



UC Santa Cruz Fort Ord Natural Reserve

2020-2021 Annual Report
Joe Miller - Director

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EXECUTIVE SUMMARY

This report provides an overview of activity at UC Santa Cruz Fort Ord Natural Reserve (FONR), in Marina, California for the fiscal year 2020-2021. FONR is a 600 acre reserve that protects maritime chaparral, coastal scrub, grassland, and oak woodland on part of the former Fort Ord army base. Reserve staff and interns monitor and maintain habitat for multiple protected species throughout the reserve. As part of the University of California Natural Reserve System, FONR provides a living laboratory and outdoor classroom for researchers, K-12 students, university students and faculty, and the greater Monterey Bay community.



While 2020-2021 was an unconventional year due to restrictions on reserve use due to COVID-19 precautions; progress toward research, teaching, and public service goals continued. In 2020-2021 Reserve Director Joe Miller was assisted by Restoration Steward Brett Bell and Restoration Assistant Annie Allenbaugh. Multiple UC and CSU interns and volunteers contributed to work on the reserve as well.

Figure 1. Undergraduate students from UCSC Professor Barry Sinervo's Herpetology class check cover boards for amphibians at UCSC FONR

Instructors from UCSC, CSU Monterey Bay, and Cabrillo College continued use reserve resources, though most were unable to bring field classes to the reserve. Represented disciplines included environmental science, ecological assessment, biology, ecology, and environmental studies, scientific illustration, and others.

As was the case for much of the nation's educational infrastructure, use at FONR was curtailed by the closures related to the COVID-19 pandemic, which started after the Winter quarter ended in March 2020. FONR staff continued to facilitate limited ongoing graduate and undergraduate research once approvals were acquired from university staff. After the closures, staff also adjusted their role to create multiple presentations to assist in virtual outreach and instruction. These included teleconferencing and video virtual field trips, instructional clips for biology courses, articles, data sharing, and presentations. Despite these nonstandard



Figure 2. Scouts BSA Troop 614 at the FONR outdoor classroom, getting to know "Bandit" the California kingsnake

protocols related to the pandemic, in 2020-2021 over 250 users were able to access the resources at UCSC Fort Ord Natural Reserve, on nearly 1300 user-days.

With a reduction in in-person contact with students, and the elimination of indoor space use in accordance with safety protocol related to COVID-19, the reserve director shifted some energy into construction of additional outdoor and remote infrastructure at the reserve. In 2020-2021 additional outdoor class meeting spaces were constructed, a field office container was equipped with internet connectivity and computers for staff and student use. The reserve director also constructed a large work shed to be used for equipment storage and protected outdoor workspace, with the help of generous donor funds and laborers.



Figure 3. Northern Pacific rattlesnake in the sands of UCSC FONR



Figure 4. UCSC Undergraduate intern Molly Lane teaches a young volunteer about mammalogy data collection tools.



Figure 5. CSU Monterey Bay student Kat Molinari uses mobile GIS tools to enter herpetology data collected in oak woodland habitat at UCSC FONR

The Fort Ord Natural Reserve consists of maritime chaparral habitat that is home to many rare and endemic species, as well as grasslands, coastal scrub, and oak woodland habitat. For much of the 20th century the land was occupied by the Fort Ord US Army Base. FONR staff now uses the 600-acre reserve to serve the community; helping to achieve regional conservation and education goals by supporting research, education, and outreach. The site was chosen as a UC Reserve due to the unique vegetation communities and the numerous sensitive and listed plant and animal species that occur throughout the reserve (including the federally endangered, state-threatened sand gilia, state-endangered seaside bird's beak, and the federally threatened Monterey spineflower).

In the past year we offered internship opportunities, continued animal monitoring, and monitored long-term vegetation monitoring plots with faculty and undergraduate intern assistance. Undergraduate researchers from CSU Monterey Bay and UC Santa Cruz continued a long-term population study of Coast Horned Lizard, *Phrynosoma blainvillii*, a species of special concern. UCSC Ecology and Evolutionary Biology/Environmental Studies undergraduate Molly Lane initiated a research project related to the detection of rare shrews using modified camera traps. Reserve staff has helped to organize and manage field crews to assist UCSC graduate research on reserve wide vegetation plots, where Environmental Studies PhD Candidate Jon Detka works to understand the relationships



Figure 6. FONR/USFWS Interns Alleene Roemer and Patrick Lee monitor rare butterfly habitat at Palo Corona Regional Park in Carmel, CA

Smith's blue butterfly. This work was done in assistance to US Fish and Wildlife Service, which funded the intern positions. The following report highlights these and additional efforts.

In service to greater University of California goals in the Southern Monterey Bay area, FONR staff assisted University of California Monterey Bay Education, Science and Technology Center (UCMBEST Center) with stewardship on an additional 400 acres of open space adjacent to the natural reserve in Marina, CA. This work included trespass abatement and invasive plant monitoring. FONR staff led restoration efforts of state and federally protected rare plant species, as part of a mitigation related to MBEST lands that have potential for future development.

As with most reserve activities, FONR staff included many UCSC, CSU Monterey Bay, and community College students in these activities to create hands on learning opportunities for those entering the natural science and land management fields.

between maritime chaparral plants and native fungal pathogens. These and many class-based research projects were assisted by the Director in 2020-2021.

Staff also continued to assist Army contractors with continued environmental cleanup onsite. New partnerships were formed with local non-profit organizations, university internship agencies, and educational institutions. UCSC FONR stayed actively engaged in efforts to facilitate research on adjacent protected lands, as well as on reserve property. In Spring and Summer of 2021 UCSC FONR Director Joe Miller, with assistance from UCSC Reserves Director Gage Dayton, supervised three undergraduate interns in a large-scale habitat monitoring effort to learn more about the range wide status of the Federally endangered



Figure 7. Rare plant restoration at UCSC FONR

EDUCATION

Instructional use at FONR continued in 2020-2021, with multiple changes to accommodate remote learning and safety measures on site related to COVID 19 safety protocol. Few classes were able to meet in person on the reserve, however a reduced number of class groups continued to access reserve resources and staff knowledge through remote teaching tools. Reserve staff met regularly with classes to help support and develop teaching activities, interpret and identify flora and fauna, and help with student research and public service projects. FONR is roughly one hour from the UCSC campus, minutes away from CSU Monterey Bay, and within an hour of several other higher education institutions in the greater Bay Area. With remote activities, it was refreshing to be able to work with students from a much wider geographic area. Reserve staff is working to continue some of these activities as pandemic restrictions change, with remote activities and presentations planned for k-12 students around California in the coming year. Classes included a wide variety of disciplines including biology, ecology, environmental studies, earth sciences, and art from multiple institutions (Table 1).

CLASS VISITS

2021-2021 saw reduced in-person use by classes from UC, CSU, and Community College instructors.



Figure 8. UC Natural Reserve System California Ecology and Conservation class touring the chaparral at UCSC FONR

Limited UC classes that were still able to meet in person attended for field visits. Many of the instructors that access the reserve for their classes build entire units around field visits. While this was not always possible in 2020-2021 we were still able to assist many classes remotely. Reserve staff made resources available via data sharing, video, teleconference, and providing availability for student inquiries related to reserve resources. Disciplines included ecology, biology, earth science, botany, art, and many introductory field method classes. Introductory field methods classes such as UCSC BIOE 114 (Herpetology), CSUMB BIO 360: Natural History of CA Wildlife, and CSUMB ENV 350 (Quantitative Field Methods) make extensive use of reserve resources and staff. These classes represent some of the best use of UCSC FONR, due to uniquely accessible location and habitats.

TABLE 1. FORT ORD NATURAL RESERVE CLASS USE - FISCAL YEAR 2020-2021

Course Number/Name	Institution	Instructor
University of California		
ENVS 182/183: Environmental Studies Internship	University of California Santa Cruz	Joe Miller
BIOE: 114 Herpetology	University of California Santa Cruz	Barry Sinervo
UCNRS California Ecology and Conservation	Multiple University of California Campuses	Tim Miller/ Krikor Andonian
UC California Naturalist Program	University of California Santa Cruz	Linda Anderson
California State University Monterey Bay		
BIO 195: Special Topics in Wildlife Research	California State University Monterey Bay	Gerick Bergsma
ENV 350: Quantitative Field Methods	California State University Monterey Bay	Robert Burton
ENVS 483: Environmental Impact Analysis	California State University Monterey Bay	Robert Burton
BIO 360: Natural History of CA Wildlife	California State University Monterey Bay	Jenny Duggan
ENVS 446: Landscape Ecology	California State University Monterey Bay	Jenny Duggan
SL 95-500: CSUMB Service Learning	California State University Monterey Bay	Joe Miller
Monterey Naval Postgraduate School		
SE 3201: UAS Systems Engineering	Monterey Naval Postgraduate School	Oleg Yakimienko
K-12 Education		
Green Careers Program - Watsonville Wetlands Watch	Pajaro Valley High School Watsonville, CA	FONR Staff
Wetland Stewards Program Watsonville Wetlands Watch	Pajaro Valley High School Watsonville, CA	FONR Staff

UNDERGRADUATE RESEARCH, INTERNSHIPS, AND SERVICE LEARNING

Multiple undergraduate research projects were supported by UCSC FONR staff in 2020-2021. Students from UCSC and CSUMB worked on research including but not limited to herpetology, rare mammal species monitoring, plant disease ecology, unmanned aerial systems (UAS) mapping, CSUMB Service-learning internships and UCSC Environmental Studies internships covered topics related to cartography, long term plant and animal monitoring, and scientific illustration. These projects involve many hours of individual mentorship by FONR staff and create great collaboration opportunities between reserve staff and faculty of supporting institutions. See “Current Research” below for listing of individual projects.



Figure 10. UCSC Intern Molly Lane, sharing her methods with a CSUMB undergraduate visitor to UCSC FONR

In 2020-2021 FONR staff facilitated multiple volunteer and internship positions for students from UCSC and CSU Monterey Bay. Participants were involved in a wide variety of stewardship, ecology, public service, research installations, restoration, and course facilitation internships. Agencies that provide class credit for these internships include the UC Santa Cruz Environmental Studies Internship Program, CSUMB Undergraduate Research Opportunities Center, CSUMB Science Internship Program, and the CSUMB Service-Learning Institute. FONR interns gain valuable experience while they assist staff in facilitating research, education, and public outreach. Interns are involved in a wide variety of activities including field data collection, repair and maintenance of reserve facilities, land stewardship, rare plant surveys, invasive species control, assisting with classes, vertebrate monitoring, small mammal trapping, working with k-12 and public outreach efforts, and faculty research projects. Interns were also able to make connections and learn from the larger conservation community through a variety of community projects. All of the undergraduates who participate in internships at FONR gain research and practical skills, connect with faculty and other students, and get real world experience that cannot be acquired in a traditional classroom.

Figure 11. CSU Monterey Bay Scientific Illustration student Sonja Pinck created an outreach comic that highlights how citizen science can assist reserve staff.



Figure 9. UCSC Undergraduate Suzy Xu embarks on a wildlife camera monitoring shift

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RESEARCH AND MONITORING



Figure 12. Arboreal salamander, *Aneides lugubris*

UC Santa Cruz Fort Ord Natural Reserve was established because of the unique and rare flora and fauna that occur throughout the 600 acres. Faculty, students, and independent researchers from multiple institutions use the reserve for research. FONR staff engage in natural resource monitoring efforts year-round. Below is a short overview of some of the ongoing projects on the reserve during the past year.

CURRENT RESEARCH – FISCAL YEAR 2020-2021

EVOLUTIONARY GENOMICS OF TOXICOSCORDION

Diler Haji – University of California, Berkeley

An unresolved problem in evolutionary biology is how divergent natural selection among populations in different habitats can result in barriers to gene flow between them – a process known as ecological speciation. My dissertation research addresses the role of ecological speciation in a young species flock of perennial star lilies (*Melanthiaceae: Toxicoscordion*) known for their production of neurotoxic alkaloids. *Toxicoscordion* is young, diversifying in the last 0.5-1.5 Ma in California, with range limits suggesting



Figure 13. Fremont's Deathcamas, *Toxicoscordion fremontii*

varying degrees of ecological specificity (e.g., coastal vs. alpine vs. low desert species). The group contains about eight species distributed around the Central Valley and can be collected at UC Natural Reserves, yet there is little known about patterns of genetic variation in this group. This project aims to (1) characterize the phylogenetic history and population genetics of *Toxicoscordion* in California and (2) identify genetic variants underlying adaptive phenotypic variation. To address these aims, I will need to sequence genomes from field-collected specimens representing each species and I will need to measure phenotypes across species in a greenhouse common garden, including alkaloid diversity and concentration. I hypothesize that (1) lineages in this group will show evidence of independent phylogenetic transitions to similar ecological settings, (2) individuals will show evidence of hybridization given the lack of known mating barriers but little evidence of

introgression given strong ecological selection, and (3) phenotypic traits will show functional trade-offs mediating ecological isolation.

CARRION BEETLE COMMUNITY COMPOSITION AND MOVEMENT

Tracie Hayes – University of California, Davis

This project is part of a multi-site study to determine carrion beetle (*Coleoptera, Silphidae*) community composition and movement patterns in coastal prairie and coastal scrub habitat along the California coast. Since carrion beetles rely on the rare and ephemeral resource of carrion for their reproduction, they contend with an environment where resources are patchy and competition is high.

How does carrion beetle community composition shift latitudinally in concert with environmental gradients? Do species differ in how far they travel between resource patches? Does carrion beetle community composition determine how carrion resource patches are used (e.g. greater diversity and abundance of subfamily Nicrophorinae, more burials)? Does movement capability and carcass usage correlate with population structure differences between species? Does stage of decomposition determine which species will visit a carcass?

We will begin to answer these questions with mark-recapture methods, open carrion grids, time-sorting propylene glycol traps, and collections for genetic connectivity studies.



Figure 14. Black Burying Beetle, *Nicrophorus nigrita*, at UCSC FONR (credit: Abe Borke)

COMBINING HISTORICAL ECOLOGY WITH NEW TOOLS TO UNDERSTAND CLIMATE EFFECTS ON SPECIES DISTRIBUTIONS

Mary McElroy, Steve Gaines – University of California, Santa Barbara

One of the hidden dimensions of climate change is the effect it has on changing the natural distribution of species. Numerous long-term projects have mapped the geography of marine species along the California coast, including the Partnership for the Interdisciplinary Study of Coastal Oceans (PISCO) and the Multi-Agency Rocky Intertidal Network (MARINe). Our project will combine and compare environmental DNA-based biodiversity data with long-term monitoring data to answer fundamental questions about species range shifts under climate change with a focus on marine taxa with range edges around Pt. Conception. We will explore the potential of environmental DNA to provide a globally applicable template for assessing shifts in species distributions in marine ecosystems with higher resolution and at lower costs than conventional surveys.

CALIFORNIA CONSERVATION GENOMICS PROJECT

Alayna Mead – University of California, Los Angeles

The California Conservation Genomics Project will be collecting genetic data on about 200 species across the state in order to inform conservation policy. This project will help in understanding the genetic diversity of these species and prioritize regions for conservation. Our group will be collecting several

widespread tree species and a lichen species. We will sequence individuals from across the species range and analyze how genetic diversity varies by location and climate.

CALIFORNIA NATIVE PLANT SOCIETY - RARE PLANT TREASURE HUNT

Amy Patten – California Native Plant Society



We are supporting rare plant conservation efforts throughout California by mapping new occurrences of rare species, updating historical occurrences, conserving the genetic structure of rare species through ex-situ seed banking and documenting post-fire recovery in burn areas. RPTHs also train and empower volunteers in playing an active role in conservation as citizen scientists.

Figure 15. State and federally listed species
– Sand Gilia, *Gilia tenuiflora* ssp. *arenaria*

TRANSMISSION DYNAMICS OF TICK-BORNE PATHOGENS ACROSS A LATITUDINAL GRADIENT

Samantha Sambado – University of California, Santa Barbara

Tick-borne disease risk is variable throughout California yet can be predicted based on ecological factors such as temperature and vertebrate community structure. However, the degree of risk has been measured primarily based on one pathogen, *Borrelia burgdorferi* (Bb), which causes Lyme disease. Based on preliminary data from Northern California, disease risk for Bb is less than the risk for an emerging tick-borne pathogen, *Borrelia miyamotoi* (Bm), which causes Tick-borne relapsing fever. This project will investigate both pathogens' responses to ecological factors such as tick abundances, tick seasonality, and abiotic factors such as temperature, relative humidity and precipitation to infer these differences. Ecological factors contributing to pathogen persistence and distribution will be analyzed with a mathematical model that will be parameterized by empirical data. This information will be used to build a frame work for pathogen maintenance under a changing climate and inform public health measures about where tick-borne disease risk is present.



Figure 16. Black Legged tick
in the grasslands at UCSC
FONR

POPULATION GENOMICS OF A FOUNDATIONAL CALIFORNIA NATIVE PLANT, *ACMISPON STRIGOSUS*

Lorena Torres-Martinez – University of California, Riverside



Figure 17. *Acmispon strigosus* is a tiny member of the pea family

Terrestrial habitat in California is increasingly at a nexus of remaining wilderness, wild land conversion, and intensified use brought about by rapid economic development and human population growth. These land use changes – coupled with rapid changes in climate – affect air and water quality, community composition, and at local scales alter population connectivity, and genetic variation within and among populations. Decisions on what land to focus on for preservation, and where to attempt habitat recovery must be informed by the ability of species to adapt to projected changes in habitat quality, quantity, and connectiveness. Here, we propose to analyze the population genomics of the widespread annual herb *Acmispon strigosus* (formerly *Lotus strigosus*; Fabaceae), a near-ideal model to examine population

and conservation genomics questions in California. We will i) investigate how land use changes alter genetic diversity and break down corridors of gene flow among *A. strigosus* populations, potentially promoting shifts to a self-mating system that would further erode genetic diversity, and ii) uncover genome evolution in *A. strigosus* in response to environmental changes, in particular modifications related to growth habit, soil nutrient metabolism, and symbiosis function driven by climate change and nitrogen deposition.

PRELIMINARY SURVEYS OF ABIOTIC FACTORS INFLUENCING ABOVEGROUND FUNGAL INFECTIONS ON CENTRAL CALIFORNIA MARITIME CHAPARRAL MANZANITAS

Jon Detka – University of California, Santa Cruz

UCSC Environmental Studies Gilbert Lab student Jon Detka's research is focused on exploring the influence of reduced summer marine fog exposure and drought-stress on aboveground fungal disease dieback and mortality in maritime chaparral shrubs (*Arctostaphylos*: Ericaceae). A rapidly changing global climate is likely to increase the prevalence of drought conditions and reduce the duration and geographic extent of summer maritime fog conditions along the Central California Coast. *Arctostaphylos* spp. are the most diverse group of endemic species in California maritime chaparral and increased drought stress coupled with reduced wetting associated with summer maritime fog conditions could increase the susceptibility of *Arctostaphylos* spp. to necrotrophic foliar fungal diseases and decrease the prevalence of biotrophic foliar fungal diseases. Increased disease mortality associated with necrotrophic foliar fungi among *Arctostaphylos* spp. has several potentially important conservation implications as efforts shift to conserving communities with high



Figure 18. Researchers using a low elevation drone flight to assess vegetation health in maritime chaparral.

species endemism. Conservationists and restorationists will be better equipped to accommodate changes in range dynamics of these species given increased understanding of their reliance on fog and its relation to changes in foliar disease prevalence.

LONG-TERM RESEARCH EXAMINING THE ECOLOGY OF FLORA AND FAUNA IN MARITIME CHAPARRAL

UC Santa Cruz faculty member Dr. Laurel Fox has been working on the ecology and conservation of maritime chaparral for nearly three decades. Her work has resulted in a variety of important publications that are providing insight into life history of rare species and factors that influence the abundance and distribution of species throughout the region. This past year she supported several undergraduate researchers who are assisting with a variety of projects examining plant demographics and the impact herbivores have on structuring communities. UCSC FONR interns assist Dr. Laurel Fox in field data collection.

TAXONOMY AND HABITAT ASSOCIATIONS OF THE MONTEREY ORNATE SHREW

Dr. Jennifer Duggan – California State University Monterey Bay

The Monterey ornate shrew (*Sorex ornatus salarius*) is listed as a California species of special concern. However, recent capture data at the University of California's Fort Ord Natural Reserve and the Fort Ord Natural Monument suggests that the shrew may occur in a greater variety of habitats, and in larger numbers, than previously thought. While surveys for *S. o. salarius* are necessary to improve understanding of its taxonomy, habitat preferences, and population densities, shrews are typically cryptic animals that can be difficult to detect and/or capture. Determining an effective method for sampling these cryptic animals will be a crucial first step in designing cost-effective and informative studies that minimize harm. The project uses genetic analyses to assess if shrews found across multiple habitat types (i.e., riparian and dry upland habitat) in Santa Cruz and Monterey counties belong to one wide ranging subspecies (i.e., *S. o. salarius*). Surveys conducted to collect tissue samples (i.e., tail clips) will also allow an assessment of the habitat associations of *S. o. salarius*. This information may be useful in determining if the state listing status of this rarely studied subspecies is currently warranted. Surveys collect



presence/absence data for *S. ornatus* over an area much more extensive than that sampled using livetrapping methods. These presence/absence data would be combined with site-specific (e.g., vegetation, soil, topography) and survey-specific (e.g., temperature, precipitation) data to construct a predictive habitat model for *S. o. salarius* using occupancy estimation methods. In addition, presence-absence data, as well as any site-specific abundance data collected during livetrapping, would be used to establish a baseline dataset on which future monitoring of *S. o. salarius* could build.

Figure 19. Shrews may be encountered in pitfall trap arrays at FONR

HABITAT USE, ACTIVITY PATTERNS, AND THERMAL PREFERENCE OF *PHRYNOSOMA BLAINVILLII* (COAST HORNED LIZARD)

Phrynosoma blainvillii are listed as a species of special concern in California with a known population on Fort Ord Natural Reserve land. This species ranges from the southern end of the Baja California peninsula to northern central California, west of the deserts and the Sierra Nevada. As an ectotherm, a certain range of environmental temperatures are important for allowing movement; the location of FONR is of *P. blainvillii*'s most northern coastal range, allowing for cooler temperatures, making the species presence here of interest. This study focuses on observing the daily and seasonal activity patterns, habitat use, and thermal preference of horned lizards at FONR. Observations are taken along a determined transect incorporating the various habitats present using ArcGIS to spatially locate each observation.

With little ecological data collected on *P. blainvillii*, this study will help fill a gap in our knowledge about this species' behavior relate to habitat and weather conditions. FONR can also use the results of this study as a foundation for further student research.

Reserve staff are working on a project that is establishing a long-term mark-recapture survey to monitor *Phrynosoma blainvillii*. Staff are collecting life history and habitat use information on this rare species as well as establishing a long-term monitoring program for the reserve. This research involves the PIT (passive integrated transponder) tagging of horned lizards which reside along a study transect will be monitored long term.



Figure 20. *Phrynosoma* and a backdrop of sky lupine at UCSC FONR.

LONG TERM BAT MONITORING



Bethany Schulze is a CSU Monterey Bay graduate student working on bats along the central coast. At Fort Ord, she is conducting year-round monitoring efforts using bat acoustic data loggers. This information provides data on bat use throughout the year and is providing insight into the temporal shift in bat activity and species composition at the reserve.

Figure 21. Bethany Schulze presents bat monitoring methods to a UC Santa Cruz ENVS 104 - Introduction To Field Methods class

FLORA AND FAUNA MONITORING

FONR staff and undergraduate interns from both UC Santa Cruz and CSU Monterey Bay monitor 600-acre UCSC Fort Ord Natural Reserve land. These efforts accomplish critical baseline monitoring of the reserve and, importantly, engage students in a wide range of research and stewardship techniques that teach them important skillsets. Activities include photo point surveys, herpetology cover board surveys, wildlife camera surveys, pitfall trap surveys, endangered plant monitoring, and the establishment of long-term chaparral vegetation monitoring plots.



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Figure 22. A UCSC Environmental Studies Intern installs a game camera at FONR

COASTAL FOG MONITORING

Dr. Daniel Fernandez – California State University Monterey Bay

Dr. Daniel Fernandez (CSUMB) continues to conduct his long-term monitoring of coastal fog at stations on the reserve. Fog is a significant source of summer water for many of the plants that occur along the central coast. His work is providing important information on how fog patterns are changing from year to year. In 2019 with the assistance of numerous UCSC and CSUMB undergraduate and graduate students, UCSC FONR staff built an additional 8 collectors that are placed on a coast to inland gradient. The stations will be monitored long term to help inform research regarding climate patterns and efficiency of fog collection for use.

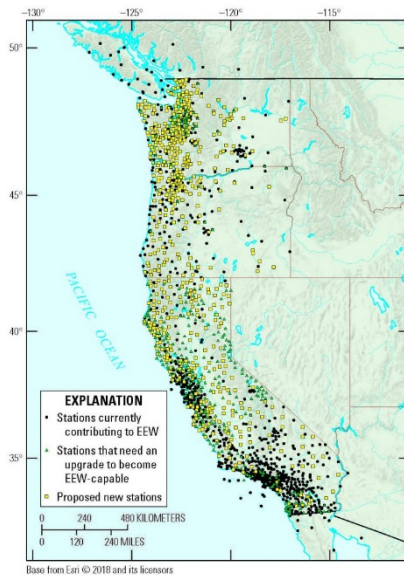


Figure 23. Three 1-meter fog collectors arranged in a transect up a slope in rare maritime chaparral habitat at FONR.

ARCTOSTAPHYLOS SEED BANKS AND ANIMAL FORAGING

Dr. Tom Parker – San Francisco State University

Dr. Tom Parker is studying a variety of abiotic and biotic factors that influence the distribution of Manzanita throughout the state. His work at Fort Ord is focused on quantifying seed banks of *Arctostaphylos pumila* and *A. tomentosa* and how density of seeds in the soil influence foraging effort of small mammals.



SEISMIC MONITORING AND SHAKEALERT EARTHQUAKE EARLY WARNING SYSTEM

University of California, Berkeley

Today, the technology exists to detect earthquakes so quickly that an alert can reach millions of people before strong shaking arrives. The UC Berkeley and its partners operating California's seismic network, CISN, are developing and implementing the ShakeAlert earthquake early warning system to identify and characterize an earthquake within few seconds after it begins. We quickly calculate the expected intensity of ground shaking, and can send warnings to people and infrastructure in harms way.

To reliably distribute warnings for all parts of the State with high earthquake hazard, it is important to have a robustly operating, dense network of seismic stations capable of providing data that can be used in ShakeAlert. The blue dots on the adjacent map are the

stations contributing to ShakeAlert now. Particularly in Northern California, more sites are needed (green triangles, yellow squares). UC Berkeley and CISN partners are looking for locations where we can install new earthquake monitoring stations. UCSC Fort Ord Natural Reserve's station went online in Summer 2019. In addition to contributing to ShakeAlert, the new stations will also support the mission of the CISN, to operate a reliable, modern, statewide system for producing earthquake information for the benefit of public safety, emergency response, and loss mitigation.

PUBLIC SERVICE AND HIGHLIGHTS

REMOTE LEARNING

In 2020-2021, reserve staff had great opportunities to create remote learning tools. One example of how an existing partnership was used to produce such material was when the reserve director was able to



Telemetry Module

work with Mammalogy professor Jennifer Duggan, from CSU Monterey Bay, to create multiple videos that help teach about the techniques that are used by field scientists. Professor Duggan is a frequent collaborator and brings many class sections to the reserve in normal years. So it was an easy transition to film a field trip, Now for years to come we can use these tools to teach remotely, classes from outside the area are already planning to use these in the coming school term.



UCSC FONR Small Mammal Trapping Field Trip with Dr. Jenny Duggan

Figures 24 and 25. Video stills from productions created to help with remote learning in 2020-2021

USFWS SMITHS BLUE BUTTERFLY HABITAT ASSESSMENT



Figure 26. FONR Director Joe Miller, with CSU Monterey Bay student Alicia Khoun and UCSC Student Alleene Roemer, surveying Smith's blue butterfly habitat at Marina Dunes State Park.

Smith's blue butterfly, *Euphilotes enoptes smithi*, is a federally listed endangered subspecies of *Euphilotes enoptes* occurs along the Central Coast of California, between far northern San Luis Obispo county and the Salinas river in Monterey. The species spends its entire life cycle within meters of two species of native buckwheat host plants, *Eriogonum latifolium* and *Eriogonum parvifolium*. Currently, there is a gap in the knowledge about where the butterfly still exists, and the current condition of suitable habitat within its range.

In Spring and Summer of 2021, with grant support from US Fish and Wildlife Ventura Office, UCSC Natural Reserve Director Gage Dayton and UCSC Fort Ord Natural Reserve Director Joe Miller supervised 3 undergraduate interns who travelled to all known occurrence locations for Smith's blue butterfly. These students completed buckwheat habitat assessments of more than 250 plots



Figure 27. Smith's Blue Butterfly, *Euphilotes enoptes smithi*

near official reports that were sourced from the California Natural Diversity Data Base (CNDDDB) over an 11 week period. While the focus of the survey was on plants, the group also recorded many additional butterfly sightings for the official record. An additional number of locations were sourced from a backlog of sightings that were found in reports not yet submitted to the CNDDDB record.



This work was an important first step in creating baseline data for an update on the status of this federally endangered species, and a great experience for the interns to work independently across a large area of the central California coast!

Figure 28. Patrick Lee photographing butterflies at Palo Corona Regional Park

SONJA PINCK – CITIZEN SCIENCE COMIC

CSU Monterey Bay Scientific Illustration student Sonja Pinck was an intern for UCSC FONR in 2020. Soja is the third intern that has worked on important art projects for the reserve. Working with the reserve director she created a project to highlight the ways in which citizen science helps to inform land managers and researchers. This project told the true story of a rare scorpion, and it's rediscovery on UCSC FONR. The piece highlights California Academy of Science's iNaturalist application, and was shared with that agency as well as published on social media and the UCSC FONR website. We have included the comic below for your enjoyment!



Figure 29. Illustration of *Paruoctonus maritimus* by Sonja Pinck, highlighting an exoskeleton reflection of ultraviolet light.

CITIZEN SCIENCE

IN ACTION AT UC SANTA CRUZ FORT ORD NATURAL RESERVE

A story about a scorpion, a scorpion specialist, and iNaturalist!

Comic illustrated by Sonja Pinck of Pink Fig Studios



One day while out checking coverboards for reptiles and amphibians, a Fort Ord Natural Reserve Steward was surprised by a creature he had never seen before!

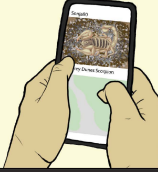


It was a scorpion, but what kind?

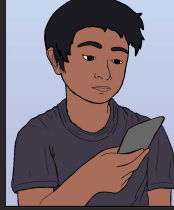


He had never seen one just like this, and there were markings on the carapace (just behind the eyes) that looked like something new...

Reserve staff always turns to iNaturalist in times like these! iNaturalist is a website and app that helps identify plants and animals, and is a community of over a million scientists and naturalists who can help you learn more about nature!



Meanwhile on iNaturalist, a scorpion specialist named Prakrit was on the case!



"Distinguished from *P silvestrii* by pigment pattern of mesosomal terga not extending to posterior margin of terga..." - Stan Williams

so this should be *Paruroctonus maritimus*. New locality, as far as I can tell. Very interesting!"

Prakrit thinks we have found a rare species named *Paruroctonus maritimus*, otherwise known as the Monterey Dunes Scorpion!

Back at the UCSC Fort Ord Natural Reserve office, the Reserve Manager is super excited! Plans are made to get more information about the scorpion, and make an official collection and description for the natural history museum. It seems they have found something that has never been described at the reserve!



Citizen Science is a very cool tool, where the community can help with conservation and knowledge about what lives in our special open spaces. Thanks to iNaturalist and Prakrit, UC Santa Cruz Fort Ord Natural Reserve has a new species to look out for and protect!



Scorpion Fun Facts

- There are over 1750 known species of scorpion found on all continents except Antarctica.
- Only about 25 species have venom capable of killing a human.
- Scorpions can eat a massive amount of food in one meal. Their large food storage organs combined with a low metabolism rate and an inactive lifestyle means that, if necessary, they can survive 6-12 months without eating.
- Scorpions are nocturnal. Under UV light, such as a black light, scorpions glow due to the presence of fluorescent chemicals in their exoskeleton, which may be an adaptation that helps a scorpion know when it is exposed to predators.



iNaturalist



Science Illustration Program



California State University
MONTEREY BAY
College of Extended Education
& College of Science

RESERVE USE

TABLE 2. NGO, GOVERNMENTAL, K-12, AND AFFILIATED USER GROUPS

Bureau of Land Management	UC Genomics Consortium	University of California Agriculture and Natural Resources
California Department of Fish and Wildlife	California Native Plant Society	CSUMB Return of the Natives
UC Santa Cruz Arboretum	UCSC Kenneth Norris Center for Natural History	California Academy of Sciences
CSUMB Sciences Internship Program	CSUMB Service Learning Institute	UCSC Environmental Studies Internship Office
Cabrillo College	The Monterey Bay Drone, Automation, and Robotics Technology (DART)	UC Monterey Bay Education, Science and Technology Center (MBEST)
US Department of Fish and Wildlife	Monterey Bay Tracking Club	Scouts BSA

APPENDICES

APPENDIX 1. USE DATA FOR FY 2020-2021

RESERVE USE DATA Fiscal year: 2020-2021

Campus: University of California, Santa Cruz
 Reserve: Fort Ord Natural Reserve

	UC Home		UC Other		CSU System		CA Comm College		Other CA College		Out of State College		International University		Government		NGO/Non-Profit		Business Entity		K-12 School		Other		Total		
	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	Users	UDs	
UNIVERSITY- LEVEL RESEARCH																											
Staff	3	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	21
Faculty	2	14	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	4	25
Research Scientist/Post Doc	0	0	2	6	0	0	0	0	0	0	0	0	0	0	0	0	3	15	0	0	0	0	0	0	0	5	21
Research Assistant (non-student/faculty/postdoc)	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
Graduate Student	4	72	10	37	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	110
Undergraduate Student	2	20	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	21
Professional	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	0	0	0	0	0	0	0	0	3	15
Volunteer	0	0	1	7	2	20	0	0	0	0	0	0	0	0	0	2	6	0	0	0	0	0	2	20	7	53	
SUBTOTAL	13	131	15	54	4	22	0	0	0	0	0	0	0	0	0	6	32	0	0	0	0	0	3	30	41	269	
UNIVERSITY - LEVEL INSTRUCTION (CLASS)																											
Faculty	4	27	0	0	2	14	0	0	1	5	0	0	0	0	23	23	0	0	0	0	0	0	0	0	0	30	69
Graduate Student	1	1	0	0	0	0	0	0	0	0	0	0	0	0	16	16	0	0	0	0	0	0	0	0	0	17	17
Undergraduate Student	28	100	54	351	36	174	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	625
Other	4	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	30	34	67
SUBTOTAL	37	165	54	351	38	188	0	0	1	5	0	0	0	0	39	39	0	0	0	0	0	0	0	30	30	199	778
OTHER																											
Undergraduate Student	4	10	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	15
Professional	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	2	6	3	9
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	120	0	0	0	0	0	0	9	18	15	138	
Volunteer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	2
SUBTOTAL	4	10	1	5	0	0	0	0	0	0	0	0	0	0	6	120	2	5	0	0	0	0	11	24	24	164	
HOUSING																											
TOTALS	54	306	70	410	42	210	0	0	1	5	0	0	0	0	45	159	8	37	0	0	0	0	44	84	264	1211	

APPENDIX 2. PUBLICATIONS

Beltran, R. S., Marnocha, E., Race, A., Croll, D. A., Dayton, G. H., & Zavaleta, E. S. (2020). Field courses narrow demographic achievement gaps in ecology and evolutionary biology. *Ecology and Evolution*.

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- Ryan, E. M., & Cleland, E. E. (2021). Clinal variation in phenological traits and fitness responses to drought across the native range of California poppy. *Climate Change Ecology*, *2*, 100021. <https://doi.org/10.1016/j.ecochg.2021.100021>
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APPENDIX 3. UCSC NATURAL RESERVE COMMITTEE AND CHARGE

University of California Santa Cruz
2020-2021 NATURAL RESERVES ADVISORY COMMITTEE

CHARGE

The committee provides oversight of on- and off-campus natural reserves of instructional and research interest. It is responsible for developing program vision and policy for the management and use of the UCSC Campus Reserve and of the four UC Natural Reserves System holdings: Año Nuevo Island Reserve, Landels-Hill Big Creek Reserve, Younger Lagoon Reserve and Fort Ord Reserve. The committee coordinates with the Universitywide NRS Advisory Committee that advises on policy for all

NRS reserves. In addition to the chair (Faculty Director), the committee is comprised of faculty advisors to each reserve, one faculty representative at large, one non-senate academic appointment, one staff representative, two graduate student representatives, two undergraduate student representatives, and ad hoc faculty members as needs arise. The Faculty Director, in consultation with the Dean and the Administrative Director of the UCSC Natural Reserves, appoints the committee. Membership terms begin September 1 unless otherwise specified.

DURATION OF APPOINTMENTS

Faculty Director: 5 years

Faculty Advisors: 3 years

Non-Senate Academic, Staff, and Student Representatives: 1 year

Members may be reappointed at the discretion of the Faculty Director in consultation with the Administrative Director.

Hours/Quarter: Chair/NRS Representative-20, Members-10 Reports to: Division of Physical & Biological Sciences Dean

COMMITTEE MEMBERSHIP

Faculty Director of the Natural Reserve System

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Natural Reserve System

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