



## Pacific Missile Range Facility, Barking Sands, Kauai 2013 Natural Resource Conservation – Environmental

### INTRODUCTION

**Mission:** The Pacific Missile Range Facility (PMRF) is the world's leading multi-dimensional integrated test and training range, capable of supporting surface, subsurface, air and space operations simultaneously. PMRF's mission is to enhance readiness of US and Allied forces by conducting safe and effective test and training events in an operationally realistic environment. It supports the largest multi-national naval fleet training evolution in the world, the Rim of the Pacific (RIMPAC) exercise and is the premium site for development and testing of missile defenses for the United States and our Allies around the world. At the same time, PMRF protects natural habitat for a variety of endangered, threatened and endemic species that in turn provides an unparalleled and accessible outdoor laboratory for academic research in a host of areas.

**Location and Acreage:** Located within the Hawaiian archipelago on western shores of the Island of Kauai, PMRF Barking Sands occupies a 7.5 mile, 1/2 mile wide strip of coastal land separated from its remote mountain sites on the ridges inland of the base by a plain now in agriculture. The working area of the base is the expanse of the sapphire Pacific ocean to the north, south and west with varying water depths from 20 to 2,500 fathoms, with underwater instrumentation covering 1,100 square miles for an underwater training range, and, for missile defense testing, a temporary operating area of over two million square miles. On Kauai, PMRF occupies over 2,342 acres (937 hectares) in five separate areas: the coastal Barking Sands; the upland areas of Makaha Ridge, Kamokala Ridge and Kokee sites; and a rented facility for small boats at Port Allen. PMRF oversees and coordinates training events from unit level to multi-national exercises, while simultaneously conducting or supporting research, development, testing and evaluation (RDT&E) of U.S. Navy, other Department of Defense (DoD), and Federal agency programs and platforms.



***The potential impacts of future sea level rise under consideration in the "Shoreline Survey" initiated by PMRF is an ongoing field research project. The desired outcome is to learn more about the observed fluctuations and add to the body of knowledge regarding variance.***

Each of the Kauai facilities has unique features due to its location. Barking Sands contains 5 principal vegetation types, including both native and introduced species, with smaller, landscaped project sites interspersed throughout approximately 1,991 acres (806 hectares). At the tip of the upland Makaha Ridge, the 245 acre (89 hectare) Navy facility contains landscaped portions, shrub, native forest and woodlands, and overlooks Barking Sands, PMRF underwater training ranges and beyond. The upland Kokee sites are comprised of 16 acres (6.6 hectares) and are located within the native forest habitat on a series of landscaped sites. Kamokala Ridge's magazine area of 89 acres (36 hectares) consists of shrub, forest and ruderal vegetation.

***Barking Sands*** is located on Kauai's Mana Plain, historically associated with an extensive wetland separated from the coastal beach by high sand dunes. Barking Sands abuts a 7,000 acre (2,833 hectares) agricultural zone to the inland side, providing habitat in a complex of ditches for several water birds listed as endangered or threatened pursuant to the Endangered Species Act (ESA).

These birds also frequent drainage ditches that pass through Barking Sands, while the coastal zone provides protected beaches and littoral areas where the Threatened (T) Green Turtle can bask and nest and the Endangered (E) Hawaiian monk seal hauls out to rest. Fisheries and marine resources are recovering in secured areas to a point that is expected to reach pre-human harvesting populations of both flora and fauna – a relatively unique, yet accessible location within the main Hawaiian Islands for future research.



The Makaha Ridge facility is at an elevation of approximately 1500 ft. above the Pacific, at the outermost point on the Ridge, and has been home to feral goats as well as the (E) state bird, the Hawaiian goose, locally known as the nene. The native terrestrial ecosystem is a low and dry mesic forest, woodland, and shrubland.

***Dr. Chris Bird, formerly with the Univ. of Hawaii (UH) and now associated with the Univ. of Texas at Corpus Christi, is recognized as one of the world's leading experts in research on the marine macroinvertebrate known locally as the "opihī", a commercially and culturally significant limpet fishery in Hawaii. His professional and dedicated efforts to study and develop a "grass roots" management strategy to restore the Hawaiian limpet fishery is supported by various national grant programs and the PMRF study by NAVFAC Hawaii Environmental. Pictured with part of the Island of Niihau in the background are the Bird's team and students/staff of Ke Kula Niihau O Kekaha Native Hawaiian Language Charter School.***

Kokee sites are in the native forest area of Kokee State Park, at an elevation of approximately 3,200 ft. above sea level. The native terrestrial ecosystem is also a lowland dry and mesic forest, woodland, and scrublands. Four of five sites within the Kokee complex are landscaped and contain Navy assets used in tracking radar, telemetry, communications and command and control. NASA occupies the 5<sup>th</sup> site.

Kaula is home to a variety of nesting seabirds, and routine ship-based surveys of these populations are performed.

The Kamokala Ridge magazine area is used for storage of ordnance used in training and testing programs. The location is relatively arid and dominated by non-native plants and woody scrub, although it too is ecologically classified as a lowland dry and mesic forest, woodland, and shrubland.

The Mauna Kapu Facility is a 2 acre (1 hectare) communications and radar site located on Oahu within the Honouliuli Forest Reserve. It is a mixture of lowland dry and mesic forest, woodland, and shrubland with no known T&E species.

Kaula Islet, southwest of the Island of Niihau, is a volcanic cone remnant of which the Navy uses approximately 4 hectares on the southern tip for inert air-to-surface weapons delivery.

**Civilian and Military Population:** Seventy five military, 152 govt. civilian, 518 Operations & Maintenance (O&M) contractor personnel, and 182 contractors representing over 25 companies provide assistance to specific functional groups or for specific program support. The staff is concentrated at Barking Sands, which provides the command and control center for (RDT&E), fleet training – including anti-submarine warfare, submarine commander qualification and multi-national exercises including the semi-annual RIMPAC exercise .

## BACKGROUND

PMRF's Revised Integrated Natural Resources Management Plan (INRMP) was signed by PMRF on 18 November 2010 and by Commander Navy Region Hawaii on 16 December 2010. The revision was completed over several years, with multiple communications and meetings with a working group of stakeholders that included the U.S. Fish and Wildlife Service (USFWS), the National Oceanographic and Atmospheric Administration's (NOAA) National Marine Fisheries (NMFS) and Office of Protected Species (OPS), and State of Hawaii Dept. of Land and Natural Resources (DLNR), along with the Hawaii State Department of Business and Economic Development and Tourism, the Coastal Zone Management (CZM) program office, and County of Kauai representatives.

In implementing the INRMP, PMRF adopted a team approach for the daily management of the natural resources program. Support, coordination and guidance come from the field-experienced Wildlife Biologists at Naval Facilities Engineering Command, Hawaii (NAVFAC HI) and NAVFAC Pacific (NAVFAC PAC) on Oahu. On Kauai, the INRMP implementation is supported by a contract Wildlife Biologist, two Range Complex Sustainment Support contractors, the U.S. Dept. of Agriculture's Wildlife Services Field Technicians (WSFT) responsible for implementation of the Bird Aircraft Strike Hazard (BASH) program and predator control, and the first-responder eyes and ears provided by base Physical Security team. Physical Security team diligently reports and documents wildlife sightings 24/7/365.

The overall program has been and continues to be exemplary, in spite of acknowledged vacancies of qualified staffing during the award period. PMRF continues to be recognized for innovation and outreach in the true spirit and context of Executive Order (EO) 13352 (26 August 2004) "Facilitation of

Cooperative Conservation." As implemented at PMRF, the outreach within and outside the confines of the Navy properties has been crucial to program development and execution. This approach actively engages other departments within the facility, including the Public Affairs Office, the Public Works Office, and the Physical Security Department, with full support and cooperation of the Command – both at PMRF and CNRH. Outside the Installation, PMRF maintains strong, collaborative working relationships with the State of Hawaii Department of Land and Natural Resources, NOAA and USFWS, the University of Hawaii/Kauai Community College, the Kauai Invasive Species Committee, Non Government Organizations (NGOs) including the Cascadia Research Collective, The Nature Conservancy (TNC), the National Tropical Botanical Gardens (NTBG), the Kauai Endangered Seabird Recovery Project (KESRP), Save our Shearwaters (SOS), and two Hawaiian language charter schools for children from Ni'ihau.

PMRF is an active member of the Kauai Conservation Alliance. KCA is a consortium of government, NGOs and individuals who gather monthly to share experiences and lessons learned in their various specialties and areas of interest, with the focus on cultural and natural resource conservation and education related specifically to Kauai. It is an informal outreach forum where the wildlife biologists and concerned citizenry from different backgrounds with different mandates and/or opinions can network at a personal level. Objectives included in the 2010 INRMP update identify programs to continue as well as new areas of focus, and PMRF performed with excellence in both categories. Examples which document success during the past year are developed in the following "Accomplishments" section.

## ACCOMPLISHMENTS

### **Continuing Programs of Cooperative Conservation:**

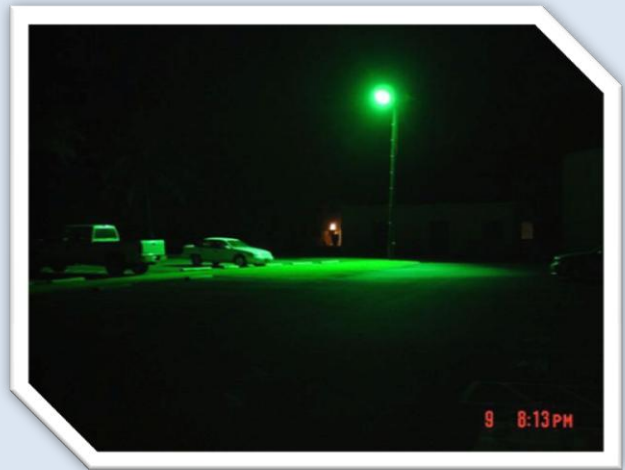
*Protection of Nocturnal-Fledging Seabirds:* Kauai has the largest population of ground-nesting seabirds in the Main Hawaiian Islands. Both Migratory Bird Treaty Act (MBTA) and ESA-protected species of

Shearwaters nest on Kauai, as well as petrels. Because these birds leave the nest – or fledge – for the first time at night, they have no practice flights. It's all or nothing, and the inland-dwelling species may have to fly several miles to reach the ocean where they can land and rest.

Their navigation systems utilize moon and starlight, and the presence of unshielded and intense coastal lighting along their flyways results in confusion and disorientation. Similar to moths around a light, the fledglings circle the area until becoming exhausted or striking an object. Once on the ground, they are unable to fly because their legs are adapted for swimming. Mounted too far back on the body to be able to balance and run on land, they become targets for predators including both feral animals and domestic pets.

During this award period, PMRF **completed** the initiative to undertake major “dark sky” improvement in lighting. In addition, testing the efficacy of “green lights” was **completed** to determine if migratory seabirds would be less distracted as is the case with migratory song birds, water birds and shore birds in Europe. While NAVFAC PAC’s Wildlife Biologist supporting PMRF continues working with the regulator through the Section 7 process of the ESA, PMRF continues to support the on-island conservation programs of the Kauai Endangered Seabird Recovery Project, Save our Shearwaters, the State Division of Forestry and Wildlife, and the Kauai Seabird Habitat Conservation Plan (KSHCP) Office through facilitation of Shearwater banding training at our Wedge-tailed Shearwaters Colony (MBTA protected; *Puffinus pacificus*). This is done in anticipation of the fallout of (T) Newell’s Shearwaters (*Puffinus auricularis newelli*), (T) Hawaiian Petrels (*Pterodroma sandwichensis*), and State-listed Band Rumped Storm Petrels (*Oceanodroma castro*), during the period between 15 Sep. and 15 Dec. An Aid Station for recovered birds is maintained by SOS inside the entrance gate to Barking Sands during the fallout season. Community member bring fallout and injured bird to PMRF knowing they will received appropriate attention.

Lighting improvements were coordinated with energy conservation initiatives – converting from conventional lamps to LEDs, using full-cutoff fixtures to prevent viewing of the light source from above. This resulted in a “dark sky” combined with energy savings. Solar powered fixtures are also full-cutoff design and horizontally mounted. Where high-wattage fixtures mounted above the horizontal are required for safety or security, they are equipped with “green” lamps.



**For the FIRST time in over 10 years, the innovative management and physical modifications initiated on Barking Sands resulted in ZERO “fallout” of these species during the 2013 season.**

The net result of these physical changes, combined with an educational outreach program to PMRF’s Ohana (“family”) and guests on Barking Sands resulted in over 80% reduction in fallout in 2012 and 100% reduction in 2013. NO fallout of birds in 2013 is the first season in over 10 years that we have not recorded a single bird down. This information and the techniques have been presented to conservation groups on Kauai, a conference on Oahu, and formally to the Kauai County Council to help spread awareness of PMRF’s effective conservation and resource management – both electrical and biological. PMRF continues to receive inquiries, most recently from the Island of Maui, and we have shared our lessons-learned with our DoD partners in Hawaii.

*The Laysan Albatross (LAAL) Surrogate Parenting Program*; To address a BASH issue, during the period 2009-2012, Drs. Lindsay Young and Eric VanderWerf of Pacific Rim Conservation (PRC) assisted the Navy in finding “foster nests” for albatross eggs that had to be removed from nearby runways to prevent aircraft from striking the large birds. To accomplish this, the Navy collected the eggs as they were laid and incubated them for 1-3 weeks to allow them to develop and determine if they were fertile. After 2-3 weeks, Young and VanderWerf would ‘candle’ the eggs (shine a bright light through the shell to illuminate the interior of the egg to determine if it was fertile) and placed as many of the fertile eggs as possible under wild nests on the North shore of Kauai whose eggs were not fertile but still had parents incubating them. This program was called the “Albatross egg swap” since infertile wild eggs were



***Dr. Lindsay Young, Pacific Rim Conservation Biologist, places a good egg donated from PMRF under a nesting adult Laysan albatross according to the "Egg Swap" protocol at Na Aina Kai Botanical Garden's protected albatross nesting area. This program has been developed integral to the BASH program while encouraging colony expansion for the protected Laysan albatross (LAAL) by providing viable LAAL eggs to protected colonies at high elevations. PMRF is contributing to the survival of the species in the event of sea level rise and habitat inundation in the Northwest Hawaiian Islands.***

replaced with fertile eggs from the runway birds. Over the course of four years, 103 eggs were placed under foster nests and 37 of those eggs resulted in chicks that successfully reached adulthood. By continuing to refine and expand this program, participants have not only managed to help solve a conservation issue of increasing the albatross population on Kauai, but also reduce human-wildlife conflicts on airfields, a rare and mutually beneficial situation. The PRC team has produced a professional paper documenting the success of this program. PMRF's Wildlife Biologist continues working closely with the USFWS Refuges staff on Kauai and State of Hawaii biologists to secure the necessary authority and permits to coordinate both the placement of sub-adults and viable eggs on private lands. During the 2013 season, *Na Aina Kai Gardens (NAK)* received viable LAAL eggs from PMRF for the first time. *NAK* satisfied regulatory agency concerns for the future security and safety of the colony. Another first in 2013 was the successful nesting of a previously-banded "PMRF bird" on private property where the owners of the acreage coordinated with various subject matter experts to create a potential colony site specifically designed to attract passing LAAL. This PMRF bird was the *first* to nest on the property.

*The Seabird Tissue Archival and Monitoring Project (STAMP)* is a component of the National Institute of Standards and Technology's (NIST) Marine Environmental Specimen Bank (ESB). STAMP's goals are (1) collecting eggs at seabird

colonies without inadvertently contaminating them, (2) processing and banking the samples under conditions that ensure chemical stability during long-term (decadal) storage for current and future researchers, and (3) analyzing subsamples of the stored material for anthropogenic contaminants. NIST expanded its biorepository capabilities in Hawaii and the Pacific Islands region in 2010, a total of 197 eggs (48 were from Barking Sands) have been banked from this region, with an additional 52 LAAL eggs (20 from Barking Sands) collected during the 2013 Laysan Albatross season.. Preliminary results from 2010 collections indicated that there was no statistical difference in contaminant levels or patterns across LAAL eggs from the main Hawaiian Islands, but there were differences compared to Alaskan murre eggs.

*Eradication of Long Thorn Kiawe (Prosopis juliflora):* Another effective program developed on PMRF in coordination with the Kauai Invasive Species Committee (KISC) and NAVFAC PAC has been the eradication and control of what is known of this extremely invasive and hardy species: Long Thorn Kiawe (LTK). LTK thorns are sharp, strong, and long enough to penetrate a vehicle tire. Because of the success of the technique it continues to be adopted as the standard practice for LTK and other woody invasive eradication and PMRF, through the support from NAVFAC HI and PAC, has been able to maintain the field services of KISC's team of technicians to help control and prevent regrowth. Thanks to this long-term commitment to seed bed management, regrowth of native coastal vegetation is evident all along the cleared areas.

## **New Initiatives in Cooperative Conservation:**

***State of the Art Marine Mammal Studies:*** With funding from Commander, Pacific Fleet (CPF) and the Navy's Living Marine Resources program, HDR Engineering, Inc., has subcontracted Cascadia Research Collective (CRC) under the leadership of Dr. Robin Baird, to undertake assessments of odontocete cetaceans off the Pacific Missile Range Facility (PMRF) in collaboration with the Marine Mammal Monitoring on Navy Ranges (M3R) project. The M3R software is the product of Navy Subject Matter Experts (SMEs) including Dave Moretti from Naval Undersea Weapons Command (NUWC), Newport, and Steve Martin from Space and Naval Warfare Systems Center Pacific SPAWARSYSCEN-PACIFIC. These efforts are designed to address a specific Navy monitoring question: what are the spatial movement patterns and habitat use of species of toothed whales and dolphins that are exposed to mid-frequency active (MFA) sonar, and how do these patterns influence exposure and potential responses. Joint projects in 2011, 2012 and 2013 have combined passive acoustic monitoring through the M3R project and boat-based field efforts by CRC, the latter involving individual photo-identification, collection of biopsy samples for genetic studies, and satellite tagging. Through these efforts 13 location-only and 14 depth-transmitting satellite tags have been deployed on four species of toothed whales: 7 short-finned pilot whales, 4 false killer whales, 10 rough-toothed dolphins, and 6 bottlenose dolphins. Data from the tagged species show that all appear to have island-associated populations with restricted ranges, and the ranges of all populations substantially overlap with the PMRF range.

***Shoreline Survey:*** In September 2012 Range Sustainment Coordinators at the Pacific Missile Range Facility observed that PMRF beaches were wider than at any time in the previous decade. At the same time the once wide beach at Kekaha, just three miles to the southeast had virtually disappeared. To find the cause of this accretion/erosion puzzle we contacted Dr. Charles T. Blay, noted geologist, educator and author of the book "Kauai's Geologic History" and Dr. Stephen V. Taylor of the Marine Options Program at Kauai Community College were contacted. Plans were mapped out for a monthly shoreline survey of our PMRF beaches. The desired outcome was to learn more about the observed fluctuations, add to the body of knowledge regarding variance, and share



***The PMRF Underwater Ranges off the western coast of Kauai have been used to study the potential impacts on marine mammal species from sound-in-water generated by US Navy testing and training.***

the results with all interested parties. Since the survey is unfunded the project equipment list is fairly basic: surveying transit w/level, stadia rod, compass, inclinometer, tape measure, stakes. Three fixed geographic points were selected along with compass headings from each point to the surf line. Measurements are taken at these points and along these headings every 10 meters, plus at any changes to the shore (vegetation lines, swales, backshore/foreshore berms). The inclination from the foreshore berm to the surf line is recorded. The data are processed by Dr. Blay and the results are shared. Currently the data is shared with the University of Hawaii Sea Grant Program, the County of Kauai and Woods Hole Oceanographic Institution. Since this is the first monthly study of its kind for this location this list is expected to grow. Students from the Marine Options Program participate in each month's survey. One student created a video describing the survey genesis. It is posted at <http://www.youtube.com/watch?v=Gy8Jn6De7IU>. Another student entered a poster describing the process and initial results in a UH contest and won top honors across the entire University system. This is a prime example of cooperative conservation involving science, education, government, non-government organizations and PMRF, and which was most recently noted by the University of Hawaii's Sea Grant Program in their annual report as a "highlight of 2013".

***Field Testing Wedge-tailed Shearwater (WTSH) Vocalization Recordings for Population Assessments:*** The current practice of colony research at unprotected inland locations requires human access and can create pathways for terrestrial predators

that did not previously exist. As an alternative to physically entering a colony and performing burrow counts, in the summer of 2012, Dr. Andre Raine and Brooke McFarland, both from the Kauai Endangered Seabird Recovery Project (KESRP) explored an alternative. The team set up sound recording equipment at three separate locations w/WTSH populations, and conducted active-nest surveys within 10 meters and 20 meters of the sites. The three locations on Barking Sands provided three isolated populations (small, medium and large) to insure recordings would be representative of each relative population density. The effort was to determine if reasonable colony population assessments can be made with vocalization data. If this proves statistically viable, then it may be possible to conduct less "human-invasive" surveys of the inland colonies of ESA-listed nocturnal fledging migratory seabirds. The initial results are promising in that there is a correlation, but further research is required. PMRF will continue to support access to our colonies of the MBTA-protected wedge-tails with the hope that this technique will prove successful.

*Restoration of Hawaiian Intertidal Shores:* The once productive Hawaiian limpet fishery, a suite of three marine snails locally known as opihī, crashed in the early 1900's and has shown no signs of recovery. Opihi presently sell in Oahu markets for up to \$42.50 / lb, and the price is increasing exponentially. Opihi are also a culturally prominent and are an *aumakua* (guardian angel) for many Hawaiian families. To this point, the only strategy that has proven effective in promoting healthy opihī populations is Marine Protected Areas (MPA). An MPA is an area where the extraction of some or all marine resources is not permitted. Restricted access areas that are part of (PMRF) act as the largest de-facto MPA on the island of Kauai, and harbor a large population of 'opihī. While the adults are sedentary, opihī on PMRF's shorefront have a dispersive swimming larval phase that is capable of spreading to unprotected shores, thereby providing a subsidy of opihī to other locations on Kauai. To determine if restricted access on portions of PMRF is effectively restricting opihī harvest and if PMRF is a source of opihī for other parts of Kauai, we contacted Dr. Christopher E. Bird, an Assistant Professor at Texas A&M University – Corpus Christi (TAMUCC) and an Adjunct Researcher at the Hawaii Institute of Marine Biology (HIMB), and Dr. Robert J. Toonen, a full Research Professor at HIMB. Drs. Bird and Toonen are the world's experts on Hawaiian

opihī and a respected ecologists and population geneticists. Together with Dr. Bird and Haunani Seward, Principal of the Ke Kula Niihau o Kekaha public charter school (KKNK PCS), a survey of marine resources in protected and publicly accessible areas within PMRF, as well as areas flanking PMRF, was designed and executed. The goals were to 1) test the impact of protection within PMRF on both opihī populations and the intertidal community, 2) provide a hands-on educational experience for the students of KKNK PCS, 3) provide an educational/research experience for the graduate students of TAMUCC and HIMB, and 4) to strengthen the relationship between scientists, the Hawaiian community, and PMRF.

Three surveys were conducted. In the first survey, DNA samples were collected from 48 opihī on PMRF. These samples, in conjunction with opihī samples from 8 other locations on Kauai, will be subjected to population genomic analyses that can be used to estimate the amount of dispersal into and out of PMRF. In the second survey, GPS was used to map the population density of opihī along the entire PMRF coastline. Tracks on a GPS were recorded and the number of opihī seen along each Track was counted. If there were more opihī than could be counted, the track was labeled as "high density". In the second, more detailed survey, 5 locations were selected (3 restricted, 2 unrestricted) within PMRF's shoreline where all of the invertebrates were counted, all of the opihī measured, and the percent cover of all of the algae found with 15-20 transects was estimated. The transects were 0.5 m wide and several meters long, running from the highest marine life on the shore to the low water mark. All transects were recorded on geotagged photographs and their positions were recorded with a separate GPS device. These data, along with surveys from five other locations on Kauai, are being digitized and organized into a database by students at TAMUCC. The next steps are to analyze the data and create a report. These surveys were conducted in cooperation with two PMRF employees, two professors, one Postdoctoral Fellow (HIMB), 4 graduate students (TAMUCC), 8 undergraduate students (TAMUCC), a high school teacher from Oahu, a recent graduate of UH Hilo, 20 high school students from KKNK PCS, 5 teachers from KKNK PCS, and a high school teacher from Kauai High School. While conducting surveys, KKNK PCS filmed and produced an educational video on conducting the opihī surveys. The KKNK PCS students also performed brief experiments on the response of opihī to predatory snails. This is another prime example of cooperative conservation involving science, education, government, non-government organizations and PMRF.