

SUMMARY

OF RESEARCH AND COLLECTING PERMITS



Lake Mead National Recreation Area
January 1 – December 31, 2011



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**Summary of Research and Collecting Permits
Lake Mead National Recreation Area
January 1 – December 31, 2011**

SUMMARY: This report summarizes activities authorized by scientific research and collecting permits for Lake Mead National Recreation Area (LAKE) and Grand Canyon-Parashant National Monument (PARA) during calendar year 2011. Permits that were active for any portion of the year have been included, and investigator annual reports have been attached as an appendix. This report was prepared by Mike Boyles and Shannon Gutierrez, in the Environmental Compliance Branch of Resource Management.

INTRODUCTION

Preserving park resources unimpaired and providing for appropriate visitor uses of parks requires a full understanding of a park's natural resources, ecological processes, and visitor interests that can be obtained only by the long-term accumulation and analysis of information produced by science. The National Park Service has a research mandate to provide management with that understanding, using the highest quality science and information available. Timely and reliable scientific information is essential for sound management decisions and interpretive programming.

A Scientific Research and Collecting Permit is required for most scientific activities pertaining to natural resources or social science studies in National Park System areas, especially those activities that involve fieldwork or specimen collection or have the potential to disturb resources or visitors. Any individual may apply for a permit if he/she has the qualifications and experience to conduct scientific studies or represents a reputable scientific or educational institution or a federal, tribal, or state agency. However, it is important that applicants demonstrate that they have the financing and other necessary resources to see the project through to completion.

By permitting independent research, LAKE expands its ability to collect data and improve understanding of the resources under its stewardship. The park serves as a vast natural laboratory, and with park staff and funding becoming increasingly more limited, projects conducted by universities and sister agencies represent unique opportunities to improve our understanding of the Mohave Desert, Colorado River, and Lake Mead ecosystems.

PROCEDURES FOR REVIEWING APPLICATIONS AND ISSUING PERMITS

Potential researchers submit their applications, along with full study proposals, online into the National Park Service Research Permit and Reporting System (RPRS) database. The LAKE permit coordinator initiates park review by ensuring the application package is complete and forwarding the application and all supporting materials to the Chief of Resource Management, the Environmental Compliance Specialist, the Park Archaeologist, and the subject matter expert (typically the Branch Chief of Vegetation, Wildlife, or Physical Resources). The Museum Technician is also consulted for any studies involving permanent collections that will not be discarded or destroyed through analysis. For research proposed in PARA, the PARA Superintendent is included in the review team. The standard review period is two weeks, but

may be shorter if the application is a simple renewal, or longer if the proposal has broad significance requiring additional input, such as from the Management Team.

Each proposal is reviewed for compliance with National Environmental Policy Act requirements and other laws, regulations, and policies. The Chief of Resource Management, who has been delegated approval authority by the Superintendent, makes a decision to approve or deny a research and collecting permit based on an evaluation of favorable and unfavorable factors (see examples, below), and on an assessment of perceived risks and benefits. While park managers will work with applicants to arrive at a mutually acceptable research design, there may be activities where no acceptable mitigating measures are possible, and the application may be denied.

Favorable factors

The proposed research:

- contributes information useful to an increased understanding of park resources, and thereby contributes to effective management and/or interpretation of park resources; provides for scheduled sharing of information with park staff, including any manuscripts, publications, maps, databases, etc., which the researcher is willing to share;
- addresses problems or questions of importance to science or society and shows promise of making an important contribution to humankind's knowledge of the subject matter;
- involves a principal investigator and support team with a record of accomplishments in the proposed field of investigation and with a demonstrated ability to work cooperatively and safely, and to accomplish the desired tasks within a reasonable time frame;
- provides for the investigator(s) to prepare occasional summaries of findings for public use, such as seminars and brochures;
- minimizes disruption to the park's natural and cultural resources, to park operations, and to visitors, including sensitivity to the deployment and retrieval of field markings and research equipment;
- discusses plans for the cataloging and care of collected specimens and includes coordination with park staff on matters of data management and specimen curation;
- clearly anticipates logistical needs and provides detail about provisions for meeting those needs; and
- is supported academically and financially, making it highly likely that all fieldwork, analyses, and reporting will be completed within a reasonable time frame.

Unfavorable factors

The proposed research:

- involves activities that adversely affect the experiences of park visitors;
- shows potential for adverse impact on the park's natural, cultural, or scenic resources, and particularly to non-renewable resources such as archeological and fossil sites or special-status species (the entire range of adverse impacts that will be considered also includes construction and support activities, trash disposal, trail conditions, and mechanized equipment use in sensitive areas);
- shows potential for creating high risk of hazard to the researchers, other park visitors, or environments adjacent to the park;
- involves extensive collecting of natural materials or unnecessary replication of existing voucher collections; requires substantial logistical, administrative, curatorial, or project

monitoring support by park staff; or provides insufficient lead time to allow necessary review and consultation;

- is to be conducted by a principal investigator lacking scientific institutional affiliation and/or recognized experience conducting scientific research; and
- lacks adequate scientific detail and justification to support the study objectives and methods.

If approved, the permit is signed by the Chief of Resource Management and sent to the principal investigator, who must also sign and agree to the conditions of the permit. All researchers are sent a copy of LAKE standard conditions and NPS standard conditions (both attached as Appendix A) along with any unique restrictions that were developed as part of the application review. Investigators must submit an annual report of activities for each calendar year that the permit is active. The 2011 reports are attached as Appendix B (but as of the March 31 reporting deadline, 25 of the 76 required reports had yet to be submitted). Upon completion of the study, copies of final reports or publications should be submitted to the park. The park research coordinator determines whether copies of field notes, databases, maps, photos, and/or other materials should be included. All submitted materials are retained in the Park Archives.

ACTIVE PERMITS IN 2011

There were 76 permits active at LAKE and PARA during all or a portion of 2011. The studies authorized by these permits represent 23 different research disciplines, as shown in Table 1. Formal collections of plants, invertebrates, and geologic materials are being generated by currently permitted research. The discipline with the largest number of permits (19) was Exotic/Invasive Species, primarily due to the large number of studies on Quagga mussels. The RPRS defines 64 different research disciplines, and 41 of these are not currently represented by any research at LAKE or PARA. However, there is considerable overlap in many of these categories, and it is not uncommon for studies to incorporate elements of multiple disciplines. The park's permit coordinator, who assigns the disciplines in the RPRS, is responsible for determining the single category into which the proposal best fits.

While this summary is intended to be as comprehensive as possible, it does not reflect the full scope of what is occurring at Lake Mead for a variety of reasons. First, park staff who conduct research as part of their job are not currently required to have a permit (a policy which has changed at LAKE over the years and may change again in the future). Second, the park has a long history of working cooperatively with other agencies, many of whom may have ongoing programs (especially on the lake itself) that have never been permitted. Third, many activities conducted by outside entities have been authorized with special use permits, even though they include data collection components that make them more suitable for research and collecting permits. The park is attempting to capture these non- and improperly permitted activities under research and collecting permits whenever opportunities arise.

Table 1. Number of Permits by Research Discipline

Discipline	Total	Discipline	Total
Exotic / Invasive Species	19	Geo-Sedimentology / Stratigraphy	0
Plant Communities (Vegetation)	7	Geo-Thermal / Volcanology	0
Water Resources	5	Glaciers	0
Birds / Ornithology	4	History – Cultural	0
Inventory Natural Resources	4	History – Natural	0
Invertebrates (Insects, Other)	4	Information Systems (Non-Spatial)	0
Herpetology (Amphibians / Reptiles)	4	Integrated Pest Management	0
Cave / Karst	3	Land Use – Agriculture	0
Geology / General	3	Land Use – Forestry	0
Soils	3	Land Use – Mining, Oil, Gas	0
Ecology (Aquatic, Marine, Terrestrial)	2	Land Use – Range Land	0
Fish / Ichthyology	2	Lichens	0
Geostructure / Tectonics	2	Management (Administration)	0
Mammals	2	Maps / Cartography / GIS	0
Monitor Natural Resources	2	Microbes	0
Threatened / Endangered / Rare Species	2	Night Sky / Light Pollution	0
Vascular Plants	2	Other	0
Water Quality	2	Paleontology	0
Atmosphere / Climate / Weather	1	Petrology / Mineralogy	0
Fire (Behavior, Ecology, Effects)	1	Protista (Including Algae, Fungi)	0
Geomorphology / Surface Processes	1	Recreation / Aesthetics	0
Mosses / Bryophytes	1	Restoration – Cultural	0
Air Pollution Effects	0	Restoration – Natural	0
Air Quality	0	Social Science	0
Animal Communities / Wildlife	0	Soundscapes / Natural Quiet	0
Anthropology / Ethnography	0	Toxicology	0
Archeology	0	Veterinary Sciences	0
Coastal / Marine Systems	0	Viruses / Prions	0
Contaminants / Hazardous Materials	0	Visitor Impacts	0
Geochemistry (inc. Minerals / Petrology)	0	Water / Hydrology	0
Geography	0	Watershed Management / Assessment	0
Geophysics / Seismology	0	Wetlands / Floodplains	0

Below is a list of the 76 permits that were active during all or part of 2011. They have been grouped by research discipline, with disciplines listed alphabetically.

Atmosphere / Climate / Weather

1. National Oceanic and Atmospheric Administration. *U.S. Regional Climate Reference Network*.

Birds / Ornithology

1. SWCA Environmental Consultants. *Southwestern Willow Flycatcher Studies*.
2. U.S. Geological Survey-Western Ecological Research Center. *Population Status and Reproductive Ecology of the Western Burrowing Owl (*Athene cunicularia hypugaea*) in Clark County, NV*.
3. South Sierra Research Station. *Lower Colorado River Distribution and Habitat use by the Yellow-billed Cuckoo (*Coccyzus americanus*) under the Bureau of Reclamation Multi Species Conservation*.
4. Joseph Barnes, Independent Research Project. *Dietary Assessment of Peregrine Falcons and Prairie Falcons within Lake Mead National Recreation Area (2011-2013)*.

Cave / Karst

1. Dixie State College. *A baseline survey of water and soil chemistry in KyPet Cavern*.
2. U.S. Geological Survey, Astrogeology Team. *Caves as a record of Climate Change & Biodiversity*.
3. Merriam-Powell Center for Environmental Research-Northern Arizona University. *Ecological Inventory of 15 Caves on Grand Canyon-Parashant National Monument*.

Ecology

1. University of Nevada, Las Vegas. *Mesquite and Acacia Community Assessment in Lake Mead National Recreation Area*.
2. Northern Arizona University. *Inventory of Tamarisk Leaf Beetle (*Diorhabda carinulata*) and Vegetation in Lake Mead Recreation Area*.

Exotic / Invasive Species

1. Wen Baldwin, Independent Research Project. *Dreissenid Mussel Collecting*.
2. Nevada Department of Agriculture. *Gypsy moth survey*.
3. Portland State University. *Field evaluation of the service life of foul-release coatings in Columbia River*.
4. University of Arizona. *Genetic Characterization of The Lake Mead Population of the Invasive Mussel *Dreissena bugensis* (Quagga mussel)*.
5. Tamarisk Coalition. *Tamarisk Biological Control Monitoring*.
6. National Park Service. *Monitoring for Quagga Mussels*.
7. University of Nevada, Las Vegas. *Quagga Mussel Monitoring in Lake Mead*.
8. U.S. Geological Survey-Southwest Ecological Research Center. *Visual and Infrared Monitoring of Tamarisk and the Tamarisk Beetle on the Virgin River, Nevada*.
9. University of Nevada, Las Vegas. *Potential Impacts of Invasive Quagga Mussels on Diet and Feeding Habitats of Young of the Year (YOY) Striped Bass in Lake Mohave*.
10. University of Nevada, Las Vegas. *Develop Effective Decontamination Protocols for Wildland Firefighting Equipment Exposed to Quagga/Zebra Mussels: Testing the Efficacy of Quaternary Ammonium Compounds on Killing Dreissenid Veligers & Adults*.

11. University of Nevada, Las Vegas. *Using Pressurized Hot Water Spray to Kill and Remove Dreissenid Mussels on Watercraft: Field Testing on the Efficacy of Water Temperature, High Pressure, and Duration of Exposure.*
12. University of Nevada, Las Vegas. *Abundance of quagga mussels in Las Vegas Bay, Lake Mead.*
13. University of Nevada, Las Vegas. *Sterile male release technique (SMRT) with irradiation as a potential novel method for attenuating invasive quagga mussels – A laboratory experiment.*
14. Southern Nevada Water Authority. *Tamarisk feeding invertebrates along the Las Vegas Wash.*
15. University of Nevada, Las Vegas. *Protocol for Testing the Effectiveness of an Algaecide, EarthTec, on Killing and Preventing the Colonization of Quagga Mussels.*
16. Colorado State University-Pueblo. *Development of new quantitative PCR primers to detect and enumerate Dreissena polymorpha veligers in freshwater.*
17. Nevada State College. *Ecosystem Change and Invasive Species Study.*
18. University of California – Santa Barbara. *Effectiveness Monitoring of Spring-fed Wetlands and Riparian Restoration Treatments.*
19. Portland State University. *Zebra Mussel/Quagga Mussel Monitoring and Education and Outreach.*

Fire (Behavior, Ecology, Effects)

1. Northern Arizona University. *Interactions between climate and fire in northern Arizona.*

Fish / Ichthyology

1. BIO-WEST Inc. *Virgin River Fish Survey.*
2. BIO-WEST Inc. *Lake Mead Razorback Sucker Study.*

Geology / General

1. University of Nevada, Las Vegas. *Late Cenozoic Mapping of the Spirit Mountain SE 7.5 minute quadrangle, Arizona-Nevada.*
2. U.S. Geological Survey, Western Earth Surface Processes Team. *Geologic map of the Lake Mead National Recreation Area and surrounding areas.*
3. University of Reno. *Relations between magmatism and extension in the northern Colorado River extensional corridor, northwest AZ and southern NV.*

Geomorphology / Surface Processes

1. University of Nevada, Las Vegas. *Provenance Study of Conglomerates at Callville Bay and Sandy Cove.*

Geostructure / Tectonics

1. UNAVCO Inc. *Plate Boundary Observatory (PBO) component in Lake Mead National Recreation Area to monitor tectonic and magmatic process using high precision GPS.*
2. University of Nevada, Las Vegas. *Muddy Creek Formation: a Record of Late Miocene Tectonics and Sedimentation in Southern Nevada.*

Herpetology (Amphibians / Reptiles)

1. National Park Service. *Relict Leopard Frog Monitoring and Management.*
2. National Park Service. *Population dynamics and habitat requirements of Rana onca, the Relict Leopard Frog, at Lake Mead National Recreation Area.*

3. U.S. Fish and Wildlife Service. *Desert Tortoise Population Monitoring Using Line Distant Sampling Methodology Throughout the Mojave Desert.*
4. U.S. Geological Survey-Biological Resources Division. *Genetic Variation of Isolated Island and the Adjacent Mainland Populations of common lizards and small mammals in Lake Mead National Recreation Area.*

Inventory Natural Resources

1. U.S. Department of Agriculture, Forest Service. *Annual Forest Land Inventory of Arizona and Nevada.*
2. Clark County Desert Conservation Program. *Clark County Rare Plant Inventories.*
3. National Park Service. *Road Kill Specimens.*
4. Southern Utah University. *Targeted Vegetation Survey & Prep of NPS Technical Report on Flora of Grand Canyon-PARA, AZ (or Annotated Vascular Plant Database & Pub for Grand Canyon-PARA – Phase II).*

Invertebrates (Insects, Other)

1. University of Vermont & State Agricultural College. *Evolution of major geographic variation in social structure of a desert ant.*
2. College of Southern Nevada. *Entomology Survey of the Lake Mead National Recreation area.*
3. Eastern Carolina University. *Deciphering systematic relationships among three Western North American tarantula sister species in the Aphonopelma “eutylum group.”*
4. University of Nevada, Las Vegas. *Physiological Ecology of Drosophila mojavensis.*

Mammals

1. Arizona Game and Fish Department. *Evaluation of Measures to Promote Desert Bighorn Sheep Highway Permeability Phase III-Post Construction U.S. Highway 93.*
2. U.S. Geological Survey-Western Ecological Research Center. *Development of a Habitat Management Plan to Maintain Viability of the Desert Bighorn Sheep Population in the River Mountains, Nevada: Phase I.*

Monitor Natural Resources

1. Southern Nevada Water Authority. *Handling desert tortoise, banded gila monster & chuckwalla in association with biological monitoring of construction activities for the SNWA construction projects on NPS lands.*
2. U.S. Department of Agriculture. *Lake Mead National Recreation Area Ecosystem Health Monitoring Study.*

Mosses / Bryophytes

1. University of Nevada, Las Vegas. *Bryophytes of the Mojave Desert.*

Plant Communities (Vegetation)

1. National Park Service. *Plant Surveying, Monitoring, Mapping and Collecting.*
2. University of Nevada, Las Vegas. *Collection of classification & accuracy assessment field data in support of vegetation mapping of four Mojave Desert Network parks.*
3. UC Davis. *Population Genetics and systematics of Yucca brevifolia (Agavaceae)*
4. University of Nevada, Las Vegas. *Investigation of plant colonization and succession in the Lake Mead drawdown zone.*

5. Salisbury University. *Quantification of Nordihydroguaiaretic acid(NDGA)in field collected Larrea tridentate.*
6. U.S. Geological Survey. *Germination, recruitment and demography of Joshua trees (Yucca brevifolia) in National Parks in the Mojave Desert (Lake Mead NRA).*
7. U.S. Geological Survey. *Germination, recruitment and demography of Joshua trees (Yucca brevifolia) in National Parks in the Mojave Desert (Parashant NM).*

Soils

1. University of Nevada, Las Vegas. *Restoring function of biological soil crusts on gypsum-dominated soils in the Eastern Mojave, Lake Mead NRA.*
2. University of Nevada, Las Vegas. *Predicting recovery of biological soil crusts.*
3. U.S. Geological Survey, Colorado Plateau Research Station. *Collection of Soil Samples and Rock Swabs from Bat Hibernacula Caves: Monitoring of White-Nosed Syndrome in the West.*

Threatened / Endangered / Rare Species

1. U.S. Fish and Wildlife Service. *River Mountains Desert Tortoise Translocation Effectiveness Monitoring.*
2. Arizona State University. *Lake Mead and Lake Mohave Fisheries Study.*

Vascular Plants

1. National Park Service. *Native Plant Nursery Seed and Propagule Collection.*
2. National Park Service. *Botanical Fieldwork Required to Fulfill My Duties as the Grand Canyon - Parashant National Monument (GCPANM) Botanist.*

Water Quality

1. Mohave Community College. *Microbiological Analysis of Lake Mohave water samples.*

Water Quality Monitoring

1. City of Las Vegas. *Water Quality Monitoring.*

Water Resources

1. U.S. Geological Survey. *Installation of Bank-Operated Cableway at U.S. Geological Survey Site 09419800 Las Vegas Wash below Lake Las Vegas near Boulder City.*
2. U.S. Geological Survey. *Bank-Operated Cableway Installation - Virgin River above Lake Mead near Overton, NV.*
3. U.S. Geological Survey. *Lake Mead Evaporation Study.*
4. National Park Service. *Mojave Desert Inventory and Monitoring Network Arid Lands Springs Protocol-Pilot Testing (Lake Mead NRA).*
5. National Park Service. *Mojave Desert Inventory and Monitoring Network Arid Lands Springs Protocol-Pilot Testing (Parashant NM).*

MAXIMIZING USE OF INDEPENDENT RESEARCH TO MEET PARK NEEDS

After a decade of ample funding provided through the Southern Nevada Public Lands Management Act, the park is entering a period of smaller budgets and correspondingly reduced staffing levels. As a result, the park is losing much of its capacity to collect its own scientific data. In the past, Resource Management staff collected data related to desert restoration, native plant propagation, rare plant mapping, exotic plant control, threatened and endangered species

monitoring, bird community dynamics, prescribed fire effects, and a host of other topics related to the management and protection of park resources. As this ability is lost, it becomes imperative for Park Management to seek out alternative means of acquiring this data, and utilizing external researchers is a prime method of doing so.

The RPRS allows parks to post their research needs and preferences, enabling potential investigators to search and review the types of research activities that park managers are most interested in attracting. LAKE and PARA are not currently taking advantage of this feature. If utilized, the information could not only reside on the RPRS but also be linked to the park website and elsewhere for broader distribution. There are several documents which, when complete, should be posted to the RPRS to identify LAKE's priority research needs. These include the park's Natural Resource Condition Assessment, the Southern Nevada Agency Partnership Science Synthesis, the USGS Water Science Summary, and the Long-Term Limnological and Aquatic Resource Monitoring and Research Plan for Lakes Mead and Mohave.

Some issues, like the introduction of Quagga mussels, have such high profiles and wide-reaching impacts that this form of "advertising" may not be necessary. Nearly 20% of the permits currently active at LAKE are related to Quagga mussels. However, other topics of management concern garner little attention. All but one of the 19 permits in the category of Exotic and Invasive Species are related to either Quagga mussels or tamarisk, even though the park has documented well over 100 exotic species and spends considerable time and effort controlling non-natives such as Sahara mustard, fountain grass, and others. In addition, in an area of such prehistoric cultural diversity, the park has no permits focused on anthropology or archaeology (although such studies may also be authorized with an Archaeological Resources Protection Act permit). Finally, considering the park's proximity to a metropolitan area of approximately two million people, there are ample opportunities to study air quality and light pollution and to explore social sciences as they relate to recreation and visitor impacts, but none of these topics are the focus of current research.

As the Resource Management Division begins its development of a Resource Stewardship Strategy, past and present research should be examined as potential data sources for determining environmental baselines, trends, and target conditions. Furthermore, as the planning process identifies gaps in the knowledge base, park staff should consider the ability of outside researchers to help inform the Strategy and begin thinking about how best to partner with them so that benefits to both parties are maximized. In this way, the park can use all available tools to achieve the mission of protecting resources and leaving them unimpaired for the enjoyment of current and future generations.

APPENDIX A: STANDARD PERMIT CONDITIONS

Park Conditions at Lake Mead NRA

- 1 This permit, issued by the National Park Service (hereafter referred to as NPS), allows the named principal investigator to collect certain animal, plant, water, or mineral resources in the locations and quantities specified. Archeological and paleontological materials may not be collected or disturbed under this permit unless accompanied by a current Antiquities Permit.
- 2 Field assistants may collect only under the direct supervision of the principal investigator or co-investigator named on the permit. The permit holder is responsible for seeing that each assistant understands the permit stipulations. Assistants collecting independently must be issued their own collecting permits.
- 3 This permit does not give the bearer license to violate any NPS regulations.
- 4 A pre-field work meeting may be required between the principal investigator(s) and NPS staff to clarify and reinforce permit conditions, access, research/collecting methods, reporting, communications and other items related to this permit and the research proposal.
- 5 Before initiating field research please contact the designated NPS liaison. Identify yourself by name, organization, or agency, and describe where you will be working, and vehicle(s) being used.
- 6 If designated parking areas are not convenient, park in a safe place with plenty of sight distance for other traffic that does not cause any damage to the resources.
- 7 Place a copy of the enclosed *Research and/or Collecting Permit* in the driver side window of your parked vehicle.
- 8 Provide information to inquiring park visitors in a courteous and informative manner.
- 9 All collecting (if permitted) must be done away from roads, trails, and developments, unless otherwise specified in the permit.
- 10 The Superintendent may require an inventory and locality record (UTMs) for any or all specimens before they are removed and, after the collection has been assembled, to submit it for examination.
- 11 Two hard copies and one electronic copy (PDF format) of all scientific and other publications resulting entirely or in part from research and/or collecting through the issuance of this permit will be furnished to Lake Mead NRA, Attention: Park Archives.
- 12 This permit expires on the date shown. Permits will be issued for a maximum of three years. If the study requires more than three years for completion, the investigator may apply to renew the permit at the end of the initial three year period. Investigator's Annual Report must be completed on time or the permit will be suspended until the IAR is completed.
- 13 Violation of these terms and conditions may result in the suspension or revocation of the permit. Failure on the part of the collector(s) to adhere to the policies outlined by the park and those policies as stipulated in the Code of Federal Regulations (CFR), Title 36, Section 2.5, and National Park Service (NPS) Management Policies may result in the withdrawal of this collecting permit.
- 14 36 CFR, Chapter 1, Section 2.5 -- Research Specimens: further defines and clarifies the basic conditions under which this permit is issued.
- 15 All equipment (instruments, vehicles, boats, footwear, etc) used in the park must be cleaned and dried prior to use and upon exit from the Park. Such equipment must be free of mud, water, or debris that could harbor non-native organisms and all such equipment is subject to inspection by NPS personnel. All permittees are hereby notified that Lakes Mead and Mohave harbor invasive quagga mussels that can do substantial harm to uninfested waters (including park springs). Their microscopic larval stage is easily transported via mud or water. All researchers are required to take all precaution to prevent the spread of these aquatic invasive species. Recommended decontamination procedures are available at <http://www.protectyourwaters.net>.
- 16 Changes to the project scope or methods used must be reviewed and approved by the NPS prior to implementation. Submit any proposed modifications of the research proposal to the designated NPS liaison.



GENERAL CONDITIONS For SCIENTIFIC RESEARCH AND COLLECTING PERMIT

United States Department of the Interior
National Park Service

1. **Authority** - The permittee is granted privileges covered under this permit subject to the supervision of the superintendent or a designee, and shall comply with all applicable laws and regulations of the National Park System area and other federal and state laws. A National Park Service (NPS) representative may accompany the permittee in the field to ensure compliance with regulations.
2. **Responsibility** - The permittee is responsible for ensuring that all persons working on the project adhere to permit conditions and applicable NPS regulations.
3. **False information** - The permittee is prohibited from giving false information that is used to issue this permit. To do so will be considered a breach of conditions and be grounds for revocation of this permit and other applicable penalties.
4. **Assignment** - This permit may not be transferred or assigned. Additional investigators and field assistants are to be coordinated by the person(s) named in the permit and should carry a copy of the permit while they are working in the park. The principal investigator shall notify the park's Research and Collecting Permit Office when there are desired changes in the approved study protocols or methods, changes in the affiliation or status of the principal investigator, or modification of the name of any project member.
5. **Revocation** - This permit may be terminated for breach of any condition. The permittee may consult with the appropriate NPS Regional Science Advisor to clarify issues resulting in a revoked permit and the potential for reinstatement by the park superintendent or a designee.
6. **Collection of specimens (including materials)** - No specimens (including materials) may be collected unless authorized on the Scientific Research and Collecting permit.

The general conditions for specimen collections are:

- Collection of archeological materials without a valid Federal Archeology Permit is prohibited.
- Collection of federally listed threatened or endangered species without a valid U.S. Fish and Wildlife Service endangered species permit is prohibited.
- Collection methods shall not attract undue attention or cause unapproved damage, depletion, or disturbance to the environment and other park resources, such as historic sites.
- New specimens must be reported to the NPS annually or more frequently if required by the park issuing the permit. Minimum information for annual reporting includes specimen classification, number of specimens collected, location collected, specimen status (e.g., herbarium sheet, preserved in alcohol/formalin, tanned and mounted, dried and boxed, etc.), and current location.
- Collected specimens that are not consumed in analysis or discarded after scientific analysis remain federal property. The NPS reserves the right to designate the repositories of all specimens removed from the park and to approve or restrict reassignment of specimens from one repository to another. Because specimens are Federal property, they shall not be destroyed or discarded without prior NPS authorization.
- Each specimen (or groups of specimens labeled as a group) that is retained permanently must bear NPS labels and must be accessioned and cataloged in the NPS National Catalog. Unless exempted by additional park-specific stipulations, the permittee will complete the labels and catalog records and will provide accession information. It is the permittee's responsibility to contact the park for cataloging instructions and specimen labels as well as instructions on repository designation for the specimens.

- Collected specimens may be used for scientific or educational purposes only, and shall be dedicated to public benefit and be accessible to the public in accordance with NPS policies and procedures.
 - Any specimens collected under this permit, any components of any specimens (including but not limited to natural organisms, enzymes or other bioactive molecules, genetic materials, or seeds), and research results derived from collected specimens are to be used for scientific or educational purposes only, and may not be used for commercial or other revenue-generating purposes unless the permittee has entered into a Cooperative Research And Development Agreement (CRADA) or other approved benefit-sharing agreement with the NPS. The sale of collected research specimens or other unauthorized transfers to third parties is prohibited. Furthermore, if the permittee sells or otherwise transfers collected specimens, any components thereof, or any products or research results developed from such specimens or their components without a CRADA or other approved benefit-sharing agreement with NPS, permittee will pay the NPS a royalty rate of twenty percent (20%) of gross revenue from such sales or other revenues. In addition to such royalty, the NPS may seek other damages to which the NPS may be entitled including but not limited to injunctive relief against the permittee.
7. **Reports** - The permittee is required to submit an Investigator's Annual Report and copies of final reports, publications, and other materials resulting from the study. Instructions for how and when to submit an annual report will be provided by NPS staff. Park research coordinators will analyze study proposals to determine whether copies of field notes, databases, maps, photos, and/or other materials may also be requested. The permittee is responsible for the content of reports and data provided to the National Park Service.
 8. **Confidentiality** - The permittee agrees to keep the specific location of sensitive park resources confidential. Sensitive resources include threatened species, endangered species, and rare species, archeological sites, caves, fossil sites, minerals, commercially valuable resources, and sacred ceremonial sites.
 9. **Methods of travel** - Travel within the park is restricted to only those methods that are available to the general public unless otherwise specified in additional stipulations associated with this permit.
 10. **Other permits** - The permittee must obtain all other required permit(s) to conduct the specified project.
 11. **Insurance** - If liability insurance is required by the NPS for this project, then documentation must be provided that it has been obtained and is current in all respects before this permit is considered valid.
 12. **Mechanized equipment** - No use of mechanized equipment in designated, proposed, or potential wilderness areas is allowed unless authorized by the superintendent or a designee in additional specific conditions associated with this permit.
 13. **NPS participation** - The permittee should not anticipate assistance from the NPS unless specific arrangements are made and documented in either an additional stipulation attached to this permit or in other separate written agreements.
 14. **Permanent markers and field equipment** - The permittee is required to remove all markers or equipment from the field after the completion of the study or prior to the expiration date of this permit. The superintendent or a designee may modify this requirement through additional park specific conditions that may be attached to this permit. Additional conditions regarding the positioning and identification of markers and field equipment may be issued by staff at individual parks.
 15. **Access to park and restricted areas** - Approval for any activity is contingent on the park being open and staffed for required operations. No entry into restricted areas is allowed unless authorized in additional park specific stipulations attached to this permit.

16. **Notification** - The permittee is required to contact the park's Research and Collecting Permit Office (or other offices if indicated in the stipulations associated with this permit) prior to initiating any fieldwork authorized by this permit. Ideally this contact should occur at least one week prior to the initial visit to the park.

17. **Expiration date** - Permits expire on the date listed. Nothing in this permit shall be construed as granting any exclusive research privileges or automatic right to continue, extend, or renew this or any other line of research under new permit(s).

18. **Other stipulations** - This permit includes by reference all stipulations listed in the application materials or in additional attachments to this permit provided by the superintendent or a designee. Breach of any of the terms of this permit will be grounds for revocation of this permit and denial of future permits.

APPENDIX B: INVESTIGATOR ANNUAL REPORTS

Atmosphere/Climate/Weather
<p>National Oceanic and Atmospheric Administration. <i>U.S. Regional Climate Reference Network</i> (LAME-2011-SCI-0020)</p> <p>This site is currently transmitting temperature and precipitation measurements. The latest data is available from the following URL:</p> <p>http://www.ncdc.noaa.gov/crn/usrcrn/</p>
Birds/Ornithology
<p>SWCA Environmental Consultants. <i>Southwestern Willow Flycatcher Studies</i> (LAME-2008-SCI-0013)</p> <p>No activity was conducted this report year.</p>
<p>United States Geological Survey-Western Ecological Research Center. <i>Population Status and Reproductive Ecology of the Western Burrowing Owl (<i>Athene cunicularia hypugaea</i>) in Clark County, NV</i> (LAME-2008-SCI-0019)</p> <p>Report Pending</p>
<p>South Sierra Research Station. <i>Lower Colorado River Distribution and Habitat use by the Yellow-billed Cuckoo (<i>Coccyzus americanus</i>) under the Bureau of Reclamation Multi Species Conservation</i> (LAME-2009-SCI-0014)</p> <p>Report Pending</p>
<p>Joseph Barnes, Independent Research Project. <i>Dietary Assessment of Peregrine Falcons and Prairie Falcons within Lake Mead National Recreation Area (2011-2013)</i> (LAME-2011-SCI-0027)</p> <p>Collection of prey remains from peregrine falcon and prairie falcon nest areas was hampered in the fall of 2011 because a comprehensive assessment of reproductive efforts of either species was not conducted during that year's breeding season. This limited the ability of the PI to identify and access current nests from the targeted territories. Benefiting from assistance from NPS staff, The PI attempted to collect prey remains from all peregrine territories. However, at times the actual nest location used in 2011 was unknown so the PI assessed the sites and collected from historical nests when applicable. Prey remains were collected from six peregrine falcon territories and two prairie falcon territories from 10 November to 10 December. The PI did not collect prey from one targeted territory (Boyscout Canyon) because the nest cliff was deemed unsafe to climb. All prey remains have been retained in storage by the PI to await identification and analysis until prey is collected after the 2012 breeding season for the two species.</p>
Cave / Karst
<p>Dixie Sate College. <i>A baseline survey of water and soil chemistry in KyPet Cavern.</i> (PARA-2011-SCI-0005)</p> <p>No activity was conducted this report year.</p>
<p>U.S. Geological Survey, Astrogeology Team. <i>Caves as a record of Climate Change & Biodiversity.</i> (PARA-2011-SCI-0001)</p> <p>During 2011, we placed 42 instruments in Resort Cave and 25 in Basket Cave. Deployment of temperature and humidity sensors in Basket Cave occurred June 2011; the deployment of sensors to Resort Cave occurred 28 Aug- 03 Sep 2011.</p>

Cave / Karst (continued)
<p>Merriam-Powell Center for Environmental Research-Northern Arizona University. <i>Ecological Inventory of 15 Caves on Grand Canyon-Parashant National Monument</i> (PARA-2010-SCI-0001)</p> <p>From this work, two milestones have been attained: (1) inventory of several caves on Parashant for hibernating and torporing bats, and (2) bait sampling of one cave for cave adapted arthropods.</p> <p>We surveyed 11 caves in Mohave County, Arizona from 05 – 11 February 2011. Nine caves occurred on Parashant, and two were on Bureau of Land Management, Arizona Strip Field Office lands. We detected 65 bats consisting of 59 <i>C. townsendii</i>, 5 <i>Myotis</i> sp. and 1 unknown bat species. The unknown bat was roosting upright with the majority of its body lodged within a small pocket on the ceiling. Only the interfemoral membrane was observable.</p> <p>We identified two bat hibernacula (Basket cave, n=44 and Jerky cave, n=17), and three “torpor” caves (Eldel cave, n=1; Bibbidi cave, n=1; and Millipede cave, n=2). In the “torpor” caves, bats were roosting in the entrances and twilight zones. Millipede Cave is not located on NPS lands; it occurs on adjacent BLM Arizona Strip Lands.</p> <p>From 29 April through 02 September, we inventoried Resort Cave for cave adapted taxa. We deployed 21 bait sampling stations and conducted timed direct intuitive searches (at 20 minutes) at two locations within the deep zones of this cave. Bait stations consisted of seven sweet potato, seven chicken liver and seven tree branch/ bark baits (<i>Juniperus osterosperma</i>). All bait stations were checked daily for two days, and tree branch/bark baits remain deployed and will be checked on subsequent visits to the cave.</p> <p>Crickets from the recently identified new genus (cf. <i>Ceuthophilus</i> nov. sp. nov.) were the most commonly observed species during this study. We observed 122 individuals and collected 12 specimens on day one, and 125 and 14 specimens on day two. Because mark/recapture techniques were not employed, double counting between days one and two is likely. Due to the large population of crickets within this cave, chicken liver and sweet potato baits were completely consumed by crickets upon the second day of monitoring.</p> <p>One cave adapted centipede was discovered, and this represents the first record of a cave-adapted centipede for Arizona. This new species is belongs to the family Anopsobiidae and appear closely related to the genus <i>Buethobius</i>. More work will be required to sort out the taxonomy and describe this new species. Wynne is working with Dr. Bill Shear to do this.</p> <p>All other materials have either been sent out to taxonomic specialists or will need to be further examined by Wynne using existing taxonomic keys. Final results from the bait sampling effort will be written up as park of Wynne’s doctoral dissertation.</p>
Ecology
<p>UNLV. <i>Mesquite and Acacia Community Assessment in Lake Mead National Recreation Area</i> (LAME-2011-SCI-0016)</p> <p>Report Pending</p>
<p>Northern Arizona University. <i>Inventory of Tamarisk Leaf Beetle (<i>Diorhabda carinulata</i>) and Vegetation in Lake Mead Recreation Area</i> (LAME-2011-SCI-0017)</p> <p>Report Pending</p>
Exotic / Invasive Species
<p>Wen Baldwin, Independent Research Project. <i>Dreissenid Mussel Collecting</i> (LAME-2009-SCI-0020)</p> <p>“n/a”</p>
<p>Nevada Department of Agriculture. <i>Gypsy moth survey</i> (LAME-2011-SCI-0003)</p> <p>Ten traps were placed throughout the park's campgrounds and visitor centers. All traps were negative for gypsy moth (<i>Lymantria dispar</i>).</p>

Exotic / Invasive Species (continued)
<p>Portland State University. <i>Field evaluation of the service life of foul-release coatings in Columbia River</i> (LAME-2011-SCI-0008)</p> <p>No activity was conducted at Lake Mead NRA this report year.</p>
<p>University of Arizona. <i>Genetic Characterization of The Lake Mead Population of the Invasive Mussel Dreissena bugensis (Quagga mussel)</i> (LAME-2011-SCI-0013)</p> <p>During this report year the specimens previously collected at Lake Mead NRA were analyzed using genetic microsatellites. No new specimens were taken.</p>
<p>Tamarisk Coalition. <i>Tamarisk Biological Control Monitoring</i> (LAME-2011-SCI-0021)</p> <p>No activity was conducted this report year</p>
<p>National Park Service. <i>Monitoring for Quagga Mussels</i> (LAME-2007-SCI-0022)</p> <p>Report Pending</p>
<p>UNLV. <i>Quagga Mussel Monitoring in Lake Mead</i> (LAME-2010-SCI-0011)</p> <p>A total of 152 samples were collected from different basins of Lake Mead with intensive sampling in the Boulder Basin. The data are not normally distributed (Shapiro-Wilk Test, $W = 0.53$, $P < 0.0001$). The mean density is 4,613 mussels per square meter with maximum and minimum values as 76500 and 0 mussels per square meter. Among these 152 samples, 104 samples were collected from soft sediments and 48 were collected from rocky areas. Hard substrate samples were collected by NPS divers, who surveyed 3 transects at depths from 10 to 100 ft. Soft substrates were sampled by UNLV investigators and NPS staff, utilizing Ponar Grabs (0.052 m²). The soft sediment samples were collected from 8 transects from Boulder Basin (4 transects), Overton Arm (1 transect), Virgin Basin (1 transect), Temple Bar (1 transect), and Greg Basin (1 transect) at various depths. For the hard substrate samples, the mean density was 8,078 mussels per square meter; for the soft sediment samples, the mean density was 3,014 mussels per square meter. For a long-term monitoring plan, the stratified random sampling is used to estimate how many sampling points are needed to have a statistically representation of the entire lake. To have a 95% confidence level in representing quagga mussels in Lake Mead, 11 hard substrates and 245 soft sediment samples are needed for annual survey. It is recognized, however, that funding and human resource limitations exist that would preclude such a rigorous sampling regime at the present time. Therefore, the Interagency Quagga Mussel Meeting group must work together to identify a smaller subset of sampling sites to meet agency information needs.</p>
<p>U.S. Geological Survey-Southwest Ecological Research Center. <i>Visual and Infrared Monitoring of Tamarisk and the Tamarisk Beetle on the Virgin River, Nevada</i> (LAME-2010-SCI-0016)</p> <p>Report Pending</p>
<p>UNLV. <i>Potential Impacts of Invasive Quagga Mussels on Diet and Feeding Habitats of Young of the Year (YOY) Striped Bass in Lake Mohave</i> (LAME-2010-SCI-0020)</p> <p>In the present study, we investigate food resources of invasive quagga mussels in Lake Mohave of the lower CO. River using stomach content analysis. Usually stomach contents reflected available food resources in their immediate habitat. Adult quagga mussels were collected from three locations of Lake Mohave in summer and fall of 2011: Cottonwood Island Cove, Golden Door Cove, and Orion Cove. More than 50 microalgae species were found in mussels' stomach. The most dominant group is diatom, such as <i>Achnanthis minutissimum</i>, <i>Pseudostaurosira brevistriata</i>, <i>Nitzschia denticula</i>, <i>Denticula</i> sp., <i>Gomphonema</i> sp., <i>Cocconeis placentula</i>, and <i>Cyclotella ocellata</i>. Cyanobacteria and Chlorophyta were also present in some mussels. No significant difference in the density of total microalgae was found among the three locations or between the two sampling seasons (Two-way analysis of variance, $P > 0.05$). In addition, some zooplankton and benthic organisms were also found from mussels' stomach, such as cladocera, rotifers, ostracod, copepod nauplii, quagga mussel veligers, and oligochaetes. This experiment shows that quagga mussels can take advantage of the organism in their habitat. Therefore, high density of quagga mussels can be potential food competitors to other organisms that share the same feeding habitat.</p>

Exotic / Invasive Species (continued)
<p>UNLV. <i>Develop Effective Decontamination Protocols for Wildland & Firefighting Equipment Exposed to Quagga/Zebra Mussels: Testing the Efficacy of Quaternary Ammonium Compounds on Killing Dreissenid Veligers & Adults</i> (LAME-2010-SCI-0021)</p>
<p>Quats 128 and 256 were used and testing concentrations were: Control (0), 1%, 3% and 5%. Mortality was assessed every 6, 12, then 24 hours. Results showed that 100% mortality was reached by 48 hours in all treatment groups (both Quat 128 and 256) but controls were also alive at 48 h.</p>
<p>UNLV. <i>Using Pressurized Hot Water Spray to Kill and Remove Dreissenid Mussels on Watercraft: Field Testing on the Efficacy of Water Temperature, High Pressure, and Duration of Exposure</i> (LAME-2010-SCI-0022)</p>
<p>High Pressure boat decontamination using 1500 psi and 3000 psi at Lake Mead, NV in winter months. The results showed that fresh out of the water, average time 369 s was needed for 3000 psi on mussels with high density and 562 was needed for 1500 psi on mussels with low density. For a boat 2 weeks out of water, it took 21.3 s and 3.7 s to remove mussels at high and low densities under 3000 psi; it took 31.3 and 0.2 s to remove all mussels at high and low density under 1500 psi. For a boat 4 weeks of water, it took 21.3 s and 3.7 s to remove all mussels at high and low density under 3000 psi; it took 6.9 s and 0.9 s to remove all mussels at high and low density under 1500 psi.</p>
<p>UNLV. <i>Abundance of quagga mussels in Las Vegas Bay, Lake Mead</i> (LAME-2010-SCI-0023)</p>
<p>In Las Vegas Bay, there is no noticeable trend from inner to outer basin. The mean value is 26,053 mussels per square meter in Las Vegas Bay. However, due to the data are not normally distributed, a median is more appropriate to represent this area and the median density is 1,712 mussels per square meter. A more comprehensive analysis on the distribution of quagga mussels in Las Vegas Bay and how mussels are potentially affected by environmental variables such as temperature, oxygen, nutrients, sediment composition along Las Vegas Bay.</p>
<p>UNLV. <i>Sterile male release technique (SMRT) with irradiation as a potential novel method for attenuating invasive quagga mussels – A laboratory experiment</i> (LAME-2011-SCI-0006)</p>
<p>We used the range of exposures 0 (control), 600, 3000, 4000, and 5000 rads to determine an optimal level that damages the gametes without being lethal. The results demonstrated that quagga mussels were highly tolerant of X-Ray irradiation with high survival rates (> 95%) after treatment. Mussels from all treatments produced motile sperms and these sperms were able to bind and fuse with eggs. There was a decrease in sperm binding between treatments, which are most likely due to decreased motility and not an irradiation-induced deficiency of sperm binding mechanisms. Surprisingly, fertilized eggs in all treatments were able to divide and produce swimming trochophores. In terms of larval formation and developmental success, irradiation appears to decrease development between zygote and trochophore stage. However, a subpopulation of embryos successfully formed trochophores even at the highest X-Ray dosage. Therefore, the current experiment was not able to produce completely sterile males, even at the highest irradiation of 5000 rads in a single 15 minute session, which is at the prescribed level of human cancer radiation therapy spread over numerous treatments spanning a month. The current experiment did not find an X-Ray dose leading to generate 100% sterile males. Even a higher dose if found, may not be realistic for implementation. Therefore, irradiation may not be an effective tool to manage quagga mussels in open waters, and irradiation generates concerns, such as releasing potential mutant mussels into natural waters.</p>
<p>Southern Nevada Water Authority. <i>Tamarisk feeding invertebrates along the Las Vegas Wash</i> (LAME-2011-SCI-0011)</p>
<p>Numerous observations of tamarisk leafhopper and splendid tamarisk weevil were made throughout the Las Vegas Wash including Las Vegas Bay at Lake Mead NRA. No observations were made of the tamarisk leaf beetle.</p>

Exotic / Invasive Species (continued)
<p>UNLV. <i>Protocol for Testing the Effectiveness of an Algaecide, EarthTec, on Killing and Preventing the Colonization of Quagga Mussels</i> (LAME-2011-SCI-0014)</p> <p>The first portion of the study evaluated the effectiveness of EarthTec®, a copper sulfate based biocide, on killing invasive quagga mussels (adults, juveniles, and veligers) in Lake Mead, NV-AZ, at six doses, 0, 1, 5, 10, 17, and 83 ppm. For adult mussels, 100% mortality was reached by 96 h treated with 17 ppm and 83 ppm EarthTec®; by 168 h, more than 90% mortality was reached treated with 5 ppm and 10 ppm EarthTec®. For juvenile mussels, 100% mortality was reached by 48 h, 72 h, 72 h and 96 h for groups treated with 83 ppm, 17 ppm, 10 ppm and 5 ppm EarthTec®, respectively. For veligers, an EarthTec® dose of 3 ppm or higher killed them within 30 min or less. The second portion of the study tested the effectiveness of EarthTec® on preventing veliger quagga mussel colonization from December 2010 to early February of 2011. Veligers were dosed with 0, 1, 2, and 3 ppm of EarthTec®. Control groups (0 ppm) had more colonized mussel than the groups treated with EarthTec® ($p > 0.01$). Statistical analysis showed that a dose of 2.6 ppm can prevent colonization of quagga mussels in Lake Mead under the experimental conditions. The results showed that EarthTec® is effective in killing adult, juvenile, and veliger quagga mussels and is effective against preventing veliger colonization. This study contributes to the understanding of chemical options that are available for quagga mussel control and prevention.</p>
<p>Colorado State University-Pueblo. <i>Development of new quantitative PCR primers to detect and enumerate Dreissena polymorpha veligers in freshwater</i> (LAME-2010-SCI-0007)</p> <p>Report Pending</p>
<p>Nevada State College. <i>Ecosystem Change and Invasive Species Study</i> (LAME-2010-SCI-0024)</p> <p>Report Pending</p>
<p>University of California – Santa Barbara. <i>Effectiveness Monitoring of Spring-fed Wetlands and Riparian Restoration Treatments</i> (LAME-2009-SCI-0011)</p> <p>During this report year study consisted only of monitoring the distribution and life cycle of Diorhabda, the insect established in the region and now within LAME for the biological control of Tamarix spp. The report related to this and prior work will be submitted to NPS if there is a mechanism for doing so.</p>
<p>Portland State University. <i>Zebra Mussel/Quagga Mussel Monitoring and Education and Outreach</i> (LAME-2010-SCI-0013)</p> <p>Zebra and quagga mussels were not detected in high risk Oregon waters during two years of field surveys. No specimens were collected from National Parks for this task.</p> <p>Public, policy makers, natural resource workers and user groups were educated about the risks and impacts of ANS, especially zebra and quagga mussels, using a variety of education and outreach tools developed during this project. Juvenile and adult quagga mussels were collected from Lake Mead NRA in order to create outreach props. A variety of objects were suspended in Lake Mead for varying time intervals so that quagga mussels attached, and these biofouled objects were then removed from the water, dried at NDOW Lake Mead Hatchery, and shipped to Portland State University where the objects and attached, dead mussels were covered in plastic resin. These outreach props included fishing rod, shoes, bottles and cans, sections of chain, etc. Additionally, dead adult mussels were collected from the shorelines of Lake Mead NRA and shipped to Portland State University where paperweight/ outreach props were created by encasing mussels in clear plastic resin. The outreach props, e.g. fishing rod, are kept at Portland State University and used for displays at events such as Sportmen's Expos, presentations to fishing and hunting clubs, etc. The resin paperweights are distributed to policy makers, non-profit organizations, students, and the Oregon Department of Fish and Wildlife to hand out to general public during encounters at boater inspection stations, etc.</p>
Fire (Behavior, Ecology, Effects)
<p>Northern Arizona University. <i>Interactions between climate and fire in northern Arizona</i> (PARA-2009-SCI-0001)</p> <p>Report Pending</p>

Fish / Ichthyology

BIO-WEST Inc. *Virgin River Fish Survey*(LAME-2011-SCI-0025)

As is typical for the lower Virgin River, native fish captures were relatively low in 2011 compared to non-native captures. With the exception of flannelmouth sucker (*Catostomus latipinnis*), the native fish capture increased between the spring and fall long-term sampling events. The most notable capture was that of two woundfin (*Plagopterus argentissimus*) captured in the September 2011 on the Beaver Dam Wash reach. One woundfin had a total length (TL) of 54 millimeters (mm) and the second woundfin TL was 46 mm. Virgin River chub (*Gila seminuda*) captures increased from 58 individuals in June of 2011 to 246 (81% increase) individuals in September of 2011. Desert sucker (*Catostomus clarkii*) also increased from 428 individuals in the spring to 598 individuals in the fall (58%). Speckled dace (*Rhinichthys osculus*) increased from 244 individuals in June to 2,451 individuals in September (91%). Beaver Dam Wash proper was sampled during the July and September trip and produced the overwhelming increase of speckled dace during the September long-term monitoring trip (1,836 of the 2,451 total captured or 57%). Furthermore, Beaver Dam Wash proper provided an opportunity to sample the Virgin spinedace (*Lepidomeda mollispinus*) community on the Virgin River. A total of 87 Virgin spinedace were captured in July and 304 were captured in September. Lastly, 284 young of year sucker were captured in the spring from the Upper Gorge reach through the Beaver Dam Wash reach, and one young of year was captured between the Mesquite reach and the NDOW Burnsite. While native fish numbers appear relatively low compared to non-native fish captures, 2011 seemed to be a productive year for native fish in the Virgin River compared to past years.

No blue tilapia were found during any of the four sampling trips in 2011; however, gizzard shad (*Dorosoma cepedianum*) were found in the Riverside reach, Mesquite reach, NDOW Burnsite and Halfway Wash reach during the July, August and September sampling trips. Eight species of non-native fish were captured during the June and September long-term monitoring trips. Most notable was the drastic increase of red shiner (*Cyprinella lutrensis*) increasing from 5,298 in June to 24,384 (82% increase) in September. Several piscivorous fish also increased from June to September including: black bullhead (*Ameiurus melas*) (73%), channel catfish (*Ictalurus punctatus*) (76%), and largemouth bass (*Micropterus salmoides*) (94%). Native fish captures decreased between the July and August trips by 93% percent.

BIO-WEST Inc. *Lake Mead Razorback Sucker Study I* (LAME-2011-SCI-0026)

Catch information is reported for three long-term monitoring sites Echo Bay, Las Vegas Bay, the Muddy/Virgin River inflow area and the Colorado River inflow area. As stated previously, this information supplements information provided in Shattuck et al. (2011) and Kegerries and Albrecht (2011), which was sent out previously and contains more detailed, razorback sucker specific information. The most noteworthy observation from 2011 was an increase of razorback captures in Echo Bay (13 in 2010 and 15 in 2011). Several of the razorback sucker were captured from the north shore near the boat ramp, an area that was difficult to sample due to shallow water habitat and public boat ramp usage. This increase in razorback sucker capture in Echo Bay is important because it shows fish returning to the important spawning area in the lake that has been relatively void for several spawning seasons. For the first time a flannelmouth sucker was capture in Las Vegas Bay. The individual was captured southwest corner of the bay, near the 2011 razorback sucker spawning area. The Muddy River/Virgin River inflow area yielded the most captured razorback sucker this year. It is the second year in a row that the fish captures at this location was the highest for the lake. Furthermore, the catch per unit effort was the highest at the Muddy River/Virgin River inflow area during the past 15 years of study (Shattuck et al. 2011). Lastly, a recaptured flannelmouth sucker was captured near the 2011 spawning area at the Muddy River/Virgin River inflow area. There appeared to be an increase in the presence of gizzard shad (*Dorosoma cepedianum*) throughout the entire lake during the 2011 spawning season. The Muddy River/Virgin River inflow area appears to have the highest density of gizzard shad thus far in the lake while Echo Bay seems to have the lowest density (within the portions of the lake that we sample).

As with the long-term monitoring data set, this information is to supplement non-native fish capture data that was not provided in Kegerries and Albrecht (2011). More detailed information about native fish and larval captures can be found in Kegerries and Albrecht (2011). Additionally, a bluehead sucker (*Catostomus discobolus*) was captured near the suspected spawning areas at the Colorado River inflow area. This is the first time this species was observed in Lake Mead. The 2011 sampling season was an impressive increase of native fish captures in this area compared to the 2010 sampling season. All native fish were tagged with PIT tags and fin ray clips were taken for aging purposes. Several other species of non-native fish were also observed, the most abundant were common carp (*Cyprinus carpio*) and gizzard shad. Continued effort in this area may prove it to be a critical area for native species in the lower Colorado River basin.

Sampling in 2012, is scheduled to begin in February and will follow monitoring protocols outlined in Albrecht et al. (2006), and continue during March and April. The goal to capture wild razorback sucker at the Colorado River inflow was achieved during the 2011 spawning season, for the second consecutive year. It was accomplished using sonic-tagged razorback to locate wild fish. Continued study can help to characterize adult spawning locations, population size, and possible nursery habitat for sub-adult razorbacks in this new area. For additional results and conclusions please see Kegerries and Albrecht (2011). Sampling at all sites on Lake Mead is scheduled to continue in January of 2012.

<p>Geology / General</p> <p>UNLV. <i>Late Cenozoic Mapping of the Spirit Mountain SE 7.5 minute quadrangle, Arizona-Nevada</i> (LAME-2007-SCI-0023)</p> <p>No activity was conducted this report year.</p>
<p>U.S. Geological Survey, Western Earth Surface Processes Team. <i>Geologic map of the Lake Mead National Recreation Area and surrounding areas</i> (LAME-2008-SCI-0012)</p> <p>Report Pending</p>
<p>University of Reno. <i>Relations between magmatism and extension in the northern Colorado River extensional corridor, northwest AZ and southern NV</i> (LAME-2009-SCI-0009)</p> <p>Report Pending</p>
<p>Geomorphology / Surface Processes</p> <p>UNLV. <i>Provenance Study of Conglomerates at Callville Bay and Sandy Cove</i> (LAME-2011-SCI-0004)</p> <p>We determined that clasts from the Henry's Mountains and the Pine Valley Volcanic field (both in Utah) are geochemically distinct. We found clasts at Sandy Point and Callville Bay that match the Henry Mountain samples. We found no clasts within the Muddy Creek Formation near Overton that matched either the Henry Mountain or Pine Valley sources.</p>
<p>Geostructure / Tectonics</p> <p>UNAVCO Inc. <i>Plate Boundary Observatory (PBO) component in Lake Mead National Recreation Area to monitor tectonic and magmatic process using high precision GPS</i> (LAME-2011-SCI-0010)</p> <p>UNAVCO operates one GPS station in Lake Mead NRA, P006: 36.154183, -114.456898</p> <p>This site was visited on August 18, 2011 by two engineers for one day. Please see maintenance report for more information.</p> <p>All PBO UNAVCO maintenance reports can be accessed online at pbo.unavco.org > Station Home Page (on right side, middle of the page), enter station number</p>
<p>UNLV. <i>Muddy Creek Formation: a Record of Late Miocene Tectonics and Sedimentation in Southern Nevada</i> (LAME-2009-SCI-0024)</p> <p>No field activities were completed during the reporting year. Research activities were limited to data analysis and dissertation writing.</p>
<p>Herpetology (Amphibians / Reptiles)</p> <p>National Park Service. <i>Relict Leopard Frog Monitoring and Management</i> (LAME-2008-SCI-0006)</p> <ul style="list-style-type: none"> • Spring-time surveys were completed at all natural and active experimental sites. High-counts of adult and juvenile frogs at sites were similar to counts last year, and a maximum of 585 frogs was tallied across sites. The number of frogs at natural sites remains relatively low, and almost 80% of frogs counted were at the experimental sites. Low counts and limited apparent recruitment continues to be of concern at Rogers and Lower Blue Point, and the frogs observed at Upper Blue Point were mostly marked animals released at this site over the last few years. No relict leopard frogs were observed this spring at Perkins Pond (following observations of adult frogs last year from the initial releases). Partial egg masses and some newly hatched tadpoles were collected and brought to the lab for headstarting from three sites in Black Canyon as well as from Lower Blue Point Spring. Union Pass Spring was permitted for experimental translocation and received its first animals. To date, a total of 347 Black Canyon animals were released at Quail and Union Pass springs, and a total of 990 Blue Point animals were released at Lower Blue Point Spring, Rogers Spring and Perkins Pond. Sampling for Bd, the causal agent of chytridiomycosis, was conducted at Black Canyon Side Spring, Tassi Spring, and Upper and Lower Blue Point. Bd was detected on frogs at Lower Blue Point Spring (as seen in 2010). Positive detections were also observed in samples of bullfrogs from the Muddy River near Perkins Pond.

Herpetology (Amphibians / Reptiles) continued

National Park Service. *Population dynamics and habitat requirements of Rana onca, the Relict Leopard Frog, at Lake Mead National Recreation Area* (LAME-2008-SCI-0007)

Report Pending

U.S. Fish and Wildlife Service. *Desert Tortoise Population Monitoring Using Line Distant Sampling Methodology Throughout the Mojave Desert* (LAME-2008-SCI-0010)

The total number of kilometers walked within LMNRA was approximately 163.5 km on 15 transects. Of these, 90.0 km were walked on 8 transects in the Grand Canyon-Parashant National Monument; the area that corresponds to Gold Butte-Pakoon critical habitat was surveyed. The remainder of the transects were completed in the southern portion of the National Recreation Area that is also designated as Piute-Eldorado critical habitat. Four live tortoises and 4 shell remains were observed in the latter area; 3 of the live animals were over 180mm midline carapace length (MCL). Two live tortoises over 180 mm MCL and no shell remains were observed in GCPNM. Live animals greater than 180mm MCL are used for line distance sampling analysis.

More animals were certainly present on these transects. Observation of nearby (not on NPS lands) transmitters indicated that 14% of tortoises in Piute-Eldorado and 36% of tortoises in GCPNM were not visible (deep in burrows) while transects were walked. In addition, distance analysis indicates that due to terrain, vegetation cover, and the cryptic nature of tortoises, only 43% of visible tortoises within 20m of the transect centerline were seen by transect walkers in GCPNM. In Piute and Eldorado Valleys, only 32% of visible tortoises were seen to that distance.

Once these and other results have been incorporated into the annual range-wide analysis report for the 2011 monitoring effort (this spring) it will be available at http://www.fws.gov/nevada/desert_tortoise/dt_reports. The associated spatial data will also be posted at that time and can be requested through http://www.mojavedata.gov/deserttortoise_gov/recovery/data.php.

U.S. Geological Survey-Biological Resources Division. *Genetic Variation of Isolated Island and the Adjacent Mainland Populations of common lizards and small mammals in Lake Mead National Recreation Area.* (LAME-2010-SCI-0005)

On October 14, 2011 we investigated the status of 3 of the islands, Battleship, Sentinel, and Boulder Islands and determined the difficulty that we might have to encounter in order to gain access to go ashore on them. Battleship Island was very steep in most of the locations and appeared to be a formidable task to get on shore. Second we viewed Sentinel Island and determined that we could get ashore on the south east side. Lastly, we viewed the Boulder Islands and determine that Rock Island might prove the simplest to get on shore. We went on shore on Sentinel Island at approximately 10:30 AM on October 14, 2011. The shore was steep with approximately a 2 meter soft sand bluff which had to be traversed to gain access to the island. Within a few minutes we were able to noose 2 Side-blotched lizards *Uta stansburiana* (1 Male & 1 Female) on the southeast side of Sentinel Island and collect a genetic sample. Each sample was then placed in 95% Ethanol and stored in a cooler chest. Subsequent searches produced observations of *Uta* although none were captured, and no other species of lizards were seen nor collected. On October 29, 2011 we went to the vicinity of Hemenway Harbor to search for side-blotched lizards (*Uta stansburiana*) that would serve as mainland samples for our study. We collected 20 Side-blotched lizards (10 males and 10 females) and gathered genetic samples (tail samples) and measured and released the lizards where captured.

Inventory Natural Resources

U.S. Department of Agriculture, Forest Service. *Annual Forest Land Inventory of Arizona and Nevada* (LAME-2008-SCI-0015)

No plots last year:

We did not field any field sites in Lake Mead National Recreation Area during the 2011 field season. Due to the random location of our plots, we may have locations inside the Recreation Area in 2012 or beyond. We will contact the NRA's research coordinator(s) and specify the location(s) we plan to sample, prior to 2013.

Clark County Desert Conservation Program. *Clark County Rare Plant Inventories* (LAME-2009-SCI-0005)

Report Pending

Inventory Natural Resources cont.
<p>National Park Service. <i>Road Kill Specimens</i> (LAME-2009-SCI-0015)</p> <p>Specimens inventoried and cataloged through Education Outreach database in the Branch of Interp and Ed, Division of Visitor Services.</p>
<p>Southern Utah University. <i>Targeted Vegetation Survey & Prep of NPS Technical Report on Flora of Grand Canyon-PARA, AZ (or Annotated Vascular Plant Database & Pub for Grand Canyon-PARA – Phase II)</i> (PARA-2010-SCI-0003)</p> <p>Report Pending</p>
Invertebrates (Insects, Other)
<p>University of Vermont & State Agricultural College. <i>Evolution of major geographic variation in social structure of a desert ant</i> (LAME-2008-SCI-0011)</p> <p>Ant queens were collected in the Park during March 2011. The numbers of queens per new starting nests was recorded as part of an ongoing study of those numbers over time.</p>
<p>College of Southern Nevada. <i>Entomology Survey of the Lake Mead National Recreation area</i> (LAME-2008-SCI-0014)</p> <p>Report Pending</p>
<p>Eastern Carolina University. <i>Deciphering systematic relationships among three Western North American tarantula sister species in the Aphonopelma “eutylum group”</i> (LAME-2010-SCI-0008)</p> <p>Report Pending</p>
<p>UNLV. <i>Physiological Ecology of Drosophila mojavensis</i> (LAME-2010-SCI-0019)</p> <p>We placed 10 dataloggers at a site ~4 miles south of Gregg's Hideout. These were attached to pieces of flagging tape tied to creosote bushes. They began recording hourly temperature and humidity data beginning in June 2010. Every four months we collect the dataloggers to download the recordings and deploy new ones to provide a continuous record.</p> <p>Temperatures reached below freezing during the winter and exceeded 50 oC on several days in July. Relative humidities ranged from <1 %RH on several days in July to 100 %RH (raining).</p>
Mammals
<p>Arizona Game and Fish Department. <i>Evaluation of Measures to Promote Desert Bighorn Sheep Highway Permeability Phase III-Post Construction U.S. Highway 93</i> (LAME-2010-SCI-0009)</p> <p>We have collared sheep since 2004 to cover pre-during and post-construction evaluation of sheep movements. In November 2010 and January 2011 we collared 35 sheep to begin post construction monitoring of the overpasses and fencing. In 2010 we worked with ADOT to incorporate video surveillance systems in the overpasses, these will be completely up and running by March 2011, coinciding with the completion of sheep fencing to funnel sheep to the overpasses. As a backup we installed Reconyx still cameras on the overpasses and will do the same on the two bridges and possibly a few culverts. Official post-construction monitoring will begin once all fencing is in place.</p>
<p>U.S. Geological Survey-Western Ecological Research Center. <i>Development of a Habitat Management Plan to Maintain Viability of the Desert Bighorn Sheep Population in the River Mountains, Nevada: Phase I.</i> (LAME-2011-SCI-0022)</p> <p>Report Pending</p>

Monitor Natural Resources
<p>Southern Nevada Water Authority. <i>Handling desert tortoise, banded gila monster & chuckwalla in association with biological monitoring of construction activities for the SNWA construction projects on NPS lands</i> (LAME-2009-SCI-0016)</p> <p>Monitoring of the construction site continued. No species covered under this permit were moved or harmed during the year.</p>
<p>U.S. Department of Agriculture. <i>Lake Mead National Recreation Area Ecosystem Health Monitoring Study</i> (LAME-2009-SCI-0013)</p> <p>Report Pending</p>
Mosses / Bryophytes
<p>UNLV. <i>Bryophytes of the Mojave Desert</i> (LAME-2002-SCI-0040)</p> <p>Conducted a spore bank pilot study near the North Shore Road. Findings were negative (spores did not germinate in the collected sand samples following a recent storm flow).</p>
Plant Communities (Vegetation)
<p>National Park Service. <i>Plant Surveying, Monitoring, Mapping and Collecting</i> (LAME-2008-SCI-0002)</p> <p>Report Pending</p>
<p>UNLV. <i>Collection of classification & accuracy assessment field data in support of vegetation mapping of four Mojave Desert Network parks</i> (LAME-2010-SCI-0001)</p> <p>Report Pending</p>
<p>UC Davis. <i>Population Genetics and systematics of Yucca brevifolia (Agavaceae)</i> (LAME-2010-SCI-0012)</p> <p>No activity was conducted this report year.</p>
<p>UNLV. <i>Investigation of plant colonization and succession in the Lake Mead drawdown zone</i> (LAME-2011-SCI-0001)</p> <p>Report Pending</p>
<p>Salisbury University. <i>Quantification of Nordihydroguaiaretic acid(NDGA)in field collected Larrea tridentate</i> (LAME-2010-SCI-0017)</p> <p>Report Pending</p>
<p>U.S. Geological Survey. <i>Germination, recruitment and demography of Joshua trees (Yucca brevifolia) in National Parks in the Mojave Desert (Lake Mead NRA)</i> (LAME-2011-SCI-0009)</p> <p>A manuscript pertaining to Joshua tree seed dispersal was accepted for publication in a peer-reviewed journal. Waitman, B.A., S.B. Vander Wall, and T.C. Esque. Online 2012. Seed dispersal and seed fate in Joshua tree (<i>Yucca brevifolia</i>). <i>Journal of Arid Environments</i>.</p> <p>We presented a poster at the Ecological Society of America Conference in August in Austin, TX pertaining to the germination of Joshua trees. Reynolds, M.B.J; DeFalco, L; Esque T.; ESA 96th annual meeting (2011). Germination and establishment of the Joshua tree (<i>Yucca brevifolia</i>) in the northeast Mojave Desert: Implications for management of an iconic species. (Abstract ID:31269).</p> <p>A manuscript is prepared and currently in internal review pertaining to these findings.</p>

Plant Communities (Vegetation) continued
<p>U.S. Geological Survey. <i>Germination, recruitment and demography of Joshua trees (Yucca brevifolia) in National Parks in the Mojave Desert (Parashant NM)</i> (PARA-2011-SCI-0002)</p> <p>A manuscript pertaining to Joshua tree seed dispersal was accepted for publication in a peer-reviewed journal. Waitman, B.A., S.B. Vander Wall, and T.C. Esque. Online 2012. Seed dispersal and seed fate in Joshua tree (<i>Yucca brevifolia</i>). <i>Journal of Arid Environments</i>.</p> <p>We presented a poster at the Ecological Society of America Conference in August in Austin, TX pertaining to the germination of Joshua trees. Reynolds, M.B.; DeFalco, L; Esque T.; ESA 96th annual meeting (2011). Germination and establishment of the Joshua tree (<i>Yucca brevifolia</i>) in the northeast Mojave Desert: Implications for management of an iconic species. (Abstract ID:31269).</p> <p>A manuscript is prepared and currently in internal review pertaining to these findings.</p>
Soils
<p>UNLV. <i>Restoring function of biological soil crusts on gypsum-dominated soils in the Eastern Mojave, Lake Mead NRA</i> (LAME-2010-SCI-0006)</p> <p>In April and May 2011 a subset of the soil crust monitoring plots were observed for survival. All plots that received dry crust inoculants had survival. Plots that were established in highly disturbed areas did not show any natural re-establishment of BSC organisms. BSC organisms collected from the field in October 2008 by NPS Lake Mead NRA personnel that are still in storage were tested for survival under current storage conditions (dry, in 4 degree C cold room) using fluorescence parameters. Preliminary observation suggests that BSCs, particularly <i>Collema</i> lichen species, are able to survive long-term storage. The final survival surveys of BSC plot treatments will occur in March 2012.</p>
<p>UNLV. <i>Predicting recovery of biological soil crusts</i> (LAME-2011-SCI-0002)</p> <p>This study has been terminated. No data were collected.</p>
<p>U.S. Geological Survey, Colorado Plateau Research Station. <i>Collection of Soil Samples and Rock Swabs from Bat Hibernacula Caves: Monitoring of White-Nosed Syndrome in the West</i> (PARA-2011-SCI-0003)</p> <p>We collected two samples at six sites within Basket Cave and at one site on the surface (used as a control). Samples were collected at depths of 0 cm and 10cm following techniques developed by the Microbial Genetics and Genomics Lab at NAU. All sampling sites within the cave were plotted on a cave map, and we collected GPS coordinates for the control site. To date, most of the samples have been processed and cataloged and <i>Geomyces destructans</i> was not detected at this cave.</p>
Threatened / Endangered / Rare Species
<p>U.S. Fish and Wildlife Service. <i>River Mountains Desert Tortoise Translocation Effectiveness Monitoring</i> (LAME-2009-SCI-0021)</p> <p>Note: A single male resident tortoise had a home range that overlapped National Park Service land, therefore very little activity was conducted on Lake Mead National Recreation Area. This tortoise was found dead of suspected predation on 3 August 2011.</p> <p>We continued to radio-track both resident and translocated tortoises approximately weekly during the active season and twice a month during their inactive season. Mass and carapace length measurements were recorded monthly when possible. Additionally, resident tortoises that were encountered opportunistically were marked. We began 2011 tracking nine resident and seven translocated tortoises at the hill site and six resident and four translocated tortoises at the valley site. In collaboration with the San Diego Zoo, Bureau of Reclamation, and the University of Nevada – Reno, we conducted a single health assessment that included the collection of blood, nasal fluid, and swabs of the oral cavity on tortoises that were accessible during one of the sampling periods (May, June, and October). Samples from 18 of the telemetered tortoises were sent to the San Diego Zoo for analysis of exposure to <i>Mycoplasma</i> spp. and herpesvirus.</p> <p>After two years of no mortality among our transmittered tortoises at the hill site, four (one male, three females) of seven</p>

Threatened / Endangered / Rare Species (continued)

translocated and one (male) of nine resident tortoises died in 2011. Additionally, one resident male and one translocated female at the hill site were lost. Only the transmitters were found and the fate of those animals remains unknown. Another resident female at the hill site was found under circumstances that appeared as though the approach of the field biologist tracking the tortoise had interrupted an attack by a predator. The tortoise's transmitter was reattached and the animal survived the rest of the year. At the valley site, one (male) of six remaining resident tortoises and none of the remaining four translocated tortoises died. Many of the mortalities appeared to be predation related and occurred in June through early August. A male hill site tortoise did not emerge from its shelter site in spring. A scope was used to look into the cave and the tortoise's empty shell and a front leg were seen. Although predation is the suspected cause of death in most cases, other causes of death followed by scavenging cannot be ruled out definitively.

Biological samples from five resident and four translocated tortoises at the hill site and five resident and four translocated tortoises at the valley site were analyzed using TaqMan real-time PCR for *Mycoplasma agassizii*, *Mycoplasma testudineum*, and tortoise herpesvirus. Three tortoises at the hill site, (1 resident male and 2 translocated females) were positive for tortoise herpesvirus 2 (THV2) and the male was also positive for *Mycoplasma agassizii*. At the valley site, a resident female was positive for *Mycoplasma agassizii* and a resident male was positive for tortoise herpesvirus 2. Two of the tortoises that were positive for THV2 were among those that died later in the season.

None of the translocated tortoises have returned to their former home area on the west side of the River Mountains. It seemed that predation, likely by coyotes, affected tortoise survival again this year. Tortoise herpesvirus2 was found in both resident and translocated tortoises. Because sampling for this pathogen in wild desert tortoise populations has begun recently, we do not yet know the implications of these findings. Full analysis of the data will follow.

Arizona State University. *Lake Mead and Lake Mohave Fisheries Study* (LAME-2011-SCI-0005)

Decline of Lake Mohave razorback sucker has been documented three-plus decades. A repatriation program has captured the genetic legacy of the wild population; however, persistence of the repatriate population depends on active management.

A three-year study focused on demographics and post-stocking survival of repatriated razorback sucker in the lake. Five questions were pursued between October 2008 and May 2011: (1) post-stocking dispersal and fate, (2) routine monitoring and population estimation, (3) creel census, (4) ecological modeling, and (5) PIT scanning.

In 2008, adult razorback sucker from Yuma Cove Backwater and subadults reared at Willow Beach were implanted with acoustic transmitters, released in Fortune Cove and telemetered for six months. Sixty-seven percent of subadults and 80% of adults remained active. Thirty five percent of telemetered adults dispersed upstream where large aggregations were observed; no subadults released in 2008 were detected there. Five transmitters were recovered; no fish remains were observed near transmitters. A second study in autumn 2009, adult razorback sucker from Lake Mohave near Hoover Dam and 14 adults reared at AZGFD BP Hatchery were implanted, released near Hoover Dam and Willow Beach, and telemetered for six months. All fish from both groups remained active. Approximately 50% of fish remained upstream of Willow Beach.

Routine monitoring during December 2008, March and December 2009, March and December 2010, and March 2011 captured 60 razorback sucker. Population estimates declined for wild fish; however, the repatriate population increased by 100+% between 2009 and 2010. Wild estimates declined from 24 fish (9-480 95% CI) in 2009 to 13 (4-250) in 2010, and repatriated estimates increased from 1,439 (753-2,805) to 2,966 fish (1,509-6,063CI). The 2010 total population estimate is 2,979 fish.

Twenty striped bass and four channel catfish were scanned for PIT tags by NVDO since January 2006; none contained PIT tags. However, a 13.6 kg striped bass contained transmitter from a stocked razorback sucker. Creel census was discontinued 2009, and we developed web-based forum as a repository for striped bass catch data.

Size-survival based stocking simulations and growth and release data from Lake Mohave NFWG database reveal post-stocking survival is four to eight times higher when release size is 45 cm compared 30 cm. Uncertainty in results is due to stocking protocol differences between the 1990s and 2000's including stocking size and location.

Remote PIT-scanners were deployed February through May 2011 in the riverine portion of Lake Mohave upstream of Willow Beach from, and February through April 2011 in the basin. Effort contacted 955 unique razorback sucker. Data

Threatened / Endangered / Rare Species (continued)
<p>from 2010 and 2011 plus March roundup and electrofishing resulted in estimates 1531 and 1880 fish in basin and river zones, respectively. Seven individuals were in both zones, suggesting segregated populations, although those few fish moving between zones is adequate to maintain gene flow. Remote scanning provides insight into the population of riverine fish previously not included estimates, and movement dynamics of potential subpopulations.</p> <p>Netting efforts continue to collect growth, health, census, and genetic data. The largest possible size-at-release should be maintained for future stockings, in the greatest number possible. Stockings should be directed spatially and temporally to assess metapopulation dynamics and effects of stocking locations on dynamics. Hatchery stocking should be concurrent and numbers distributed equally between subpopulations. PIT-scanners should be deployed twice monthly, equally distributed among three subpopulation centers (River, Liberty, and Basin) with 200 scanning hours per zone nominal effort.</p>
Vascular Plants
<p>National Park Service. <i>Native Plant Nursery Seed and Propagule Collection</i> (LAME-2008-SCI-0003)</p> <p>Report Pending</p>
<p>National Park Service. <i>Botanical Fieldwork Required to Fulfill My Duties as the Grand Canyon - Parashant National Monument (GCPANM) Botanist</i> (LAME-2006-SCI-0016)</p> <p>Report Pending</p>
Water Quality
<p>Mohave Community College. <i>Microbiological Analysis of Lake Mohave water samples</i> (LAME-2011-SCI-0024)</p> <p>Report Pending</p>
Water Quality Monitoring
<p>City of Las Vegas. <i>Water Quality Monitoring</i> (LAME-2004-SCI-0004)</p> <p>PURPOSE: Water quality samples will be collected and analyzed to comply with the NPDES permits for the City of Las Vegas, City of Henderson, and Clark County Water Reclamation District. Compliance samples will be collected on Lake Mead and the Las Vegas Wash. In addition to the compliance monitoring occasional research projects are conducted to assess future discharge options. These projects are conducted on Lake Mead, the Colorado River, and Lake Mohave.</p> <p>FINDINGS: "n/a"</p>
Water Resources
<p>U.S. Geological Survey. <i>Installation of Bank-Operated Cableway at U.S. Geological Survey Site 09419800 Las Vegas Wash below Lake Las Vegas near Boulder City</i> (LAME-2011-SCI-0007)</p> <p>We installed the new bank operated cableway and have used it successfully for the majority of our monthly discharge measurements at this site. We have struggled with defining discharge during high flow events due to the high amount of sediment in the water. Doppler instrumentation has difficulties when sediment loads are very high. The manufacturer of one of our Doppler units has suggested several command-line user inputs that may be of value to us. At low flows and mid-range flows, the new bank-operated cableway is indispensable. The stage/discharge record at the low and mid-ranges has already improved thanks to the new installation.</p>
<p>U.S. Geological Survey. <i>Lake Mead Evaporation Study</i> (LAME-2011-SCI-0015)</p> <p>Annual and monthly rates of evaporation from Lake Mead from March 2010 to September 2011 have been computed from monitoring of meteorological conditions. Monitoring will continue on the lake until March 2012. Provisional micrometeorological data indicate a decrease in evaporation rates of about 25 percent during July and August of 2011 compared to the same months in 2010. Further monitoring and data analysis is required to understand the inter-annual variability in evaporation rates.</p>

Water Resources (continued)

U.S. Geological Survey. *Bank-Operated Cableway Installation - Virgin River above Lake Mead near Overton, NV* (LAME-2011-SCI-0012)

We installed the new bank operated cableway in September of 2011 during low flows in the Virgin River. Our initial test shows that the cableway itself should perform well during medium and higher flows. We cannot use the cableway during low flows because our Doppler units need at least 1.5 ft of water to operate properly. The Virgin River has been shallower than 1.5 ft since the installation of the cableway, so “wading” discharge measurements have been made. We anticipate that flows will rise during the winter or spring snowmelt, and then we will use the cableway with the Doppler unit. We have had problems with using Doppler with high sediment loads, so this cableway is very much an experimental attempt to define higher flows with Doppler at this location. If we are not successful, we will continue to explore other options for measuring higher flows. In the meantime, one of the manufacturers of our Doppler units has agreed to help us find a way to make the instrument work properly in high sediment conditions. We are hopeful that a reasonable solution can be found.

National Park Service. *Mojave Desert Inventory and Monitoring Network Arid Lands Springs Protocol-Pilot Testing (Lake Mead NRA)* (LAME-2011-SCI-0023)

Baseline data recorded. Monitoring equipment installed.

National Park Service. *Mojave Desert Inventory and Monitoring Network Arid Lands Springs Protocol-Pilot Testing (Parashant NM)* (PARA-2011-SCI-0004)

Baseline data recorded. Monitoring equipment installed.