Optimize Installations

Our need to support sustained operations

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Marine Corps Recruit Depot (MCRD) Parris Island is teaming up with other Marine Corps installations on the East Coast and collaborating with the University of North Carolina's Institutes for the Environment and Marine Science, Duke University Marine Lab, Attollo LLC, and Clemson's Center for Geospatial Technologies UAV and LiDAR (light detection and ranging) Program in an effort to integrate unmanned aerial systems (UAS) into natural resource management efforts. Funded by the Environmental Security Technology Certification Program, the collaborative project will provide an operational framework for Marine Corps Installations East to integrate UAS technology into present and future civilian-led management of natural resources. This effort will develop and validate UAS protocols and provide a training pathway to professional remote pilot certification for installation personnel; create and disseminate standardized UAS mission kits consisting of a quadcopter and fixed-wing drone; and integrate UAS technology through demonstrations that represent an array of applications for DOD natural resource management that exist across a broad range of installations. Aligned with the Commandant's line of effort to optimize installations to support sustained operations,[1] this project will ensure MCRD Parris Island continues to produce the finest quality Marines by providing modern, realistic training. This project will also provide commanders with a uniform, safe, and effective starting point for UAS employment in natural resources monitoring that can be readily expanded to other areas.

MCRD Parris Island boundary. *(Map provided by Capt Brandon Barnes.)*

Low Country Adaptation and Resilience

Changes in the environment affect personnel, resources, and facilities. The use of UAS support to management of natural resources aboard MCRD Parris Island will enhance overall Force Protection, through earlier detection of vulnerabilities and threats.[2] MCRD Parris Island is a collection of several islands, located about halfway between Savannah, GA, and Charleston, SC. The entire property is approximately 8,000 acres, half of which are salt marshes and tidal creeks that are inundated by tides twice daily. The land elevations on MCRD Parris Island range from mean sea level to only 22 feet above mean sea level.[3] The DOD manages 128 coastal installations with significant mission assets, and those along the

Horse Island boat ramp at high and low tide. *(Photo by Capt Brandon Barnes.)*

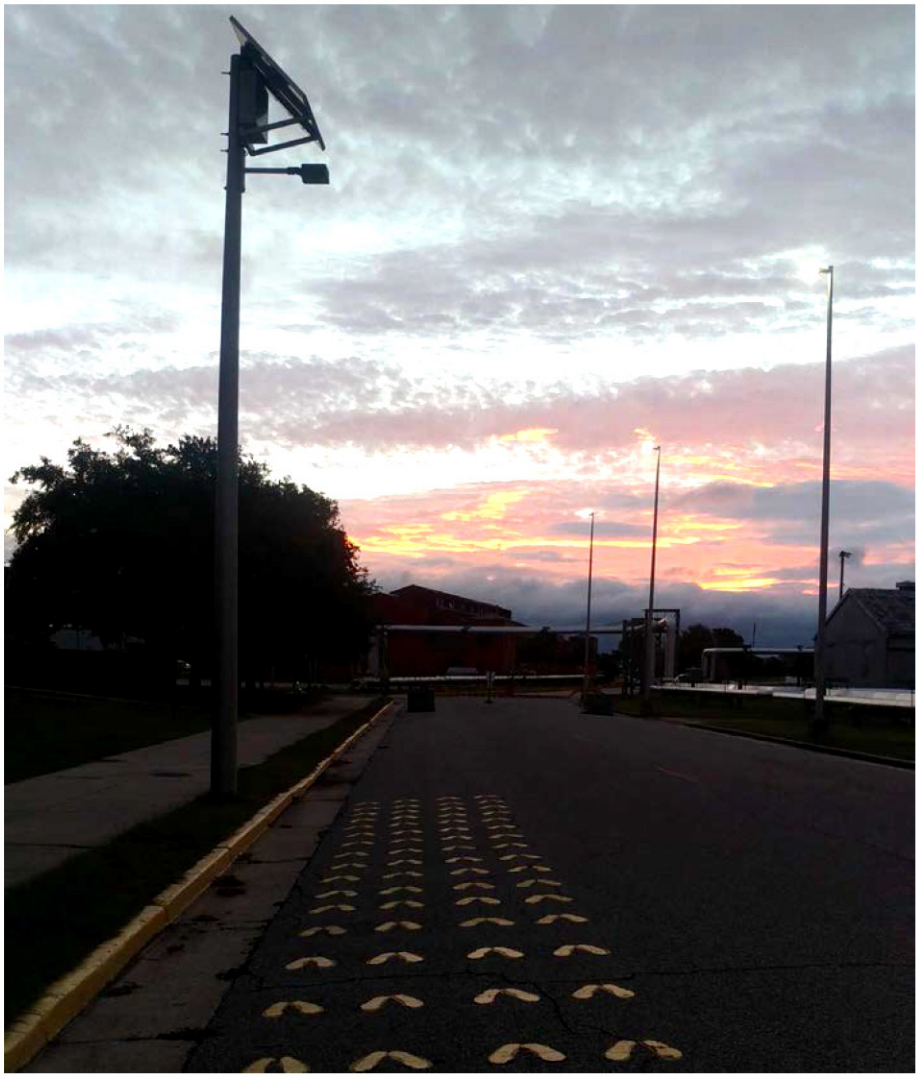
Atlantic Coast exhibit high vulnerability to sea level rise (SLR) and extreme storm events.[4] Catastrophic events occur against a backdrop of higher frequency and chronic effects from SLR .[5] While a full spectrum of solutions will be required to address the scale of threats across coastal installations, using natural coastal marshes can be a pivotal part of that strategy. Considering the extent of marshes surrounding MCRD Parris Island and the surrounding broader landscape, it is important to maximize the natural ability of marshes to provide a thriving ecosystem able to adapt to SLR. Although salt marsh loss because of inundation or erosion at the shoreline can be offset by transgression toward uplands, MCRD Parris Island already has limited upland space for facilities and training areas. Better understanding of wetlands delineation, especially over time, will help the Depot properly manage these natural resources. UASs provide reliable and sustainable platforms from which to monitor shorelines and wetland-upland boundaries, both in realtime and through long-term data collection.

With sufficient sediment, coastal marshes have the ability to increase their surface elevation. By trapping sediment during tidal events, and increasing belowground root production, marshes are able keep pace with SLR over millennia.[6] This resilience provides a low maintenance and self-sustaining natural buffer that can protect both coastlines and infrastructure. Fringing coastal salt marshes provide many benefits to coastal installations and communities including erosion control, water purification, fish and wildlife habitat, recreation, and carbon sequestration.[7] Although salt marshes have some capacity to grow vertically and keep up with SLR, erosion at the salt marsh shoreline because man-made and natural forces tends to reduce salt marsh area. Furthermore, reducing salt marsh width decreases wave dampening and the capacity of a salt marsh to buffer a military installation from erosive wave and storm energy. Even during extreme events when water levels are at a maximum and waves are highest, experiments show that salt marsh vegetation accounts for up to 60 percent wave reduction.[8]

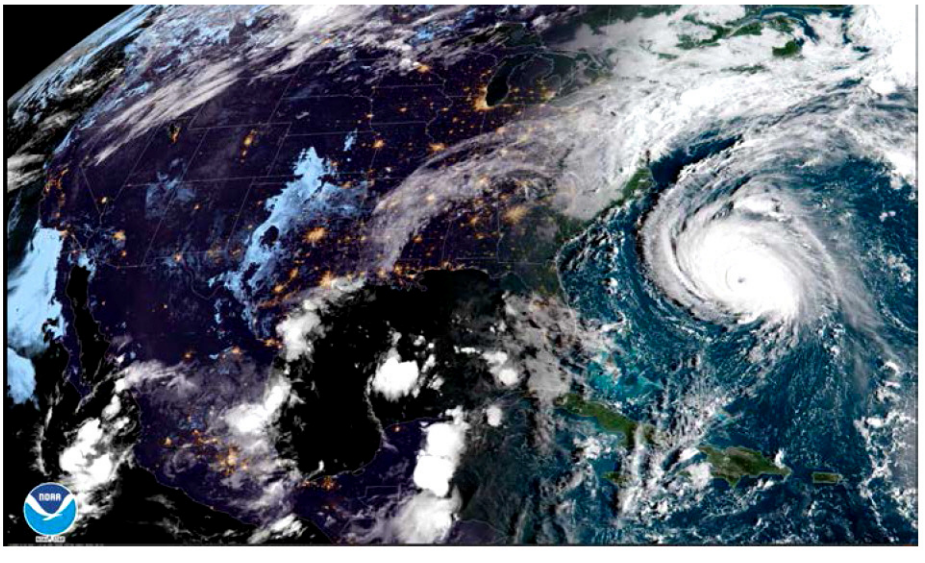
Paving the Way

As a cost effective and efficient platform to collect a wide variety of data, UASs can be used to more effectively monitor and manage natural resources. The benefits of integrating UASs into DOD natural resource management are numerous and transformative. Employment of UAS can improve the quality and efficiency of data collection and

SenseFly eBee fixed-wing. *(Photo by Susan Cohen.)*



MCRD Parris Island yellow footprints. *(Photo by Capt Brandon Barnes.)*



NOAA 2018, Hurricane Florence. *(Found at https://www.star.nesdis.noaa.gov/GOES/index.php.)*

open doors to new capabilities to help understand challenging environments. For large organizations with unique sets of management drivers and requirements such as the DOD, UASs can be a transformative tool for natural resource managers as well as other installation staff. Demonstrations of comprehensive, non-intrusive wetland monitoring focused on marsh migration, coastal erosion, and storm impacts are well-suited to the low-gradient topography of MCRD Parris Island. Use of UASs for environmental applications also provides unique, career-enhancing opportunities for DOD civilian employees, opportunities for collaboration with research institutions, and—most importantly—can be integrated into existing geospatial information systems, such as GEOFidelis, to help inform decisions at all levels.

By teaming up with other Marine Corps installations and collaborating with outside scientists, MCRD Parris Island is taking a deliberate approach to integrating UASs into their natural resource management efforts. Using the non-prescriptive Climate-Smart Conservation Guide developed by the National Wildlife Federation,[9] MCRD Parris Island is currently updating its Integrated Natural Resource Management Plan and incorporating UASs. By doing so, MCRD Parris Island will be able to more efficiently manage its natural resources while sustaining its mission of making Marines.

We Make Marines

MCRD Parris Island is one of the three Service-level training installations in the Marine Corps and has the critical mission of making Marines. It is the second oldest facility in the Marine Corps and has been the home for recruit training since 1915. Generations of men and women have stepped onto the yellow footprints to hear:

> You are now aboard Marine Corps Recruit Depot Parris Island South Carolina, and you have just taken the first step toward becoming a member of the world's finest fighting force, the United States Marine Corps.

However, extreme events like hurricanes and tropical storms continue to chal-

Malecon Drive during and after Tropical Storm Irma. *(Photo by John Stroud.)*

lenge MCRD Parris Island's ability to perform its mission.

Parris Island has seen its share of near misses. Hurricane Hugo in 1989 and Hurricane Floyd in 1999 both had tremendously destructive impacts to the coast of South Carolina but ultimately spared MCRD Parris Island the worst of the destruction seen in nearby counties and states. By the time Hurricane Florence reached MCRD Parris Island in September 2018, the winds, rain, and storm surge had mostly diminished, but it served as a stark reminder of the precarious situation of coastal military installations. If Hurricane Florence had made landfall in Savannah, GA, instead of near Wilmington, NC, MCRD Parris Island would likely have sustained catastrophic damage. In 2016, Hurricane Matthew was downgraded to a category one hurricane when it hit the coast just south of Charleston, and yet caused significant damage aboard MCRD Parris Island. Even tropical storm Irma, in 2017, caused significant impacts from storm surge, with flooding roads and debris hindering road movement.

It is not just the extreme weather events that challenge the ability of MCRD Parris Island to meet its mission. Localized flooding from heavy rain combined with high tides, in and around training areas, is a common challenge that impedes training. The problems associated with flooding are compounded by a high-water table, low topography, poorly drained soils, and an aging stormwater infrastructure. The Depot continues to wrestle with the inherent challenges associated with maintaining the facilities over time in this dynamic environment. The planning and execution of facilities development, whether for infrastructure or training needs, must consider the future environment and sustainability. For example, MCRD Parris Island recently finished construction at Inchon Range—the first of a four-phase range improvements and modernization effort. Although a major

Localized flooding around 4th Battalion obstacle course. *(Photo by Capt Brandon Barnes.)*

Inchon Range drainage basins. *(Photo by Capt Brandon Barnes.)*

part of the range improvement effort was raising the firing lines an additional nine feet to ensure continuous operation during high tide events, it is possible for the new drainage basins to convert to salt marsh as wetlands migrate inland—decreasing the amount of upland terrain around the ranges. However, as wetlands migrate inland, it is possible for the new drainage basins to convert to salt marsh. As long as recruit training takes place in the lowcountry, MCRD Parris Island will need to adapt to this dynamic environment.

Natural Resource Management

With a staff of fifteen civilians and one Marine officer, the Environmental Office at MCRD Parris Island is tasked with maintaining the critical balance of natural resource management while sustaining realistic military training for future generations of Marines. The three natural resource professionals in the environmental office include the natural resource manager, a wildlife biologist, and the conservation law enforcement officer. To meet their objectives, this team must develop innovative solutions and approaches to monitoring and managing natural resources aboard the Depot. The impacts of SLR can be seen today at MCRD Parris Island with more frequent flooding, especially during spring high tides and signs of salt water intrusion. Using the DOD database, regionalized sea level change scenarios, and extreme water level statistics, sea-level rise is predicted to be 3.4 feet above current mean sea level in 2065. A notable quantifiable impact of such a rise in sea level is a loss of approximately 40 percent of the training area. Over time, these impacts will be felt across the Depot. The ability of MCRD Parris Island to continue its legacy and mission into the future will depend on the resilience of the landscape and infrastructure.

Examining changes in salt marsh areas advances our understanding of salt marsh resilience and improves best management practices by providing high resolution metrics of spatial and biological change. The salt marsh-upland boundary is difficult to map using aerial photography collected from a

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Jericho Island salt marsh. *(Photo by Capt Brandon Barnes.)*

fixed-wing aircraft because this interface is commonly obscured or hidden by tree cover. In addition, aerial photographs are seldom available at both inter- and intra- annual time scales, a requirement for examining storm impacts to both upland and shoreline boundaries. UAS surveys can address broad wetland dynamics including marsh die-off and recovery as well as shoreline changes. Understanding changes in wetland extent and condition will give natural resource managers the information to take proactive management steps to delay or even reverse negative trends. Using UAS technology expands the role of the manager in planning and collecting data on limited, finite land resources at MCRD Parris Island.

... human-snake interactions are almost always problematic.

Eastern Diamondback rattlesnake. *(Photo by by Emily Mausteller.)*

Eagle nest in 3rd Battalion pond. *(Photo by John Holloway.)*

Changes in finite land resources can also have an impact on wildlife that currently inhabit areas potentially, directly or indirectly, impacted by SLR and a changing climate. For example, the Eastern Diamondback rattlesnake on MCRD Parris Island spends a large portion of its life on the marsh edge, which is inundated daily. With more frequent flooding events, they adapt by heading to slightly higher ground that, in some cases, is in training and other areas where interactions with people become more likely. Coupled with potentially being listed under the Endangered Species Act, human-snake interactions are almost always problematic. However, this behavior is not limited to eastern diamondback rattlesnakes. Other wildlife, such as osprey and bald eagles, share a similar story. These species nest on the edge of the terrestrial-salt water environment. Bald eagles nest in live pine trees; however, if these trees are continually inundated by salt water, they will not survive, pushing the birds to adapt by moving into more upland areas, and possibly closer to humans. This relocation may affect both nest success and utilization of training areas. Nest monitoring is difficult from the ground, and UASs offer additional methods to collect data for nest monitoring across the Depot, including small islands only accessible by boat. Forestry is another area that will benefit greatly from UAS applications. UAS will be used to monitor and record timber stands, controlled burning, canopy coverage, timber value, and even tree mortality.

MCRD Parris Island is committed to sustaining the forces in the 21st century. As a Service-level training installation, MCRD Parris Island supports the entire Marine Corps. Changes in the environment may pose a threat to making Marines, but this project will greatly increase MCRD Parris Island's ability to adapt and respond accordingly. The use

of UASs will not only improve current natural resource management practices by enabling data collection and analysis in order to support these practices but will assist with understanding impacts because of SLR. It is difficult to assess the magnitude, speed, and acceleration of impacts because of constant tidal inundation, extreme high tides, and storm events on the death of vegetation at the fringe without this ability to collect data and subsequently analyze it. This in turn can help MCRD Parris Island manage land resources and training requirements into the future, aligning to critical overall support functions of providing readiness, training, deployment, employment, force protection, and sustainment.[10] MCRD Parris Island may be one of the first Marine Corps installations to deal with significant impacts because of SLR. This project will help optimize MCRD Parris Island to support sustained operations.

Notes

1. Gen David H. Berger, *Sustaining the Force in the 21st Century a Functional Concept for Future Installations and Logistics Development*, (Washington, DC: 2019).

2. Ibid.

3. Department of the Navy, "Marine Corps Recruit Depot Parris Island, South Carolina," in *Integrated Natural Resource Plan 2008–2013*, (Washington, DC: 2008).

4. GAO Report, "Climate Change Adaptation: DoD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts," (Washington, DC: May 2014).

5. William Sweet, and Joseph Park, "From the Extreme and the Mean: Acceleration and Tipping Points of Coastal Inundation from Sea Level Rise," *Earth Futures*, (Hoboken, NJ: Wiley, 2014).

6. James Morris, P.V. Sundareshwar, Christopher Nietch, Bjorn Kjerfve, and D.R. Cahoon, "Responses of Coastal Wetlands to Rising Sea Level," *Ecology*, (Columbus, OH: Ecological Society of America, 2002).

7. Edward Barbier, Sally Hacker, Chris Kennedy, Evamaria Koch, Adrian Stier, Brian Silliman, *"The Value of Estuarine and Coastal Ecosystem Services," Ecological Monographs*, (Columbus, OH: Ecological Society of America, 2011).

8. C.C. Shepard, C.M. Crain, and M.W. Beck, "The Protective Role of Coastal Marshes: A Systematic Review and Meta-analysis," *PLOS ONE*, (San Francisco, CA: Public Library of Science, 2011).

9. Information is available at http://www.nwf.org.

10. *Sustaining the Force in the 21st Century.*