Golden Gate National Recreation Area Research Priorities

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Biological Resources

Wildlife

Birds

- Wildlife inventory and habitat relationship work on GOGA new lands in San Mateo County: landbirds.
- Study waterbird use of major wetlands at GOGA.
- Impact of ravens and raven management on sensitive bird resources.

- Wild turkey distribution and ecological impacts
- Impacts of disturbances on shorebirds

Mammals

- Wildlife inventory and habitat relationship work on GOGA new lands in San Mateo County: mammals.
- Study river otter ecology and movement patterns. What are the home ranges and movement corridors for river otters in an urban setting?
- What percentage of river otter diet is attributed to salmon and does this vary seasonally?
- Evaluate tools to manage urban carnivores: aversive conditioning, effects of public outreach.
- Understand coyote ecology and movement patterns at the urban interface.
- Study gray fox abundance and habitat relationships at GOGA
- Study abundance and ecological impacts of black tailed deer
- Go batty -- foraging ecology, roosting, and disturbance impacts on bats.
- Study puma distribution, genetics and movement patterns on park lands in Marin and San Mateo counties
- Study of cascading trophic effects of sudden oak death on wildlife including woodrat and spotted owls.

Fish

- Evaluate body burden of resident fish (and/or macrocrustaceans) in Crissy Field marsh for contaminants (especially methylmercury and chemicals of emerging concern)
- Effect of algal biotoxins (anatoxin and microcystin) on native lagoon fish (Rodeo Lagoon)
- Evaluate collections at local depositories and implement collections where species gaps are present
- Evaluate seasonal movement patterns of fish under changing environmental conditions (e.g., streamflow, temp, DO, etc)
- Evaluate the significance of open canopy conditions on energy pathway in streams and influence on productivity, individual fitness, and abundance of stream taxa

Reptiles & Amphibians

- Wildlife inventory and habitat relationship work at Rancho Corral de Tierra in San Mateo County: herptofauna.
- Surfactants (used by NPS) and their effects on frogs and fish
- What is the current distribution and abundance of western toads?
- Utilization of eDNA to determine status (presence/not found) of aquatic/semi-aquatic herptofauna throughout GOGA
- Evaluate potential re-establishment of Foothill Yellow Legged Frogs
- Radio-telemetry study of California red-legged frogs movement and habitat use at sites with seasonal wetlands (e.g., Rancho and Milagra)
- Are egg mass counts an accurate measurement of the effective population of California red-legged frogs and if not, are the biases known and accountable (e.g., do females double clutch or lay partial masses)?
- What is the age class structure of California red-legged frogs at a sustainable site?
- What constitutes a barrier to juvenile/adult California red-legged frog movement?

Invertebrates

- Non-native insects: abundance, distribution, impacts, watch-out list, preventative measures, management recommendations
- Wildlife inventory and habitat relationship on GOGA lands: invertebrates.
- Inventory bees and other pollinators and study floral relationships
- Inventory tarantulas and arachnids
- Inventory ants
- Inventory earthworms
- Investigate groundwater-associated aquatic invertebrates. Initial findings suggest a specially adapted endemic fauna.
- What are the impacts of climate change on phenological relationships between insects and plants including pollinator species and other host-plant specific insects such as mission blue butterfly?
- Bioenergetics: what is the nutrient/energy pathway at various locations in the Redwood watershed (lagoon, middle reach, and headwaters)? How does expansion of new Zealand mudsnail affect pathway, growth/survivorship, and habitat suitability for native aquatic species?
- What limits expansion of New Zealand mud snail within a watershed? Are there hydraulic constraints?
- Conduct CA bioassessment invertebrate inventories on streams and ponds/wetlands lacking past surveys

Threatened and Endangered Wildlife-Mission blue butterfly

- Long term data analysis for existing Mission blue butterfly population data; analysis of how long term occupancy data can be used to understand population trends
- Studies on mission blue butterfly host plant flexibility and preferences including use of *Lupinus arboreus* at Wolfback Ridge
- Study habitat isolation effects on Mission blue butterflies including metapopulation analysis and genetic analysis
- Genetic study of mission blue butterfly population at Oakwood Valley compared to other populations
- Climate change impacts on mission blue butterfly phenology and abundance
- Conduct study to better understand Mission Blue Butterfly host plant pathogen dynamics, especially as they relate to climate change (moisture, fire, etc.)

Threatened and Endangered Birds

- Complete time series trend analysis on Northern Spotted Owl fecundity and population and factors affecting fecundity including climate change impacts on spotted owls (e.g., ,SOD impacts and woodrats)
- Barred owls - impact assessment on Spotted Owls
- Northern spotted owls—movement patterns and habitat relationships
- Assess Western snowy plover habitat locations on beach in relation to beach profiles (width and slope)

Threatened and Endangered Aquatic Species

- Are annual trends in population of California freshwater shrimp associated with measurable environmental conditions such as streamflow and water temperature?
- Can eDNA be a useful tool for evaluating presence/absence of tidewater goby in a variety of estuarine habitats?
- Evaluate various inexpensive digital camera systems to enumerate adult upstream salmonid migration or downstream smolt outmigration
- Comparison of coho and steelhead fisheries data with collected habitat data. What are strong habitat associations?
- Can a model be developed that predicts the frequency, depth, and location of coho and steelhead redd scour using available hydrologic info and easily obtainable field data?
- What is the adult residence time of coho at the beginning and end of the spawning season?
- Does smolt trap monitoring delay outmigration of juvenile coho and steelhead?
- What is the age of freshwater entry and age of returning coho adults based on scale analyses?
- Can non-invasive sampling be conducted of salmonid redds to determine species and parentage information?
- Conduct study of steelhead habitat use and potential within Rodeo Lagoon watershed

Miscellaneous

- Climate impacts on wildlife species abundance, distribution and ecology
- Evaluate effects of visitor use on wildlife
- Evaluate effects of trail closures and openings on wildlife
- Evaluate landscape connectivity and wildlife corridors, identify critical breaks in habitat connectivity and areas with excessive roadkill mortalities.
- Conduct assessment of aquatic species migratory corridor needs and opportunities relative to GOGA waters, particularly for species highly vulnerable to climate change
- Expand wildlife camera network in Redwood Creek Watershed and San Mateo
- Track emerging invasions of non-native animals (pigs, turkeys, bullfrogs, cats, rats, red fox) and document the impacts of invasive animals on native wildlife and habitat

Vegetation

- Modeling of potential shifts in plant communities in response to climate change including changing impacts of fog, fire and other disturbances and identifying variability in predicted change across the landscape, between community types, related to life history strategies of individual species and including paleoecological perspectives in understanding future change
- Climate change impacts on redwood forests including identifying drought-tolerance thresholds
- Modeling changes in species distributions in response to climate change, especially sensitive and special status species including constraints on dispersal.
- Impacts of climate change and local topography on fog
- Investigating the importance of seeps and other refugia in climate change resilience
- Impact of climate change on invasive plant species
- Role and relative importance of edaphic factors and soil microbial communities in determining distribution and successional patterns of plant communities

- How plant pathogens may change in distribution or otherwise interact with climate change to impact plant communities
- Add Muir Woods study plot to ongoing study to improve understanding of redwood demographics and incorporate ecophysiology to detect climate change impacts
- Impacts of exotic species on vegetation including:
    - Where has the greatest displacement of native species taken place? Where might we expect other large-scale displacements to take place?
    - Which communities have the greatest proportion of non-native species in terms of relative frequency and spatial extent?
    - In areas that have been invaded, what might be the reasons for invasive plant success?
    - Are invasive plant spatial patterns associated with proximity to roads or human habituated properties? Should vegetation sampling units be placed at set distances away from propagule sources to document invasions?
- Conduct herbicide and other treatment trials on oblong spurge. Conduct grassland restoration trials to follow oblong spurge control.
- Test an aster-specific herbicide to treat Cape Ivy
- Develop control techniques matrix for *Oxalis pes-caprae.* This recent invader is expanding rapidly into many coastal areas including dune and upland habitats. Effective control methods are needed.
- In riparian areas, can cape ivy be effectively eradicated with heavy machinery immediately prior to slope regrading?
- Broom Control: evaluate the use of fire, herbicides, and mechanical removal (weed wrenches, mowers, chainsaws) to reduce or eliminate French/Scotch broom
- Evaluate the use of fire to control invasive nonnative plants
- Create potential expansion model for wind dispersed invaders in coastal habitat, *Helichrysum petiolare* and *Ageratina adenophora*
- Develop expansion and colonization models for invasive perennial grasses to identify priority areas to prevent invasion
- Identify the seed viability of *Helichrysum petiolare* and/or *Ageratina adenophora* under a variety of conditions
- Identify factors related to species-specific rates of spread.
- Develop expansion models for invasive perennial grasses, specifically tall fescue, *Festuca arundinacea* and Harding grass, *Phalaris aquatica* and South African veldt grasses (*Ehrharta* sp.).
- Evaluate the rate of spread for *Rubus armeniacus* (formerly known as R. discolor) across bioregions (Coastal California [North and South] and Sierra Nevadas – California EPMT)
- Evaluate the rate of spread for *Eucalyptus globulus* across bioregions in Northern and Southern California
- Evaluate the effects of select thinning of Eucalpytus on understory species. (in collaboration with Network Fire Program)
- Of species identified by the California Invasive Plant Council - what species most effectively exclude native recruitment and establishment? Of those that are most dominant; are there acceptable or tolerable levels and at what threshold should control be implemented?
- Native community response to treatments
- What are benefits to rare species vs. impacts/damage to rarities from restoration actions?
- Monitor spread of invasive plant species by remote sensing
- Use of LiDAR to revise NWI Maps

- Disturbance and grassland ecology
- Novel methods for restoring invaded herbaceous communities with intermixed invasive & native plants
- Sudden Oak Death:
  - Wildlife impacts
  - Impacts on veg; weeds
  - Impacts on fuel loading and potential fire behavior
- Impacts of sudden oak death and/or soil-borne Phytophthora species on vegetation communities
- Distribution of soil-borne Phytophthora park wide especially in restoration sites
- Pitch Canker—impact on bishop pine forest structure, weeds
- Map, assess, and prioritize native grasslands parkwide for treatment
- Common garden experiments to determine optimal range of seed collecting zones for plant guilds
- Model fire behavior in eucalyptus forests before and after thinning treatment
- Fire and rare plant management in chaparral: Can fire or fuels management successfully increase recruitment and survival of rare chaparral species?
  - Mason's ceanothus
  - Marin manzanita
- What is the natural fire return interval for each of the main vegetation types in PORE/GOGA? What signal (fuels loads, species composition/density, etc…) in each vegetation type indicates that a particular stand has departed from a natural fire return interval?
- Which specific vegetation stands have experienced the greatest departure from their natural fire regime? Which portions of PORE/GOGA have experienced the greatest departure from a natural fire regime?
- What are the consequences of fire suppression to certain species and vegetation types?
- What is the interaction between climate change and fire suppression?
- Identifying pollinator mechanism and seed viability for T&E plants such as Hickman's potentilla
- Investigate impact of soil borne phytophthora species on rare manzanita species
- Comprehensize life cycle analysis of T&E plant species (e.g. *Potentilla hickmanii*), identifying hazards and bottlenecks at each life cycle stage, and management actions to mitigate threats.
- Gene sequencing to determine genetic variability in populations of T&E plant species
- Phytolith analysis to model the historic location of grasslands.
- Develop cost-effective method for fine-scale mapping and/or monitoring of native grasslands.
- What is the impact of historic land use on present day plant communities
- Phenology – including correlate long-term data sets
- Determine the makeup of historic coastal wetland communities and inundation/salinity regimes through use of phytolith and diatom analyses.
- Lichen Inventory
- What is the role of fog on species composition: anticipated effects of possible fog reduction associated with climate change.
- Install fog research station at Muir Woods in collaboration with TCB3; improve existing weather station
- Install fog research station at Montara Mountain

- Improve understanding range, species composition, trends in second growth redwood stands and assess vulnerability and habitat expansion potential
- Complete assessment of riparian habitat connectivity and identify opportunities for restoration
- Conduct pilot study to better understand groundwater dynamics and test groundwater management techniques to benefit redwood health

Marine/Estuarine Environment

- How dynamic are eelgrass beds within GOGA in San Francisco Bay?
- What are the trends in crab and fish species catch and size at designated fishing piers?
- Studies that improve our knowledge and understanding of marine resources
- Monitor and control invasive Spartina species
- Complete large scale community map of rocky intertidal community using aerial imagery and LIDAR
- Use of LiDAR to map shallow subtidal areas
- Monitor water quality in Crissy Marsh to inform management (inlet mgmt, Quartermaster Reach, tunnel tops project, TMDLs)

Cultural/Natural Resources

- Evaluate presence/absence of animal and plant species historically present in park (pre-European) using historic records (e.g., cores, midden records)

Physical Processes

Air/Climate

- Impacts of climate change on Bay Area National Park ecosystems, communities, infrastructure, and species.

Water

- Monitor Redwood Creek water quality near Muir Woods (road runoff, PAHs)
- What are the percentages of culverts (and where) causing erosion on park lands?   Pacific Coast Science and Learning Center Research Priorities for the San Francisco Bay Area Network of Parks
- What is the extent of diurnal streamflow depletion of different riparian communities during the summer-fall low flow period?
- Are groundwater withdrawals in the West Union Creek basin (San Mateo Co.) affecting summer baseflows?
- Use of remote technology to evaluate floodplain flow velocities, flooding depths and inundation extent at Lower Redwood Creek (Muir Beach) under a range of flow conditions
- Inventory age and source water in park springs
- Conduct watershed assessments of stream thermal profile

- Use of LiDAR to Identify flood hazards
- Conduct stream inventory and data gathering for stream condition and geomorphology
- Hydrologic functioning of abandoned logging roads and impacts on watersheds
- Coastal Water Quality and circulation patterns. Integrating results of baseline study in winter 2006 -07/spring 07
- Inventory locations of seeps and springs in San Mateo and assessment of current conditions
- Study the potential for raising groundwater levels and restoring creek functions for Redwood Creek watershed
- Study potential impacts of both legal and illegal water diversions (Rancho, Phleger, Stinson Gulch) on instream resources
- Monitor beach water quality (pathogens) per AB 411; partner with counties
- Monitor water quality in San Mateo lands (equestrian uses, TMDL)
- Monitor Redwood Creek water quality near Muir Woods (road runoff, PAHs)

Natural Lightscapes

- Monitor night light levels at priority sites
- Night sky studies (quality assessment, improvement plans)

Natural Soundscapes

- Monitor sound pressure levels at priority sites
- Soundscape Monitoring and Research (e.g. social science studies, ecological questions, wildlife disturbance ,marine soundscapes)
- Evaluate existing sound recordings throughout park for biodiversity purposes

Miscellaneous

- Determine extent of historic wetlands through Coast Geodetic Survey maps
- Develop/strengthen partnerships with universities (e.g., SFSU) to encourage research of geologic exposures and promote education
- Conduct watershed and erosion assessment at Rancho in relation to past land use practices and identify vulnerabilities and restoration priorities
- Assess potential impacts of beach nourishment on benthic community at south Ocean Beach
- Update existing about information to mitigate risks from hillslope erosion (e.g., erosion maps)
- Reassess threats to resources from hill-slope erosion in Redwood Creek Watershed
- Complete LIDAR survey and analysis to improve understanding of coastal bluff erosion rates
- Develop and implement monitoring or volunteer program to detect paleontological features eroding from bluffs and provide public education about resource protection
- Develop and implement beach geomorphology monitoring at park beaches in Marin County (Stinson Beach, Rodeo Beach, Muir Beach); and monitor beach/nearshore geomorphology at Ocean Beach by maintaining partnership with USGS
- Monitor channel profiles, cross-sections, and sediment transport at Redwood Creek Watershed Including Muir Beach) and Tennessee Valley

- Expand and build on regional LiDAR mapping projects underway by NOAA/USGS to address park-specific resources and locations. Examples include: tracking beach erosion/accretion dynamics; assessing vulnerability of coastal habitats to SLR and winter storms; analysis of historic shoreline changes; produce detailed topographic and/or bathymetric of restoration

sites/watersheds/projects; produce maps of park infrastructure; baseline maps of infrastructure, geologic features, etc.

- Monitor bluff erosion
- Fault Mapping
- Paleontological resources (inventories, condition assessments)
- Coastal processes studies throughout the park building on USGS work (e.g., nearshore wave and current measurements, beach dynamics, evaluate sediment transport rates and pathways, etc.)
- Monitoring of beach morphology to evaluate storm effects, seasonal changes and long-term trends
- Focused studies on beach and lagoon dynamics at Muir Beach to evaluate processes affecting tidal lagoon opening/closing, sediment sources affecting timing of beach berm build-up and breaching)
- Bedload and suspended sediment yield monitoring in Redwood Creek, repeat surveys conducted in 2003-04; evaluate sediment yield to restoration area; update sediment rating curve