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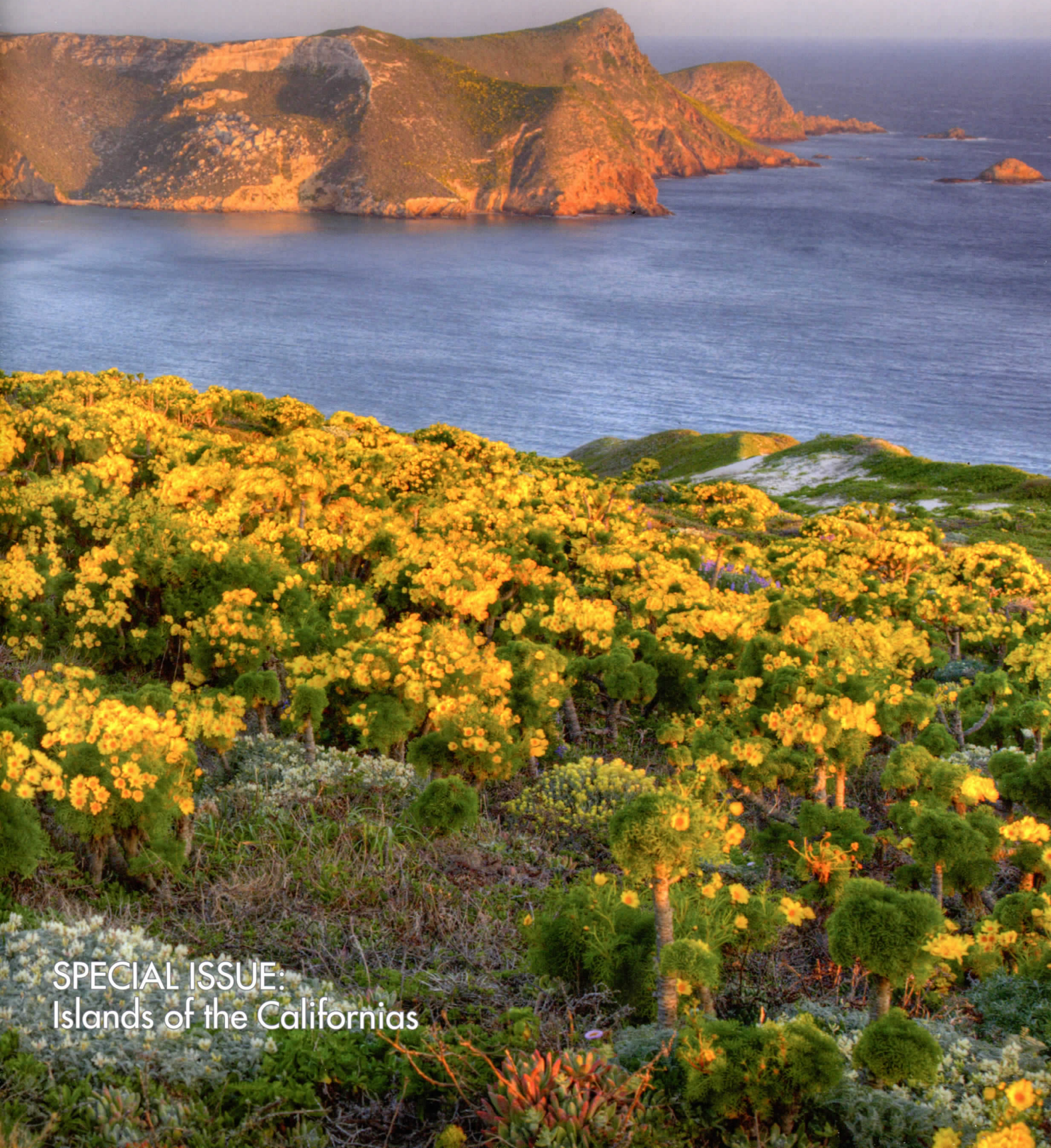

SPECIAL ISSUE:
Islands of the Californias

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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 GECI 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.

THE FUTURE OF CALIFORNIA ISLANDS CONSERVATION IN A CHANGING WORLD

Denise Knapp[1], Donaxi Borjes-Flores[2], Peter Dixon[3], William Hoyer[4], John Knapp[5], Luciana Luna-Mendoza[6], Kathryn McEachern[7], Julio Hernández-Montoya[6], Bryan Munson[4], Paula Power[8], y John Randall[5]

The Islands of the Californias are precious gems strung along the coast of western North America—stunningly beautiful, rich in cultural history, and home to plants and animals found nowhere else in the world (Knapp and Randall, Guilliams et al., this issue). Managed primarily for biodiversity conservation, they provide an opportunity to demonstrate what is possible with vision and a dedicated, sustained effort. As contained systems, they are also important laboratories for learning and innovation.

What does global change have in store for these gems? Drought, warmer temperatures, precipitation extremes, ocean warming and acidification, and sea level rise (IPCC 2014) are all occurring at accelerated rates. Decreasing fog frequency (Johnstone & Dawson 2010) will hurt plants that rely on this vital moisture source, such as the Bishop pine (*Pinus muricata*) (Carbone et al. 2013). Habitats already rare on the islands—such as dunes, coastal bluff scrub, and coastal marshes—will shrink. It is predicted that up to 66% of California's endemic plant taxa will experience range reductions within a century (Loarie et al. 2008). Invasive species will likely be favored over natives (Sandel and Dangremond 2012). Sensitivity to climate change may be higher on the coast than in inland areas (Ackerly et al. 2015), and animals on the Channel Islands may be even more vulnerable than their coastal mainland counterparts (Bova et al. 2012).

These changes are happening, and while the islands have made remarkable progress (Munson et al., Oberbauer et al., this issue), they haven't completely recovered from the introduced ungulates that overgrazed and browsed them for over a century (McEachern et al., this issue). Fewer, smaller rare plant populations with reduced genetic diversity are hindered in their ability to attract pollinators and reproduce, and are less able to adapt to environmental changes. Our goal has been to reverse these human-caused changes and give plants a fighting chance at survival so that their biodiversity can provide the islands resistance to invasion, resilience to disturbance, and adaptation to future environments.

Thankfully, innovative and inspiring restoration is happening on the California Islands (Mazurkiewicz et al., this issue). Efforts should continue to be strategic and data-driven, prioritizing the restoration of ecological function. For example, the interconnections of food and pollinator webs should be carefully considered. Ongoing restoration of dense mosaics of diverse habitat will reduce fragmentation and favor native wildlife over invasive species such as Argentine ants and rats. By continuing and strengthening biosecurity measures, we will protect these systems from future invasions. Restoration and reintroduction projects should be used as experiments wherever possible—taking plants out of their presumed range limits, for instance, to learn more about their requirements. Finally, we suggest storing funds in order to respond quickly to wildfires or take advantage of high rainfall years for planting.

Changes, both good and bad, are being felt and observed on California's Islands. As stewards, we can be flexible with our goals and targets and practice adaptive management while using the best available data and modern tools. Techniques such as structured decision making and risk assessment may be used to balance trade-offs and ambiguities. Working together, we can continue to harness our passion for island restoration and find efficiencies by sharing knowledge. Our Botanical Collaborative (Hoyer et al. in review) is being strengthened and archipelago-wide goals formalized. We are working to combine information across climate, geology, and land use gradients, which will help us to understand the limits of rare, endemic, and invasive species' environmental tolerance and show us ways forward.

We may need to act boldly to prevent species collapse in the face of climate change. For instance, a mainland common garden experiment for Torrey pines (*Pinus torreyana*) conducted by U.S. Forest Service botanists on Santa Barbara Botanic Garden property is showing

1. Santa Barbara Botanic Garden
2. Comision Nacional de Areas Naturales Protegidas
3. Catalina Island Conservancy
4. U.S. Navy, Naval Facilities Engineering Command Southwest
5. The Nature Conservancy
6. Grupo de Ecología y Conservación de Islas
7. U.S. Geological Survey, Western Ecological Research Center
8. Channel Islands National Park

that hybrids of the Santa Rosa Island and San Diego subspecies are more robust than both mainland and island individuals. The increased genetic diversity of these hybrids may buffer them from pest outbreaks and climate changes. Taxa like the relict island ironwood (*Lyonothamnus floribundus*) may already be declining beyond our control (see Guilliams, this issue); perhaps this evidence will guide us to manage selected high-profile stands for education and inspiration.

While the islands have been recovering following the removal of introduced vertebrates, many areas like this Island oak (*Quercus tomentella*) grove on Santa Rosa Island still need a lot of help. Photo by Denise Knapp.

In this, the era of big data and advanced technology, we must use such resources to our advantage. Island scientists are actively compiling existing data across the archipelago and collecting the information we will need in the future (Randall et al. in review). We are using and contributing to existing databases, while creating a customized Island Information System that lets us go farther, faster. Let's also (with thought and care) consider bold new approaches such as translocations, biocontrol, and even genome editing to tackle extensive weed populations like crystalline iceplant (*Mesembryanthemum crystallinum*) or fennel (*Foeniculum vulgare*). We are up against a suite of modern forces—let's use modern tools.

Across the island chain, land managers must play to their strengths. For example, although Santa Catalina's greater visibility has made it tougher to remove all the invasive animals, it receives over a million visitors a year. The Catalina Island Conservancy is building a prominent new interpretive center near the island's entrance to educate visitors and enhance their experience. With education, the public will become stewards for the priceless resources of these islands and better understand the threats that they face. Catalina can be the gateway to the archipelago and help us to conserve the island chain as a whole.

To promote the appreciation and conservation of these islands, we all need to get better at telling their stories. We can tell both a human and a botanical story, for example, by re-tracing the steps of early scientists (Junak et al., this issue) as we "re-discover" the islands' plants, animals, and communities.

Let's promote the islands as places of inspiration and hope—with exceptional beauty and uniqueness, and fascinating human and natural history stories. Now more than ever people need meaningful natural experiences to inspire them to conserve and restore special places. Forty years ago, it was hard to imagine just how amazing the recovery of these islands would be. Today, the botanists who saw them in their weakened state are in awe at how resilient native species can be when given a chance to thrive. The islands will continue to offer optimism in a changing world for what is possible if we work together.

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