



University of California
Fort Ord Natural Reserve
2021-2022 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 2021-2022. FONR is a 600 acre reserve that protects maritime chaparral, coastal scrub, grassland, and oak woodland habitats 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.



Figure 1 CSUMB undergrads Miranda Quevedo, Aleah Adame, Summer Alinaeem worked together with Renske Kirchholtes (UCSC California Ecology and Conservation instructor) on a mammal survey 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 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 Monterey gilia, state-endangered seaside bird's beak, and the federally threatened Monterey spineflower).

In the past year we offered multiple internship opportunities; monitoring flora and fauna across the reserve while teaching vital natural science fieldworks skills. 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 Environmental Studies undergraduate Maia Perry completed a research project related to exploring

2021-2022 was a successful year on the reserve, and we were able to see reserve use increase to exceed pre pandemic visitation numbers from research and educational users. Reserve activity is under the supervision of UCSC Reserves Administrative Director and FONR Director Joe Miller. Restoration Assistant Annie Allenbaugh, donor funded student employees Sarah Layer and Ruby Montgomery, and multiple UC and CSU interns and volunteers contributed to work on the reserve as well.



Figure 2 *Gilia tenuiflora* ssp. *arenaria*, Monterey Gilia

unidentified lichens on the reserve. Reserve staff has helped to organize and manage field crews to assist UCSC Professor Laurel Fox research on reserve wide vegetation plots. Multiple CSU Monterey Bay students worked with reserve staff to complete mammalogy research projects in collaboration with CSUMB Undergraduate Research Opportunities Center. UCSC Environmental Studies PhD Candidate Jon Detka worked to understand the relationships between maritime chaparral plants and native fungal pathogens. These and many more independent and class-based research projects were assisted by the Director in 2021-2022.



Figure 3 A young visitor discovers a shrew specimen at a pre-k through 1st grade field trip.

FONR was able to re-start Nature Detectives, which is a program that provides nature reserve visits each Spring to all three City of Marina elementary schools, in which every Pre-K, Kindergarten and 1st grader gets an opportunity to learn about the amazing biological diversity at their local nature reserve. This program is very popular with students, parents, and teachers. We are so fortunate that this donor supported program is back!

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 prevention, illegal camping abatement, invasive plant monitoring, state mandated reporting, and



Figure 4 UCSC Undergraduate Elijah Muller showing strength through rare plant propagation in a UCSC rooftop greenhouse

and rare plant restoration work to mitigate for future University of California development projects on these lands that were acquired by UCSC upon army base closure. UCSC Greenhouses have been a generous partner in this restoration work. Staff also continued to assist Army contractors with access for continued environmental cleanup onsite.

FONR staff included 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. The following report highlights these and additional efforts.

EDUCATION



Figure 5 UCSC Natural History of Fungi class learns about lichens from Norris Center for Natural History affiliate Ken Kellman, and UCSC FONR Intern Maia Perry. The class had a great overnight trip to UCSC FONR, led by naturalist and fungi expert Christian Schwarz.

CLASS VISITS



Figure 6 Results of a fungal foray at the UCSC FONR outdoor classroom

Instructional use at FONR has reached its highest level in 2021-2022. Staff supports a variety of class visits that span multiple disciplines. Reserve staff met regularly with classes to help support and develop teaching activities, interpret and identify flora and fauna, and help with student research projects. FONR is roughly 45 minutes from the UCSC campus, minutes away from CSU Monterey Bay, and within about an hour of several other higher education institutions in the greater Bay Area. The site has become a favorite location for classes due to ease of access to a field student site, as well as no cost overnight

accommodations for classes at the outdoor classroom and campsite. Represented classes included a wide variety of disciplines including biology, ecology, environmental studies, earth sciences, and art from multiple institutions and including several UC's, CSUs, and Community Colleges (Table 1).

TABLE 1. FORT ORD NATURAL RESERVE CLASS USE – FY2021-22

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	Sean Reilly
BIOE 82: Introduction to Field Research and Conservation	University of California Santa Cruz	Sean Reilly, Gage Dayton, Allison Gong, Kristen Heady, Andy Kulikowski, Ingrid Parker
ENVS 19: Natural History of Fungi	University of California Santa Cruz	Christian Schwarz
UCNRS California Ecology and Conservation	Multiple University of California Campuses	Tim Miller
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
BIO 364: Mammalogy	California State University Monterey Bay	Jenny Duggan
BIO 320: Microbiology	California State University Monterey Bay	Jenny Duggan
BIO 340: Ecology	California State University Monterey Bay	Gerick Bergsma

ENVS 464: Wildlife Management and Conservation	California State University Monterey Bay	Jenny Duggan
SL 95-500: CSUMB Service Learning	California State University Monterey Bay	Joe Miller
ENVS 189: Coastal Field Studies	San Jose State University	Rachel Lazzeri-Aerts
BOT 433: Field Botany – CA Plant Diversity	California Polytechnic State University, San Luis Obispo	Jenn Yost
Monterey Naval Postgraduate School		
SE 3201: UAS Systems Engineering	Monterey Naval Postgraduate School	Oleg Yakimienko
Community College		
Biology 11C: Ecology	Cabrillo College	Allison Gong
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



Figure 8 UCSC FONR Intern and CSU Monterey Bay student Elise Vasquez meets a Heerman's Kangaroo Rat on the grasslands of FONR



Figure 7 Gwyneth Merryman (UCSC) and Elise Vasquez (CSUMB) work together on pitfall trap monitoring for amphibians in oak woodland

Multiple undergraduate research projects were supported by UCSC FONR staff in 2021-2022. Students from UCSC and CSUMB worked on research including but not limited to herpetology, mammalogy, plant disease ecology, unmanned aerial systems (UAS) mapping, community ecology research, and entomology. 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 9 FONR Interns Daniela Martinez, Ruby Montgomery, and Elise Vasquez speak to 1st grade students from Marina, CA

INTERNSHIPS, VOLUNTEER POSITIONS, AND SERVICE LEARNING

In 2021-2022 FONR staff hosted multiple volunteer and internship positions that served over 40 participants from UCSC, CSU Monterey Bay, and the general community. Interns were involved in a wide variety of stewardship, ecology, public service, research installations, rare plant restoration, and outdoor education. 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, reptile and amphibian monitoring, small mammal trapping, avian point counts, working with k-12 and public outreach efforts, and faculty research projects. Interns were also able to make connections and learn from the larger



Figure 10 FONR internships involve everything from light construction to botany: FONR staff works hard to provide skills useful for land stewardship and natural science professions.

conservation community through a variety of 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.

RESEARCH AND MONITORING



Figure 11 FONR student staff member Ruby Montgomery collects rare plant location data for yearly seaside birdsbeak (*Cordylanthus rigidus* ssp *litoralis*) monitoring.

CURRENT RESEARCH – FY 2021-22

FONR was established to preserve educational and research access to unique and rare flora and fauna that occur throughout the reserve. Faculty and graduate students from multiple institutions use the reserve for research. Below we provide a short overview of some of the ongoing research projects on the reserve during the past year.

SMITH'S BLUE BUTTERFLY HABITAT SURVEYS

Joe Miller, Aileene Roemer, Alicia Khoun, and Patrick Lee – Fort Ord Natural Reserve



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 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.

The Macrolichens Of A Single Oak



Figure 12 Lichen illustration by Maia Perry, UCSC FONR Intern

Maia Perry And Ken Kellman – University of California, Santa Cruz

UC Santa Cruz Norris Center affiliate Ken Kellman and Undergraduate Maia Perry have taken on the sampling and identification of all lichens that grow on an individual Coast Live Oak at Fort Ord Natural Reserve. The work served as a start to cataloging lichens at the reserve, and Mr. Kellman's mentorship was an exceptional training opportunity for a Fort Ord Natural Reserve undergraduate intern. Maia is working on completing a field guide with illustrations of the findings, to be made available for reserve visitors upon completion.

SHREW DETECTION RESEARCH

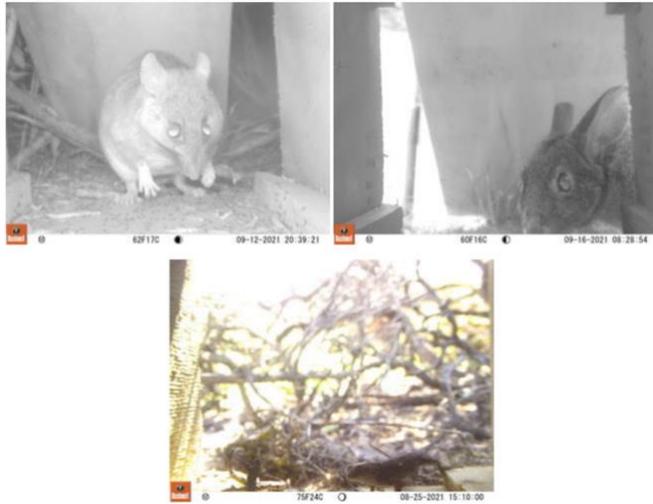


Figure 13 Images from a modified game camera used in Molly Lane's research

Molly Lane – University of California, Santa Cruz

Wildlife cameras can offer a variety of information, including demographic makeups, species distributions, and general activity and behaviors. Traditional use of cameras has been for large mammals, however, using cameras for small mammal monitoring has increased in the last

several years. In order to compensate for the size needed to trigger the infrared sensor and to detect a species with a high metabolism, I developed an open boxed camera trap for small mammals. This work produced a novel horizontal camera trap used to detect the distribution of the Monterey ornate shrew (*Sorex ornatus salarius*). The trap model at Fort Ord Natural Reserve in Marina, CA over four sessions in August and September 2021. The traps did not catch any shrews, however other small mammals were captured, demonstrating potential applications of these camera traps.

NORTH-COASTAL HANTAVIRUS SURVEILLANCE

Christopher Kilonzo, Tina Feiszli, Megan Saunders, and Christian Irian - California Department of Public Health

As part of the Vector-Borne Disease Section of the California Department of Public Health, we conduct environmental surveillance for zoonotic diseases transmitted by arthropod and rodent vectors. Hantavirus Pulmonary Syndrome (HPS) is the most important rodent-borne disease in California with 87 human cases reported between 1980 and 2019. In California, exposure to hantavirus has mostly been reported following exposure to high elevation rural areas in the Sierra Nevada mountain range. As follow up to a human hantavirus case in a Santa Cruz county resident, who lived and worked in coastal scrub habitat, we are interested in expanding our surveillance to better understand risk of hantavirus exposure in north-coastal California. Fort Ord Natural Reserve is the ideal habitat to conduct surveillance (trapping of deer mice with live Sherman traps, taking a blood sample, releasing animals at the site they were trapped, and testing the blood sample for both viral RNA and antibodies to hantaviruses).

SAMPLING POTATO PSYLLID AND SOLANUM SPP. FOR CANDIDATUS LIBERIBACTER SOLANACERUM

Jaimie Kenney, Kerry Mauck and Savana Becerra – University of California, Riverside

The bacteria *Candidatus Liberibacter* includes several emerging bacterial pathogens of southern California crops, such as the causal agent of Zebra Chip Disease of Potato, *Candidatus Liberibacter psyllauros* (a.k.a. *Ca. L. solanacearum*). Many of these bacteria are known to be transmitted by psyllids, small, sap-sucking insects common as agricultural pests. However, little is known about the ecology and evolutionary history of either *Ca. L.*

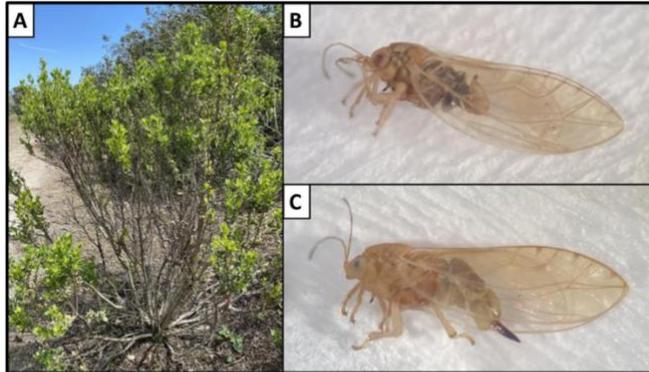


Figure 1: A) Coyote brush (*Baccharis pilularis*) from which we collected psyllids at Fort Ord Reserve in April 2022. **B)** Male *Calinda longistylus* psyllid collected at Fort Ord Reserve. **C)** Female *Calinda longistylus* psyllid collected at Fort Ord Reserve.

psyllauros or its psyllid vector, *Bactericera cockerelli*. Our lab group recently found *Ca. Liberibacter psyllauros* in herbarium specimens of native *Solanum* spp. that were collected up to 49 years ago, decades before *Ca. L. psyllauros* was first recorded in crops in the region. The aim of this project is to discern the historic distribution of this pathogen in native *Solanum* by sampling herbarium specimens from across the western United states, as well as elucidating its evolutionary history and present-day prevalence in native *Solanum* and psyllid vectors by collecting fresh tissue samples for DNA extraction and sequencing.

INFLUENCE OF PLANT PATHOGENS AND HERBIVORY ON SHRUB RECRUITMENT IN CALIFORNIA MANZANITA DIEBACK

Jon Detka and Laurel Fox – University of California, Santa Cruz



Figure 14 Undergraduate students measure transects in chaparral at FONR

Plant pathogens and herbivory can create important disturbances in forest and shrub communities where they kill or cause canopy dieback of structurally important plant species. Here I propose an experiment to measure interactions between the effects of plant diseases and mammalian herbivores on shrub seedling recruitment in maritime chaparral manzanita dieback gaps. Disturbance events like fire, storms, drought, and landslides shape the composition and diversity of

plant communities through effects on resource availability, abiotic conditions, trophic interactions, and microbial communities. Plant pathogens and herbivores can create important disturbances in forest and shrub communities where they kill or cause canopy dieback of structurally important plant species. Pathogens and herbivores are known to drive succession and maintain diversity in grassland and forest communities, but it remains if the same occurs in shrublands. Such natural enemies may be especially important disturbance agents during long fire-free periods in fire-prone shrublands, when dense vegetation, dominated by a limited number of structural species, may favor enemy outbreaks. While disease outbreaks have been documented in southern and inland chaparral systems⁶, there are no studies on the impacts of foliar pathogens in key coastal chaparral shrubs during the fire-free phase. Only one known published field study has investigated the role of fungal pathogens in chaparral shrub species, following claims made by Riggan et al. (1994) that dieback patterns in several species of wildland chaparral shrubs could be explained by episodic changes in abiotic conditions coupled with pathogen-induced branch dieback. Study will test the hypothesis that shrubs growing inside patches of dieback are more susceptible to herbivores or fungal pathogens than shrubs growing outside dieback patches. *Ericameria ericoides* is used as a test species given its prevalence at the field site, profuse airborne seeds that disperse into gaps, tendency to germinate readily in the field, and susceptibility to browsing by common vertebrate herbivores⁹. And yet, *E. ericoides* is rarely found in dieback patches. To test this hypothesis, the study will measure rates of herbivory and disease on *E. ericoides* seedlings planted in gaps that are either products of manzanita disease dieback or are not associated with disease dieback.

RIPARIAN & WETLAND BLM-AIM SURVEYS

Peter Brommer – California Native Plant Society

A crew of 3 from CNPS collected data at 3 targeted sites in Fort Ord. This project is in collaboration with the Bureau of Land Management surveying wetland and riparian habitats across seven states in the Western US. They are looking to collect baseline data that represents the general health of these ecosystems and how management practices on these lands are affecting them.

AMPHIBIAN HABITAT ASSOCIATION SURVEYS

Joshua Beasley – CSU Monterey Bay

Amphibian road mortality is often a result of many environmental factors. By assessing habitat associations of different local amphibian species, predictions can be made about the likelihood of road mortality on roads adjacent to those habitats. Our project will conduct night surveys to collect GPS location data of encountered amphibians. Amphibian location data will then be compared with habitat types to assess the strength of species association with habitat type.

TESTING A PHYLOGENETIC TRAIT FRAMEWORK FOR SOIL MICROBIOMES

Jennifer Martiny, Alberto Barron Sandoval, and Claudia Weihe – University of California, Irvine

To determine the potential effects of climate change on microbial communities and their role in carbon cycling, we propose: To survey the diversity of microbial communities at 29 locations along the Californian

precipitation/temperature gradient using the UC Natural Reserve System, as the distribution of the reserves covers all of California's major ecosystem types. We will collect leaf litter samples for the purpose of isolating strains from the leaf litter. In addition, we will capture the whole communities using metagenomic shotgun sequencing from leaf litter and soil. With the observations, we will compare microbial communities across California and their differences depending on biogeography. We will also isolate strains from leaf litter from the different sites with the aim to capture *Curtobacterium* sp., as this will guide us to determine locations for further studies.

BRACHYPODIUM INVESTIGATION

Emma Aronson and Jon Botthoff – University of California Riverside

Invasive species can shift the composition of key soil microbial groups, thus creating novel soil microbial communities. To better understand the biological drivers of invasion, we studied plant microbial interactions in species of the *Brachypodium distachyon* complex, a model system for functional genomic studies of temperate grasses and bioenergy crops. While *Brachypodium hybridum* invasion in California is in an incipient stage, threatening natural and agricultural systems, its diploid progenitor species *B. distachyon* is not invasive in California.

I propose to investigate the root, soil, and rhizosphere bacterial composition of *Brachypodium hybridum* in both its native and invaded range, and of *B. distachyon* in the native range. I propose to use high-throughput, amplicon sequencing to evaluate if the bacteria associated with these plants differ, and whether biotic controls may be driving *B. hybridum* invasion. These associated plant microbiomes could inform future management approaches for *B. hybridum* in its invaded range and could be key to understanding, predicting, and preventing future plant invasions.

ANALYZING SMALL MAMMAL HABITAT CHOICE AT UCSC FORT ORD NATURAL RESERVE – CSUMB UNDERGRADUATE RESEARCH OPPORTUNITIES CENTER



Summer Alinaeem – CSU Monterey Bay

CSUMB undergraduate researcher Summer Alinaeem studied small mammal diversity and distribution across reserve parcels on UCSC Fort Ord Natural Reserve. Trapping was done in all represented habitat types, and the work revealed important habitat data that will contribute to management decisions by FONR staff.

Figure 15 Summer Alinaeem presents research at the CSUMB Spring 2022 research showcase.

CAL E DNA WILDFIRE RISK STUDY: PRE-FIRE SEASON SOIL SAMPLING

Staff are taking soil samples from sites in California that have recently experienced severe drought and/or are at high fire risk in anticipation of the 2022 fire season. The same sites will be sampled after fire season has ended. Environmental DNA from the samples will be analyzed when funding allows, with an aim to better understand how ecosystems recover from fire at a microbial level.

CALIFORNIA CONSERVATION GENOMICS PROJECT

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. The group will be collecting several widespread tree species and a lichen species. The group 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.

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

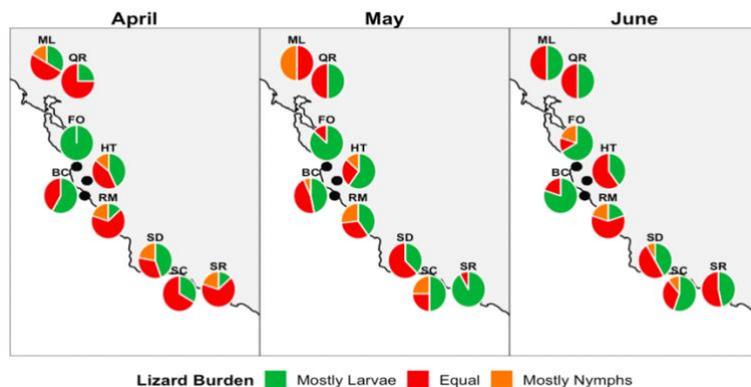


Figure 16 Fort Ord is a unique and important reserve when understanding the relative importance of co-feeding of juvenile ticks. Fort Ord, possibly due to its mild weather, has a later start to its tick season where larvae tend to be the only life stage in April and nymphs don't become as common until June

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 framework for pathogen maintenance under a changing climate and inform public health measures about where tick-borne disease risk is present.

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 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



Figure 17 Shrew specimens (*Sorex* spp.) from the UCSC FONR collection.

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.

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



Figure 18 *Phrynosoma blainvillii* basking in open dune habitat on UCSC FONR

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.

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.

GENERAL 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, small mammal monitoring, UAV mapping, and the establishment of long-term chaparral vegetation monitoring plots.



COASTAL FOG MONITORING

Dr. Daniel Fernandez – California State University Monterey Bay

Dr. 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.



FORT ORD NATURAL RESERVE ENTOMOLOGICAL SURVEY

Dustin Lofland and Jerry Wilson are working to identify invertebrate species across UCSC Fort Ord Natural Reserves using an extended array of trapping methods.

Figure 19 Velvet ant, *Dasyutilla californica*

CALIFORNIA LEPIDOPTERA SURVEY

California Academy of Sciences is working on this project as part of an ongoing collaborative project to survey and study the Lepidoptera of California, this project will serve to enhance our understanding of the moth fauna of the state.



Figure 20 Fresh specimens from a night of light trapping for moths

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.

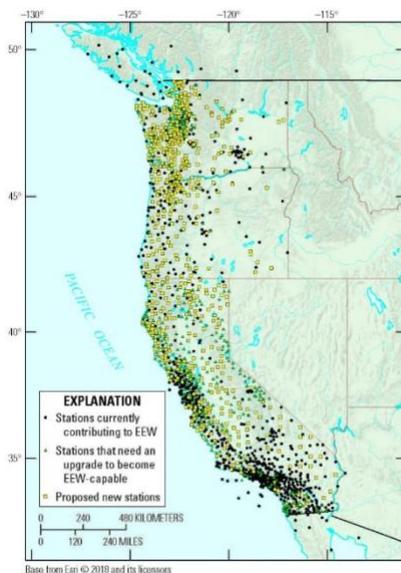
CNN-BASED CLASSIFICATION OF WOODY SHRUB SPECIES IN CALIFORNIA MARITIME CHAPARRAL USING HIGH-RESOLUTION UAV IMAGERY

Jon Detka – University of California, Santa Cruz

This work will provide valuable ground-truthing survey data of woody plant species cover across maritime chaparral dominated regions of the Fort Ord Natural Reserve as part of ongoing research to use drone technology and artificial intelligence to classify woody shrub species cover and understand the ecological role of plant diseases in California’s maritime chaparral shrublands.

SEISMIC MONITORING AND SHAKEALERT EARTHQUAKE EARLY WARNING SYSTEM

University of California, Berkeley Seismology Lab



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, CISEN, 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 CISEN 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 CISEN, to operate a reliable, modern, statewide system for producing earthquake information for the benefit of public safety, emergency response, and loss mitigation.



Figure 21 Marina Ca kindergarten students learn about UCSC Fort Ord Natural Reserve natural history from a CSUMB Watershed Institute Intern

CITY OF MARINA SCHOOLS – NATURE DETECTIVES K-1ST GRADE FIELD TRIPS



Figure 22 A student meets "Bandit" the California kingsnake

During the COVID 19 Pandemic, reserve use was sharply curtailed due to health safety measure, most notably it was unfortunate to cancel one of our most important missions, to reach K-1st grade students from Marina Ca elementary schools. With generous support from donors, were fortunate to be able to bring the program back this Spring of 2022.

In collaboration with CSUMB Return of the Natives (RON) program, FONR hosted several hundred kindergarten and first grade classes from Marina elementary schools. Staff and interns visited each classroom prior to field

trips in order to meet students and provide an overview of what they might expect to see at the reserve. In-class activities included an art project that helps university staff measure nature and science knowledge before and after the trip. Classes were then brought to the reserve by bus and parents of the students are also encouraged to attend. Once at the reserve, students are led on a short hike to visit stations where undergraduates teach them about a variety of natural history topics. Funding for busses is provided by the UCSC Reserves as public schools in Marina are financially challenged and transportation costs often present an unsurmountable hurdle for the schools. Kids learn about insects, mammals, reptiles, and birds from university students and reserve staff. For some of these students, this is their first exposure to a hands-on learning activity focused on science in the outdoors - their enthusiasm is infectious. Nature Detectives served approximately 600 elementary students and community members this year. This program was started in 2013 and we plan to continue the program next year. In addition to helping the public-school students, this event is a great way for university students to gain valuable teaching experience.



Figure 23 Reserve Director Joe Miller gives a safety talk, and introduces Marina, CA elementary students, teachers, and parents to Fort Ord Natural Reserve.

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
Clovis Unified School District	The Western Section of The Wildlife Society	Monterey Peninsula Unified School District
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	Santa Cruz Museum of Natural History	HomePlace, Monterey CA
CSUMB Undergraduate Research Opportunities Center (UROC)	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
United States Naval Postgraduate School	Department of Defense Base Realignment and Closure (BRAC)	US Army Reserve

APPENDICES

APPENDIX 1. USE DATA FOR FY 2020-2021

RESERVE USE DATA Fiscal year: 2021-2022

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	Users	UDs	
UNIVERSITY - LEVEL RESEARCH																													
Staff	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Faculty	2	35	1	4	1	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	55
Research Scientist/Post Doc	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	4	12	0	0	0	0	0	0	0	0	5	15
Research Assistant (non-student/faculty/postdoc)	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	5	18	0	0	0	0	0	0	0	0	7	23	
Graduate Student	1	17	4	6	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	31	
Undergraduate Student	17	167	0	0	17	192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	359	
Professional	3	3	0	0	0	0	0	0	0	0	0	0	0	0	28	104	6	17	0	0	0	0	0	2	2	39	126		
Volunteer	1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	42	17	52		
SUBTOTAL	23	236	8	18	19	216	0	0	0	0	0	0	0	0	28	104	15	47	0	0	0	0	0	18	44	113	665		
UNIVERSITY - LEVEL INSTRUCTION (CLASS)																													
Staff	4	8	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	11	
Faculty	8	16	0	0	5	75	2	4	1	20	0	0	0	0	13	88	0	0	0	0	0	0	0	0	0	0	29	203	
Research Scientist/Post Doc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0	0	0	0	0	0	0	0	0	6	6	
Research Assistant (non-student/faculty/postdoc)	1	3	0	0	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	5	10	0	0	13	25	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	22	39	
Undergraduate Student	216	545	26	26	425	861	20	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	687	1472	
Other	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25	27	27		
SUBTOTAL	236	584	29	29	443	961	22	44	1	20	0	0	0	0	23	98	0	0	0	0	0	0	0	25	25	779	1761		
OTHER																													
Staff	1	2	5	5	5	5	0	0	0	0	0	0	0	0	2	2	0	0	8	18	0	0	0	0	0	0	21	32	
Graduate Student	5	10	0	0	6	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	34		
Undergraduate Student	3	9	0	0	18	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	138		
K-12 Instructor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	19	0	0	19	19		
K-12 Student	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	448	448	0	0	0	0	0	448	448		
Professional	0	0	1	1	0	0	0	0	0	0	0	0	0	1	3	1	4	0	0	0	0	71	165	0	0	74	173		
Other	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	1	20	0	0	131	186	0	0	134	226		
Docent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	15	2	16		
SUBTOTAL	10	22	6	6	29	158	0	0	0	0	0	0	0	3	5	3	24	9	38	467	467	203	366	730	1086				
TOTALS																													
	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	Users	UDs	
TOTALS	271	842	43	53	491	1335	22	44	1	20	0	0	0	0	54	207	18	71	9	38	467	467	246	435	1622	3512			

APPENDIX 2. UCSC NATURAL RESERVE COMMITTEE AND CHARGE

UNIVERSITY OF CALIFORNIA, SANTA CRUZ

2021-2022 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 system-wide NRS Advisory Committee that advises on policy for all NRS reserves.

In addition to the chair (Faculty Director), membership of the committee is comprised of faculty advisors to each reserve, one faculty representative at large, one non-senate academic appointment, one staff representative, one graduate student, two undergraduate students, 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 Students: 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

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