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Matt Guilliams is the Tucker Plant Systematist at the Santa Barbara Botanic Garden. A native Californian, Matt has worked with the plants of the state since 1998. At the Garden he focuses on biodiversity of the Central Coast and Channel Islands, as well as on studies of the Boraginaceae and Montiaceae.

Steve Junak has been exploring the California Islands and studying their plants for almost 50 years. He worked as a botanist at the Santa Barbara Botanic Garden for 37 years, has retired from that job, and is currently a Research Associate there. He co-authored the Flora of Santa Cruz Island (1995), wrote the Flora of San Nicolas Island (2008), and is currently working with several other authors on a flora for Catalina Island.

Denise Knapp has a Ph.D. in Ecology from the University of California, Santa Barbara and an M.A. degree in Geography from the University of California, Los Angeles. She has worked on vegetation, fire ecology, invasive species, rare plant, and habitat restoration projects; her current focus is plant-insect interactions, especially pollinators. She has worked as an ecologist in California, particularly the Channel Islands, for two decades.

John Knapp's love-affair with the California Islands started when, at two years old, his father would leave him to play on Tin Can Beach (now Bolsa Chica) while he went for a run, and John would look across the Catalina Channel at the mountain in the sea wondering what awaited him out there. What he found was great beauty and the need for dramatic conservation intervention, and after working on the islands for the past two decades he now serves as the California Islands Ecologist with The Nature Conservancy. His goal is to develop strategies, methodologies, and tools to more effectively and efficiently address the conservation challenges facing the islands, which is best summarized by Willis Linn Jepson who wrote in 1907, "*In the long run protection must come by the devices and resources of united effort, high intelligence, and careful handling.*"

David Merzurkewicz is a Wildlife Biologist for Channel Islands National Park focused on seabirds and habitat restoration. He has been working on the California Islands for the past decade. The scope of his work within the Park encompasses ecological restoration for seabird nesting habitat and associated plant communities as well as spearheading the Park's Inventory and Monitoring program for seabirds.

Kathryn McEachern is interested in exploring how changes in the environment affect populations of rare and endangered plants. She is a Research Plant Ecologist with the U.S. Geological Survey - Western Ecological Research Center's Channel Islands Field Station, in Ventura, California. She has been studying the distribution, abundance and demography of rare plants on the northern Channel Islands for nearly 20 years, providing research to inform and test restoration and recovery actions.

Bryan Munson is the Botany program manager for Naval Base Coronado, which includes San Clemente Island and 7 properties in San Diego County. Bryan has worked in environmental compliance for the Navy for 10 years. Bryan graduated from the University of Wisconsin-Madison with a B.S. in Biology and a minor in Environmental Studies.

Tom Oberbauer has had a lifelong interest in islands and has had the opportunity to visit most of the California and Baja California Pacific Coast Islands as well as many in the Sea of Cortez. He has written a number of articles describing the botany of the islands including for *Fremontia*.

Federico Méndez-Sánchez is an oceanographer with a MSc in Environmental Management from The University of Auckland, New Zealand. He also has twelve years of experience working on conservation, restoration, and sustainable development of the islands and has been the Director General of GEI since March 2017.

John Randall is a Lead Scientist for The Nature Conservancy's California Chapter. He supervises a team of four other scientists working to conserve and manage protected areas and corridors with the aim of linking them into a statewide network. His own work is currently focused on the conservation and management of the biodiversity of the Islands of the Californias, and on contributing to an urban conservation program for Greater Los Angeles by assessing the distribution of biodiversity and opportunities for enhancing it across the region.



RESILIENCE OF UNIQUE ISLAND VEGETATION

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The Islands of the Californias are well known for their unique vegetation comprised of numerous island specialist (See Williams et al. this issue) including ancient species like Catalina ironwoods (*Lyonothamnus floribundus*) as well as modern insular endemics like manzanitas (*Arctostaphylos*), buckwheats (*Eriogonum*) and tarplants (*Deinandra*). Until a couple of decades ago, these islands harbored only a shadow of their former biodiversity. Nearly all islands suffered century-long overgrazing and browsing which eliminated vegetation and eradicated many of their unique botanical components. The loss of vegetation caused a cascade of destruction including pollinator decline and erosion. Each island shares its own compelling story of the recovery and resilience of native flora and fauna.

THE CHANNEL ISLANDS

In the 1970's the Navy began efforts to remove feral animals on **San Clemente Island**. Before goat

Above: By 1888 it is estimated, based on historical records, that there were only 100 Torrey pines (*Pinus torreyana*) on Santa Rosa Island. Today, after herbivore removal, there are over 12,000 trees—one-quarter of which are saplings. Photo by Michael Kauffmann.

removal for instance, much of the island was denuded of natives or dominated by non-native annual grasses. The lower terraces supported a sparse cover of maritime sage scrub and slopes in the canyons were barren. In 1975, a notable discovery was one San Clemente Island paintbrush (*Castilleja grisea*) on a cliff face in the midst of the protection of cacti. The only populations of San Clemente Island bush-mallow (*Malacothamnus clementina*) were found shielded amongst rusting metal scraps and debris of an old landfill and on an inaccessible cliff in China Canyon. So denuded was the island that there was little, if any, vegetation that could be classified as sage scrub habitat.

The last goat was removed from San Clemente Island in 1991 (Seward 1992), following the removal of feral deer and pigs which was achieved in the 1980's.

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9. Channel Islands National Park



Sheep removal on Santa Cruz Island has greatly affected vegetation as seen in these photos. Before (top) goat removal in early 1980s only a few Coast Live Oak (*Quercus agrifolia*) and Bishop pine (*Pinus muricata*) survive but after (bottom) in 2005 large shrubs like *Ceanothus arboreus* and *Baccharis pilularis* are returning. Photos by Peter Schuyler.

Now, sage scrub vegetation covers the upper terraces of the island and down into the canyons. Maritime desert scrub composed of Box-thorn (*Lycium californicum*) and cacti (*Opuntia littoralis*, *Cylindropuntia prolifera*, and *Bergerocactus emoryi*) has expanded along the lower terraces near the Pacific. New populations of San Clemente Island paintbrush have become a major component of the sage scrub vegetation. Giant coreopsis (*Leptosyne gigantea*) was re-discovered on the island indicating the potential that it could be re-established as a component of the vegetation. Island mallow (*Malva assurgentiflora*) has been planted to mimic its formerly extensive cover while woodlands plants like Catalina cherry (*Prunus ilicifolia* subsp. *lyonii*) and Santa Cruz Island ironwood (*Lyonothamnus floribundus* ssp. *asplenifolius*) have regrown in the canyons. Even the grasslands have shifted composition to include natives like Foothill needlegrass (*Stipa lepida*) and broom baccharis (*Baccharis sarothroides*) where non-native grassland previously dominated the landscape.

Santa Cruz Island was subjected to grazing until 2001 (Van Vuren 2014) with up to 50,000 sheep—nearly one per acre—by the late 1800s in addition to numerous cattle and feral pigs. Root crowns of chaparral shrubs more than half a meter above the existing ground level indicated extreme soil loss and pine logs lay on barren gravel in the 1970s above Prisoners Harbor—providing a hint of the former vegetation.

Beginning in the 1990s with herbivore removal Bishop pine (*Pinus muricata*) began to spread while chaparral shrubs, including island manzanitas (*Arctostaphylos crustacea* subsp. *insulicola*, *A. crustacea* subsp. *Subcordata*, and *A. insularis*), white-haired manzanita (*A. viridissima*), bigpod ceanothus (*Ceanothus megacarpus* var. *megacarpus*), feltleaf ceanothus (*C. arboreus*), and island ceanothus (*C. megacarpus* var. *insularis*) have expanded dramatically. There are now places on the island among the ironwoods where evidence of the introduced vertebrates is all but gone!

Santa Rosa Island, at the start of the 21st century, was mostly devoid of native vegetation due to a suite of introduced vertebrates. The island has seen a progression of herbivore removal initiatives including an early removal of sheep and cattle that remained until 1998. By 2011 all other ungulates including deer, elk, and pigs were removed. In the early days of island occupation when introduced herbivores were present, barren slopes seemed to be the natural environmental state with dry, open canyons lacking any riparian vegetation. Along a southern ridge, a remnant grove of Island oaks (*Quercus tomentella*) appeared to be on stilts with roots exposed two meters above the soil line.

Here too, after the removal of grazing animals, the vegetation has rebounded. Riparian canyons are filled with rushes and sedges (*Juncus* and *Carex*), southern cattails (*Typha domingensis*), arroyo willow (*Salix lasiolepis*) and flowing water. Bishop pine groves on Black Mountain are spreading and Torrey pines (*Pinus torreyana*) which by 1888 were estimated to number around 100 individuals are thriving—with an estimated 12,300 trees, one-quarter of which are saplings. Chaparral shrubs like toyon (*Heteromeles arbutifolia*) and California huckleberry (*Vaccinium ovatum*) have sprouted from rootstocks where no recent vegetation existed. Vegetation has expanded and coalesced, reducing fragmentation and providing habitat for plants that need shrub canopies, like the Coast paintbrush (*Castilleja affinis*) on Carrington Point. The native perennial bunch grass community is also rebounding near Becher's Bay and other locations.

The remarkable recovery of vegetation continues on **San Miguel Island**, which prominent botanist Edward L. Greene called “a huge sand dune” following only 40 years of intensive herbivory. The recovery has been remarkable and can be seen when comparing aerial imagery from 1929 to more recent aerial photos in Johnson (1980) article about erosion on San Miguel Island.

Santa Catalina Island has been exposed to the greatest variety of introduced ungulates, including bison and black buck antelope. After multi-year programs to remove goats and pigs, mule deer and bison are the last remaining large herbivores. However, the potential for recovery is evident. After a fire in a region protected from feral animals, native chaparral endemics such as feltleaf ceanothus, Channel Island tree poppy (*Dendromecon harfordii*), Santa Catalina Island bush-mallow (*Malacothamnus fasciculatus* var. *catalinensis*) and island rush-rose (*Crocanthemum greenei*) emerged from the seed bank.

Early island botanists described Island tree mallow (*Malva assurgentiflora*) as abundant, but it was subsequently eliminated from the main island to only survive on two offshore islets. Yet, when planted and protected with fencing on the main island, this plant responds vigorously. It is interesting that though it has not been recorded from Santa Cruz Island, it is found to the west on San Miguel Island, and to the east on Anacapa Island. This raises the question of whether or not it ever existed on Santa Cruz Island.



On Guadalupe Island, *Senecio palmeri* and *Lupinus niveus* recover on formerly bare slopes after goat removal. Photo by Thomas Oberbauer.



Young Guadalupe cypress (*Hesperocyparis guadalupensis*) recovering on Guadalupe Island. Photo by Thomas Oberbauer.

Santa Barbara Island, one of the smallest islands, hosts giant coreopsis (*Leptosyne gigantea*) which was historically so abundant that on a clear day in spring the island appeared as a yellow hill on the ocean when viewed from the mainland. With the introduction of European rabbits and hares the species declined but since their removal giant coreopsis, Santa Barbara Island buckwheat (*Eriogonum giganteum* var. *compactum*) and Santa Barbara Island dudleya (*Dudleya traskiae*) have rebounded.

MEXICAN ISLANDS

Off the western coast of Mexico, on **Coronado Sur Island**, the endemic Coronado Island dudleya (*Dudleya candida*) and western island mallow (*Malva occidentalis*) have spread since the goats and burros were removed. On **San Benito Oeste Island**, after the removal of goats, burros and rabbits, the endemic San Benito Island tarplant (*Deinandra streetsii*) recovered. The **Todos Santos Islands** were also subjected to the impacts of feral rabbits from the 1970s to 1998 as well as donkeys and cats (Donlan et al. 2003). Though the rabbits and donkeys have been removed, annual grassland composed of non-natives has expanded on both islands due rabbit herbivory but some native vegetation remains on the north island, which is once again a major seabird nesting area.

On **Guadalupe Island**, vegetation communities were decimated due to goats into the early 2000s. Endemic Guadalupe Island pine (*Pinus radiata* var. *binata*), Guadalupe Island palm (*Brabea edulis*), Guadalupe Island cypress (*Hesperocyparis guadalupensis*), and island oaks (*Quercus tomentella*) declined. Chaparral components were non-existent or surviving only on cliffs. Some species, such as the composite Guadalupe Baeropsis (*Baeropsis guadalupensis*) and the endemic Guadalupe Cistanthe (*Cistanthe guadalupensis*) were extremely rare on the main island, surviving on goat-free islets. Reid Moran, the chronicler of the islands flora described the surface as “covered with rocks

that were too big to step over but too small to step around” meaning that the island was difficult to traverse because the surface was covered with ankle turning rocks, devoid of soil.

After only a dozen years, the removal of goats has allowed for tremendous change (Cecena-Sanchez et al. 2016). Three native taxa including the composite Estafiate (*Ambrosia camphorata*), the saltbush Galletilla (*Atriplex barclayana*), and Guadalupe globemallow (*Sphaeralcea sulphurea*) are reestablishing vegetatively. A suite of silver-leaved shrubs including Guadalupe Island ragwort (*Senecio palmeri*), Guadalupe Island rock daisy (*Perityle incana*) and San Clemente Island goldenbush (*Hazardia cana*) as well as the Guadalupe Island silver lupine (*Lupinus niveus*) are reclaiming large areas on the north end of the island. Even species not previously known to occur here, such as feltleaf ceanothus, have become abundant after goat removal.

Overall, the greatest action for the conservation of the California Islands has been the removal of introduced and feral herbivorous mammals. In the absence of these non-native animals each island has demonstrated an unprecedented resilience in vegetation recovery.

REFERENCES

- Cecena-Sanchez, M. L., Delgadillo-Rodriguez, J. Aguirre-Munos, A. and L. Luna-Mendoza. 2016. Phytosociological Study of the Scrub Plant Community on Guadalupe Island, Mexico. 9th California Island Symposium.
- Donlan, C. J. et al. 2003. Islands, Exotic herbivores, and invasive plants: Their roles in Coastal California Restoration. *Restoration Ecology* 11:524-530.
- Johnson, D. L. 1980. Episodic vegetation stripping, soil erosion, and landscape modification in prehistoric and recent historic time, San Miguel Island, California in. Power, D. M. Ed. *The California Islands: Proceedings of a multidisciplinary symposium*. Santa Barbara Museum of Natural History. Santa Barbara, CA. pp.103-121.
- Seward, D. R. 1992. Use of the Judas goat technique to eradicate the remnant feral goat population on San Clemente Island, California. Unpublished Master's Thesis, Oregon State University. 47 p. <https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/37022/SewardDawnRLene1992.pdf?sequence=1> Accessed March 20, 2017.
- Van Vuren, D. H. 2014. Shrub regeneration after removal of feral sheep from Santa Cruz Island, California. *California Fish and Game*. 100(3):396-403.

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Above: Elephant tree (*Bursera microphylla*) on Cedros Island.
Right: Coastal cholla (*Opuntia prolifera*) on Santa Catalina Island.
Below: Cedros Island Agave (*Agave sebastianana*) on Cedros Island.
All photos this page by Denise Knapp.





Above: Coronados liveforever (*Dudleya candida*) on South Coronados Island. Photo by Stephen McCabe.

Right: Botanist and botanist-in-training explore El Tigre Ridge on Santa Cruz Island. Photos by Denise Knapp.

Below right: On Santa Cruz Island, Wildlands Conservation Science employee Katrina Olthof is treating a remote population of the invasive carnation spurge (*Euphorbia terracina*) with the aid of helicopter transport. Photo by Morgan Ball.

Below: Federally endangered *Malacothamnus clementinus*, a San Clemente Island endemic, has expanded its range since the 1970s, when feral goats had eliminated all but one population. Photo by Dylan Neubauer.

