse, with 77 miles of coastline, windswept beaches, deep canyons and dramatic cliffs.
- The Island is dominated by 2 mountain ranges, which run the length of the Island. These mountain ranges flank a pastoral central valley.
- The Santa Barbara Channel that separates the northern Channel Islands from the mainland is very deep – more than 1000ft, and even deeper on the back side of these islands.
- These Islands were never connected to the mainland, so any species that ended up on out here would have had to fly, swim or float out.
- Up until about 18,000 years ago, these northern Channel Islands consisted of a single land mass called Santarosae. As sea levels rose during the last glacial retreat, Santarosae was divided up into the 4 islands that we now see today of Santa Cruz, Santa Rosa and San Miguel, and Anacapa.
- The waters around these islands are highly diverse, and are home to a remarkably rich and diverse number of whales, dolphins, seals, sea lions and seabirds:
 - Largest aggregation of blue whales in the world
 - San Miguel Island has the largest pinniped (seals, sea lions) rookery in the world
 - Host more than 95% of nesting seabirds in California
 - Kelp forests are a top dive destination

- The Northern Channel Islands and Santa Cruz Island specifically are in a transition zone for warm currents from the south and colder California currents from the north.
- The cold California Current that flows from the north brings colder water and air temperatures to the islands western and northern shorelines.
- The California Counter Current from the south brings warmer water from Baja attracting flora and fauna from more southerly seas.
- The mixing of these two different currents results in an upwelling of nutrients from the ocean floor which in turn makes for a highly productive marine ecosystem – hence the incredibly diverse marine life that is supported in this area.
- Going out to Santa Cruz Island is a little like taking a step back in time, and reminiscent of what much of southern California looked like 150 years ago. Even though Santa Cruz Island lies within a 200-mile radius of over 18 million people, it is an oasis of biodiversity.
- Unlike some of the other islands in the Channel Island chain, Santa Cruz Island is graced with year-round springs, which help support an assortment of different landscapes and habitats, such as:
 - > 500 native plants (~45 endemic)
 - 220 birds (~9 endemic)
 - 8 amphibians & reptiles (3 endemic)
 - 4 terrestrial mammals (3 endemic)
 - 9 bats
- The Island, and neighboring Channel Islands, are often referred to as the Galapagos of North America, with Santa Cruz being home to more than 1000 species of plants and animals, a handful of which are found on Santa Cruz Island, and nowhere else in the world.
- The concentration of unique species on Santa Cruz Island is higher than that of many states in the U.S.
- Of the 12 unique species on Santa Cruz Island, 9 are plants.
- Three are animals, the Santa Cruz Island Fox, the Santa Cruz Island scrub jay, and the Santa Cruz Island deer mouse.
- The Island fox is about the size of a small house cat and is a descendant of the larger mainland gray fox (*Urocyon littoralis*).
- Scientists believe foxes arrived at the Channel Islands from storm-generated debris about 18,000 years ago. At the time, the landmass where they landed, called Santarosae, was about 5 to 7 miles off the coast of southern California.
- As sea levels rose over the years, Santarosae separated into four separate islands. Subsequently, distinct subspecies of island fox evolved on three of the islands: Santa Cruz, Santa Rosa and San Miguel.
- Despite its diminutive size, the Island fox has reigned as the top dog of Santa Cruz Island for thousands of years.

- In addition to the diverse plants and animals, Santa Cruz Island and the Channel Islands are also steeped in a rich cultural history.
- The oldest human remains from North America were discovered on neighboring Santa Rosa Island and date back 13,800 years before present at a time when woolly mammoths roamed these islands. Present native American Chumash trace their ancestry to this time.
- There are about 3,000 archaeological sites on Santa Cruz Island.
- What is particularly unique about the archaeological history of Santa Cruz and the Channel Islands is the absence of burrowing animals which has allowed for what is essentially an intact archaeological record.
- However, the feral pigs on Santa Cruz impacted and disturbed ancient Chumash archaeological sites through their rooting, digging and rototilling activities.
- It is estimated that approximately 1,100 Native American Chumash inhabited Santa Cruz Island for over 10,000 years.
- The last Chumash left the Island in the early 1800s.

An Island at a Crossroads

- Imagine a time when Native American Chumash populated Santa Cruz Island, and the Island's native flora and fauna co-existed and thrived.
- Island fox were seen at every turn, and frolicked island wide. One-of-a-kind plant species flourished. And the native bald eagle graced the Island's 77+ miles of coastline, feeding primarily on fish and carrion, and NOT on the island foxes.
- In the mid-1800s, European settlers introduced pigs and other non-native species to the island.
- This marked the beginning of a drastic tip in the ecological balance of the Island's natural systems.
- Feral pigs rooted up soil and native plants, providing a fertile base for invasive species such as fennel, which choked out the native vegetation.
- Bald eagles died out from widespread dumping of DDT's into the marine environment.
- With no territorial bald eagles left, and an abundant year-round food supply of feral pigs, golden eagles begin colonizing Santa Cruz Island in the early 1990s.
- In addition to the pigs, golden eagles also preyed upon the diminutive Island fox. Within a few years, the island fox population plummeted to near extinction.
- Historically, the Santa Cruz Island Fox population was around 1,500.
- Golden eagles picked off the naïve Island Foxes like popcorn – these foxes which, in the absence of predation pressure, had become more active during the day and had also lost their instinct to look up.
- In the space of a few years, only a handful of Island Foxes remained on Santa Cruz Island and the northern Channel Islands.
- The population of foxes on Santa Cruz Island has increased more than tenfold since the Island fox was listed as an endangered species in 2004. The population numbers approximately 1,500 and Island Foxes are now considered as recovered.

Accomplishments in Conservation

- Resounding conservation and restoration success has been achieved on Santa Cruz Island and on the Channel Islands more generally in the last 30 years through effective collaboration and partnership across a diverse and varied number of public and private entities - The Nature Conservancy, National Park Service, U.S. Fish and Wildlife Service, Catalina Island Conservancy, U.S. Navy, California Department of Fish and Wildlife and the University of California.
- This has included the successful removal of 10s of 1000s of feral ungulates – feral sheep and pigs, deer, burros, rabbits – as well as rats and feral cats - which had a devastating impact on the Islands' landscape and native plants and animals.
- The feral pig removal program on Santa Cruz Island is unprecedented. All the pigs from the Island were completely removed in a short 18 month period
- The Santa Cruz Island Fox, as well as those subspecies on Santa Rosa and San Miguel Island, which were on the brink of extinction due to predation by non-native golden eagles which also depended heavily on pigs to sustain their existence on the northern Channel Islands, is now fully recovered, and is one of the fastest endangered species recovery programs in U.S. history.
- Geographically extinct bald eagles, decimated by DDT contaminants, are now nesting successfully on Santa Cruz Island and the northern Channel Islands for the first time in over half a century.
- And the Islands' diverse native habitats are making a spectacular comeback.

Lesson Plan 2 – Restoration Actions

- The Nature Conservancy, National Park Service, and several public and private partners engaged in a science-based program to recover the island fox and restore Santa Cruz Island's native habitat. The program involved five components: breeding island foxes in captivity, monitoring the wild population, and conducting ecological and disease research; relocating golden eagles to the mainland; re-establishing bald eagles on the island (which helped to discourage golden eagles from returning); eradicating feral pigs; and controlling invasive weeds and restoring native habitats. More details on each of the program's components can be found on www.nature.org/sci/ and www.chis.gov.

Island Fox Recovery Efforts

- The Island Fox, found only on the six largest Channel Islands and nowhere else on earth, declined by over 90% in the late 1990s and were listed as a federally endangered species in 2004.
- In less than a decade, the population went from 1,500, to fewer than 100, and the Island Fox was on the verge of extinction.
- The Conservancy and National Park Service implemented Island Fox recovery efforts that focused on captive breeding, island wide monitoring, and ecological and disease research.
- Captive Breeding: The captive breeding program was implemented to help safeguard and augment the population of foxes. The captive breeding program, which produced 85 pups since its implementation in 2002, was phased out in late 2007 due to the successful recovery of foxes in the wild and all captive foxes were released to the wild.
- Wild Fox Monitoring and Ecological & Disease Research: Scientists fit approximately 100 wild foxes with light-weight radio-collars to monitor their movement patterns using radio telemetry, and study how they interact with their habitat. Having a large proportion of the population collared allowed foxes to be closely tracked, and their survivorship and mortality rates monitored. This information allowed scientists and resource managers to quickly adjust management actions and efforts as necessary.
- Historically not native to Channel Islands, Golden Eagles set up shop on Santa Cruz Island with the niche left vacant by the disappearance of bald eagles.
- Lured by the abundant, year round supply of feral pigs, Golden Eagles also took advantage of the preying on the naïve Island Fox, and polished them off like popcorn
- Foxes evolved on these northern Channel Islands as literally the top dog, with no natural predators; in the absence of predation, they became more active during the day than at night, and lost their instinct to look up. They never saw the golden eagles coming.

Golden Eagle Relocation

- All kinds of different crazy techniques to live capture and relocate golden eagles – rappelling down sheer cliffs to look for well hidden golden eagle nests in cliff faces, setting camouflaged bow nets on the ground with bait and hiding in the bushes for days on end until a golden eagle happened by to take the bait, and capturing birds in mid-air using a net gun deployed from helicopters.
- Ultimately, over 40 birds were live captured and relocated to the far side of the Sierra Mountains in California, and there has been no golden eagle nesting activity on the Island since.

Re-Establishment of Bald Eagles

- Once a common sight on the Channel Islands, Bald Eagles disappeared from the Channel Islands by the 1960s due to widespread DDT contamination of their marine-based food supply. A 5-year feasibility program was initiated in 2002 through the National Park Service, with funding from the Montrose Settlements Restoration Program, to re-establish bald eagle presence on the archipelago.
- For the first time in over half a century, at least 20 bald eagle pairs are now nesting successfully on Santa Cruz Island and neighboring Santa Rosa, Anacapa and Santa Catalina Island and over 81 chicks have been banded.

Feral Pig Removal

- While it only took 18 months to remove all of the feral pigs on the Island, it took many, many years of careful planning and thoughtful review of all alternative options before any action was implemented.
- The feral pig eradication program on Santa Cruz Island went through extensive scientific and external review. Numerous local stakeholders, state and federal agencies were actively engaged and involved in reviewing all strategies and techniques to negate the extremely adverse impacts caused by pigs.
- Alternatives to eradication included relocation to the mainland and contraception.
- The State of California strictly prohibits relocation of pigs to the mainland. Pigs carry parasites and diseases such as brucellosis and pseudorabies that have the potential to be spread to other pigs and livestock. Moreover, CA is among is one of the top states in the country for numbers of feral pigs, and relocation would have further increased the distribution and abundance of an invasive species with great potential of causing damage.
- Contraceptives have never been proven effective for use in an eradication program. Nor is there an approved contraceptive for feral pigs.
- Moreover, contraception did not address the immediate needs of removing pigs because of habitat destruction and loss of species.
- Feral pigs are highly destructive and cause widespread erosion. Whereas sheep will browse shrubs and trees, and rip plants out from its roots, pigs will root and rototill a landscape.

- Feral pigs were responsible for the destruction of unique plant species, including 9 federally listed plants, some of which are found only on Santa Cruz Island. They were also responsible for the decline of native vegetation communities like oak woodlands on the Island. They furthered the spread of invasive species such as fennel. They attracted golden eagle predators, which in turn depredated foxes.
- A number of techniques and methods were employed to remove the pigs - doing so as humanely as possible – using humane traps, tracking dogs (trained to track not bite), aerial helicopter support, and more subversive techniques using CIA-like informants using sentinel or “Judas” pigs.
- The Judas or sentinel pigs were fitted with radio collars and GPS data loggers that track their movements to locate other pigs that they may be associating with.
- The tracking dogs were also radio collared so that their effort and locations could be quantified.
- Ground Hunting Maps: The Island was divided up by 27.5 miles of pig proof fence into discrete management zones, and efforts to remove pigs were systematic, clearing one zone at a time.
- The maps show the GPS tracks of the combined individual hunting effort on the ground, with the stars showing each of the dispatch locations
- This kind of data allowed for the quantification of total effort, and look for any gaps and alter the pig removal strategy as needed.
- Helicopter Ops: Given the challenging topography and terrain, we relied heavily on helicopter operations to support all of the ground and hunting operations.
- GPS Maps: The GPS maps show the combined effort of coverage by ground hunters, dogs and the helicopter needed to clear a zone.
- GPS Island Map: The end result was an Island in which literally every square inch of the Island was covered, and 5,036 feral pigs removed.

Native Habitat Restoration

- As a result of the conservation actions on the ground, with the removal of feral sheep and feral pigs, there has been a dramatic recovery in the Island’s native habitats.
- In the last 20 years, we have seen dramatic changes in not only vegetative cover, but in types of vegetation communities.
- Vegetative recovery has been slow, but dramatic.

Conclusion

- Just less than a decade ago, the Santa Cruz Island Fox was on the brink of extinction with its population numbering less than 100. Today, the Island fox numbers over 1,500 and it is one of the fastest endangered species recovery programs in U.S. history. Bald eagles, geographically

extirpated from the Central Coast of California, are making a comeback due to re-establishment efforts, and a handful of pairs are now nesting successfully on the Island after over half a century. Not only will you see Island Foxes and Bald Eagles flying over the Island, but you will also be able to witness firsthand much of the plant and habitat recovery that is happening now.

- The recovery of Santa Cruz Island has been nothing short of remarkable. It is a wonderful example of how investments in innovative science and technology to inform conservation management actions, and leveraging unique partnerships with government entities, academic institutions and other NGOs, has catalyzed such a rapid and transformative positive change.
- In an era where we hear so much about environmental gloom and doom, Santa Cruz Island is one of the stories of hope and opportunity, where we can make a positive difference and take what we've learned here and leverage that into action elsewhere in the world.