Department of Defense
Legacy Resource Management Program

10-466

Climate Change: Adaptive Management Tools and Strategies

Booz Allen Hamilton

December 21, 2010

Bruce Stein, National Wildlife Federation: **Assessing Vulnerability to Climate Change**
Natural resource managers need to know which species and landscapes on DoD installations are most vulnerable to climate change impacts. Climate change vulnerability is the likelihood that climate induced shifts will have an adverse impact on a given species, habitat, or ecosystem. These assessments can identify species and systems most in need of conservation actions due to climate change; develop adaptation strategies tailored for managing species and habitats in greatest need; foster collaboration by providing a shared understanding of impacts and management options; and efficiently allocate scarce resources for wildlife adaptation. Vulnerability assessments also can provide insights into what is most vulnerable and why it is vulnerable. Components of vulnerability such as sensitivity, exposure, and capacity to adapt should offer information that will allow installation personnel sufficient time to prepare for and respond to various climate change impacts.

Bruce Young, NatureServe: **Climate Change Vulnerability Index**
The *Climate Change Vulnerability Index* identifies species most at risk to climate change impacts, and it calculates a vulnerability score to correspond with the level of risk. The index can help users assess the relative risk of species; identify factors causing vulnerability; provide input to priority-setting exercises; identify areas with concentrations of vulnerable species; and publicize the vulnerability of a flora/fauna. Exposure and sensitivity to climate change ultimately determines a vulnerability score, which installation personnel can use to inform important natural resources decisions.

Mary Klein, NatureServe: **NatureServe Web Serviced Screening Tool**
This tool includes over 600,000 mapped populations and allows users to determine whether any at-risk species are known in a certain area of interest. It also offers scalable levels of information, which the users can restrict. The tool will generate more detailed information about the species occupying a certain area as the size of that specific area increases. It is currently used for emergency response, but the goal is to make the interface simple while displaying high quality biodiversity information. This will become a larger need as climate change impacts become more severe on military installations across the U.S.

Eileen Regan, AQUA TERRA Consultants: **EPA Basins 4.0 Climate Assessment Tool (CAT)**
Resource managers need tools that enable them to evaluate potential climate change impacts on endpoints that are used to make watershed planning decisions. Therefore, CAT was created to build representations of climate change scenarios at the watershed scale where most planning decisions take place. Climate change impacts such as increased wildfires, shrinking glaciers, reduced water quality, flooding, drought, and sea level rise all led to the development of this tool. The model implements a series of "what if" scenarios to eventually lead to management and planning decisions. This offers new opportunities for natural resources managers to understand and reduce aquatic risks by better incorporating information about climate change and vulnerability into their decision making process.

Craig Scranton, BNIM: **The David and Lucile Packard Sustainability Matrix**
This matrix explains the financial cost of implementing sustainable strategies as well as the environmental, societal, and monetary costs of not doing so. It shows initial cost and net present value to assess life-cycle pricing decisions for the U.S. Green Building Council's Leadership in

Energy and Environmental Design (LEED®) rating system. The matrix measures six levels of design: the Market Building; LEED Certified; LEED Silver; LEED Gold; LEED Platinum; and the Living Building, which goes beyond the LEED system. This tool, which was the first of its kind, continues to evolve as new technologies emerge. It reflects the need for a new approach to building design that is a holistic understanding of energy conservation, consumption, generation, and cost. It addresses land and water consumption, looks at the impact of buildings through the next one hundred years rather than the next twenty years, and considers more carefully the source of materials, manufacturing processes, and transportation requirements. Natural resources managers can then determine the proper actions to take regarding the built environment on DoD installations.

Bill Goran, U.S. Army Corps of Engineers, ERDC: **Alaska Climate Change Issues and 2009 Defense Workshop**
The U.S. military is collaborating with many other federal, state, and academic organizations to better understand both climate change impacts and the trajectory of these changes. This workshop highlighted some of those environmental changes in Alaska, an area that has experienced a higher warming rate and more pronounced climate change impacts than other regions. Consequences like widespread permafrost degradation and hydrologic reorganization in lowlands, drier soils and more frequent fires in uplands, and melting arctic sea ice will all influence training missions in that region and force commanders to explore alternative transportation routes without minimizing security. The workshop effectively highlighted landscape changes and showed how those changes will factor into the decision making process of DoD installation personnel.

Alyssa Rosemartin, USA National Phenology Network: **Plant Monitoring Program**
The USA National Phenology Network (USA-NPN) is an emerging partnership between federal agencies, the academic community, and the general public to establish a national initiative focused on phenology as a tool to understand how plants, animals and landscapes respond to climate change and variation. In March 2009, the USA-NPN released a plant monitoring program, followed by the release of an animal monitoring program in the spring of 2010. The USA-NPN will eventually strive to integrate these programs with historical datasets. Other future directions include integration with national, international, formal, and informal science networks; enhancing availability of remote sensing phenology products; and improving tools for contemporary and historic data entry, downloads, and visualization. DoD managers can use these datasets to make more informed decisions regarding their natural landscapes, species, and the training mission.

Chris Oswalt, USDA Forest Service: **Forest Inventory and Analysis (FIA) Program on Measuring Forest Carbon**
The FIA program projects how forests are likely to appear in 10 to 50 years. This enables researchers to evaluate whether current forest management practices and policies are sustainable. The FIA program reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership. Numerous acres on DoD installations contain forests, as well as the species that live in those landscapes. It is essential for

natural resources managers to properly oversee these areas to maintain a natural landscape, avoid endangered species listings, and ensure the training mission continues.

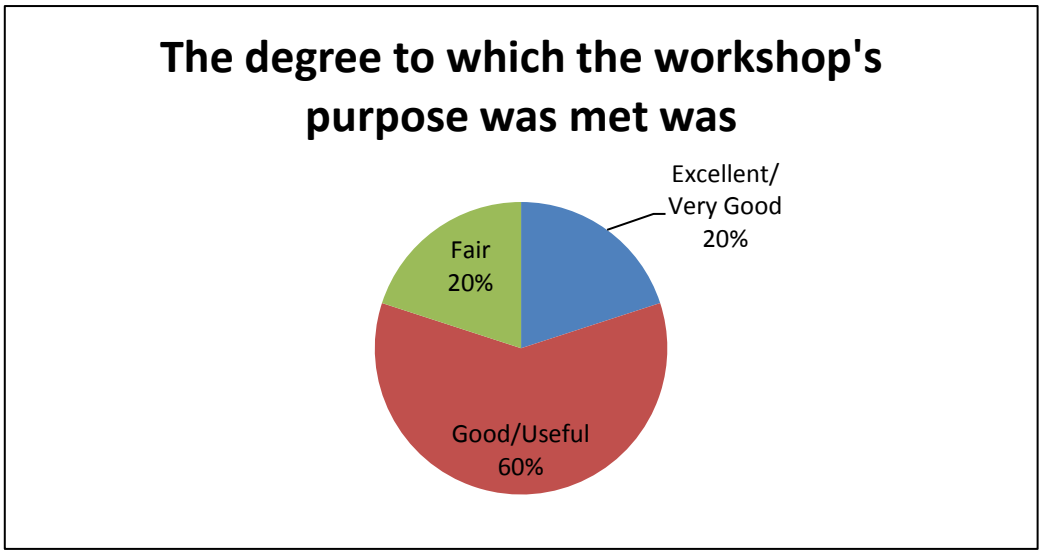
Sharon Coe, USDA Forest Service: **Vulnerability of Species At-Risk to Climate Change**
The U.S. Forest Service Rocky Mountain Research Station (Albuquerque Lab) developed a decision support tool for assessing vertebrate species' vulnerability to climate change. Vulnerability assessments inserted species at Fort Huachuca and Barry M. Goldwater Range to show how natural resources managers can make decisions that will benefit the species as well as the military personnel carrying out the mission.

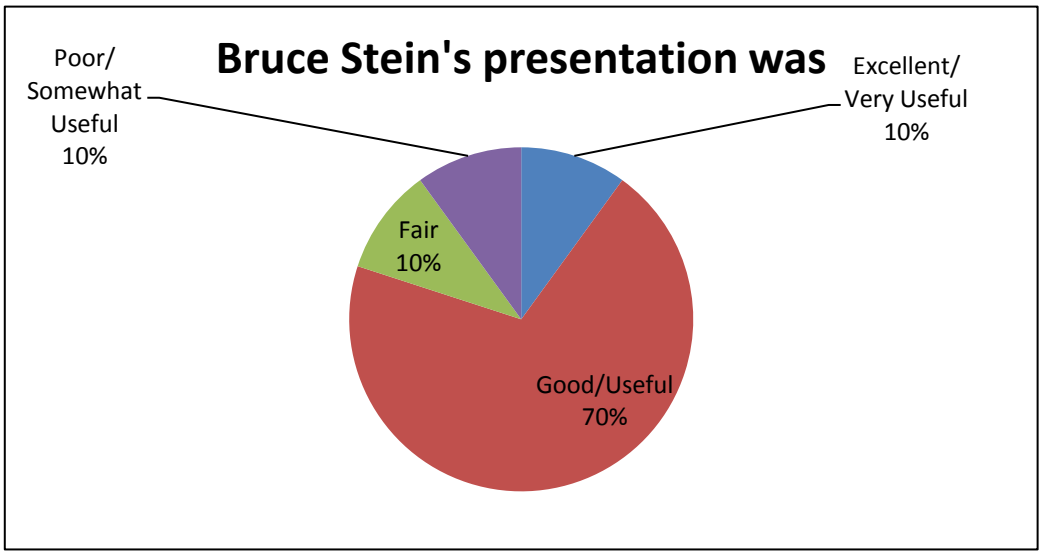
Rich Fischer, U.S. Army Corps of Engineers: **Integrated Climate Change and Threatened Bird Population Modeling to Mitigate Operations Risks on Florida Military Installations**
Climate change (via sea level rise and altered weather patterns) is expected to significantly alter low lying coastal and intertidal areas, which provide significant seasonal habitats for a variety of shoreline-dependent organisms. Many coastal military installations in Florida have significant coastal habitats and shoreline-dependent bird data that strongly illustrate their seasonal importance for birds. This project is developing a meta-population model of the Snowy Plover in Florida to assess the risk of climate change impacts and human disturbances on this species. The approach integrates three types of models: a habitat model of the species, results of climate models, and a demographic model. The integrated model incorporates effects of climate change, land-use change, and other threats on both the habitat and the population dynamics of the species. To date, preliminary habitat modeling efforts have been conducted with the Sea Level Affecting Marsh Model (SLAMM). The model was implemented with topological data at landscape-scale (30m) resolution and with LiDAR-based (1-2m) data. These early results have pointed out challenges in integrating different scales of ecosystem information for near-shore habitats and set the stage for subsequent global sensitivity and uncertain analysis efforts. The projections from these models will produce site-specific information that can identify the significance of military lands in contributing to the long-term sustainability of threatened and endangered species under various scenarios. Installation personnel can then use the projections in multiple-criteria decision analysis theoretical models, built on the Risk-Informed Decision Framework (RIDF) developed by the U.S. Army Engineer Research and Development Center (ERDC), to integrate uncertain regional and species information with the values and intuition of decision makers.

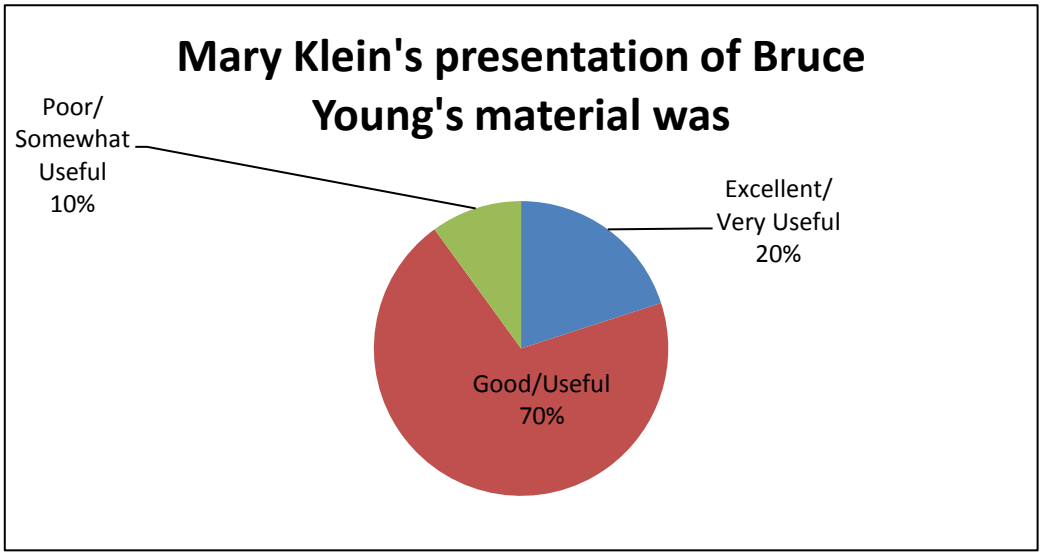
Climate Change Tools for Adapting Management Strategies Workshop
Participant Evaluation Statistics

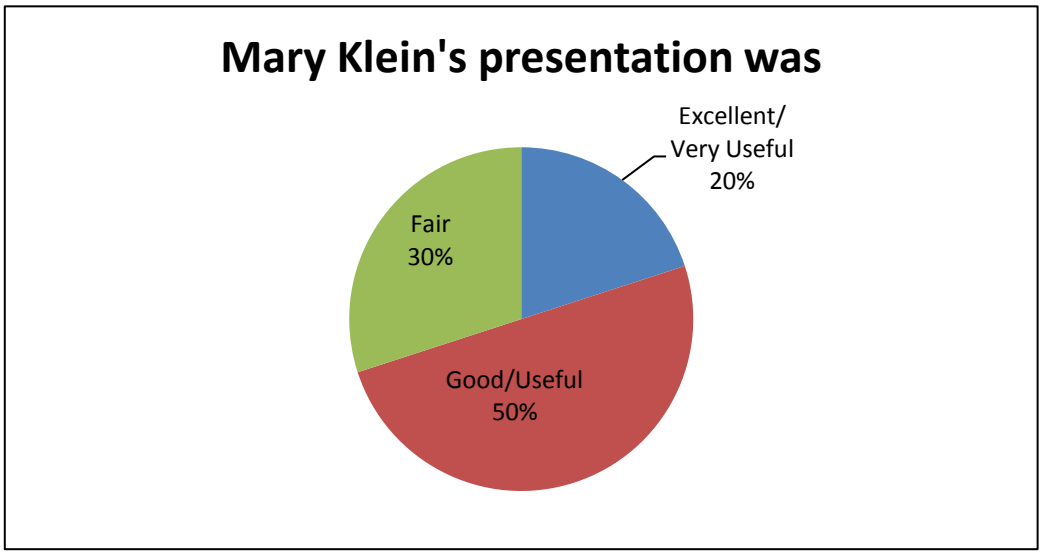
	Raw Numbers	Percentage
This workshop was designed to increase knowledge of different tools that are available to DoD natural resources managers for use on their installations to help them adapt management strategies in light of climate change impacts. The degree to which this purpose was met was		
Excellent/Very Useful	1	20
Good/Useful	3	60
Fair	1	20
The informative value, usefulness, and applicability of Bruce Stein's presentation was		
Excellent/Very Useful	1	10
Good/Useful	7	70
Fair	1	10
Poor/Somewhat Useful	1	10
The informative value, usefulness, and applicability of Mary Klein's presentation of Bruce Young's material was		
Excellent/Very Useful	2	20
Good/Useful	7	70
Poor/Somewhat Useful	1	10
The informative value, usefulness, and applicability of Mary Klein's presentation was		
Excellent/Very Useful	2	20
Good/Useful	5	50
Fair	3	30
The informative value, usefulness, and applicability of Eileen Regan's presentation was		
Excellent/Very Useful	1	10
Good/Useful	4	40
Fair	5	50
The informative value, usefulness, and applicability of Craig Scranton's presentation was		
Good/Useful	2	22
Fair	4	45
Poor/Somewhat Useful	2	22
Very Poor/Not Useful	1	11
The informative value, usefulness, and applicability of Bill Goran's presentation was		
Excellent/Very Useful	4	40
Good/Useful	3	30
Fair	3	30
The informative value, usefulness, and applicability of the poster session tools were		
Excellent/Very Useful	1	13
Good/Useful	3	37

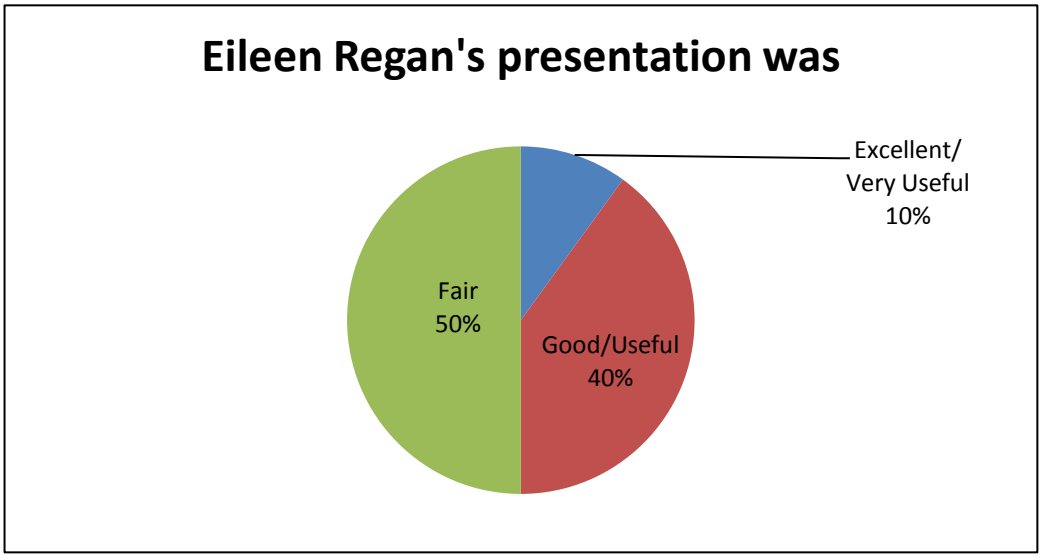
Fair	3	37
Poor/Somewhat Useful	1	13
Supplemental information provided was		
Excellent/Very Useful	1	10
Good/Useful	4	40
Fair	5	50
Overall, the presenters were		
Excellent/Very Useful	1	10
Good/Useful	7	70
Fair	1	10
Poor/Somewhat Useful	1	10
The set-up and time allotment for the poster session was		
Excellent/Very Useful	2	25
Good/Useful	3	37.5
Fair	3	37.5



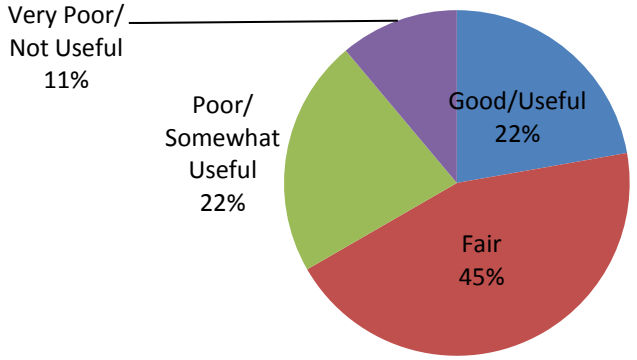



Mary Klein's presentation of Bruce Young's material was
Poor/ Somewhat Useful 10%
Excellent/ Very Useful 20%
Good/Useful 70%

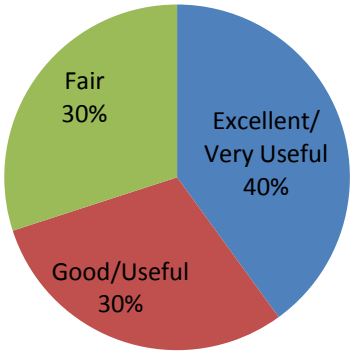

Mary Klein's presentation was
Excellent/ Very Useful 20%
Fair 30%
Good/Useful 50%


Eileen Regan's presentation was
Excellent/ Very Useful 10%
Fair 50%
Good/Useful 40%

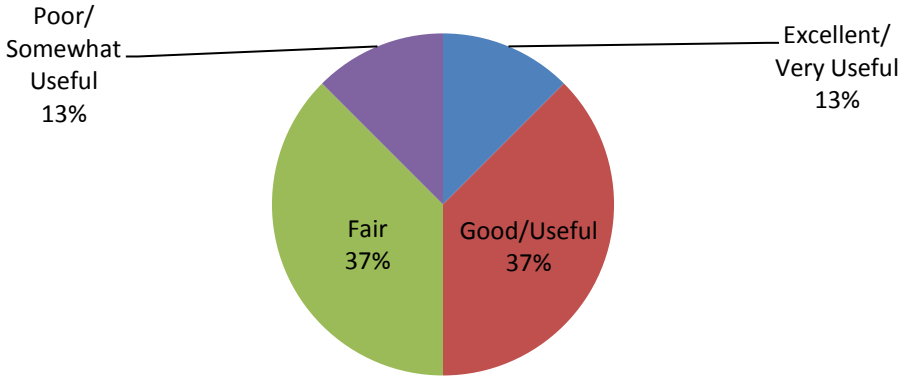
Craig Scranton's presentation was



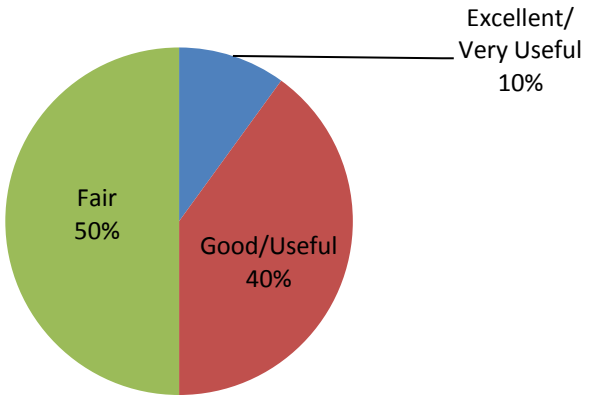
Bill Goran's presentation was



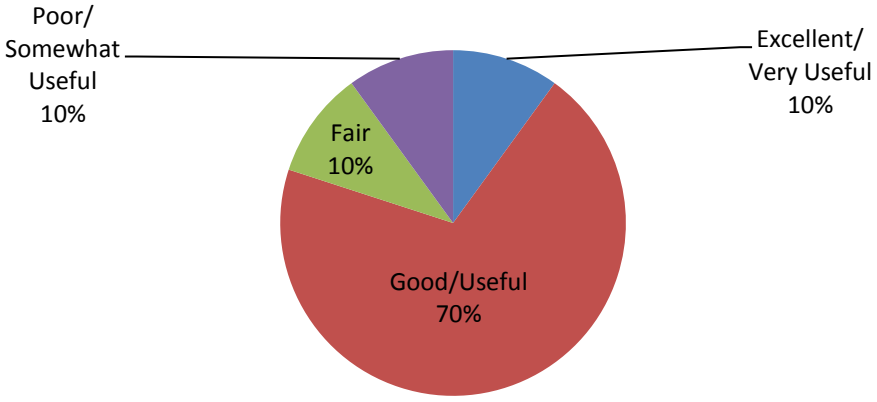
The poster session tools were



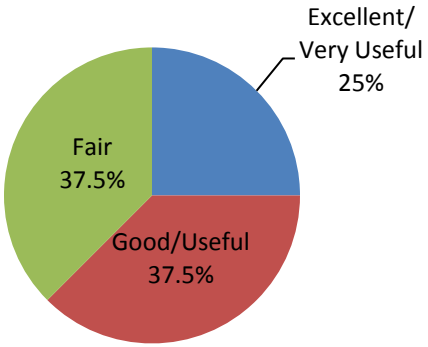
Supplemental information provided was



Overall, the presenters were



The set-up and time allotment for the poster session was



What did you find most useful/beneficial about this course? Why?

"The attention to the topic of climate change"
"How to begin to implement climate change tools and analysis"
"Actual tools available were demonstrated"
"NatureServe databases and resources – I was unaware of these"
"Focus on pragmatic actions was good"
"Tools available"
"CAT and SAR screening"

What did you find least useful/beneficial about this course? Why?

"Climate change needs to be presented on a broader scale. As NR managers, we get minimal input on building designs up-front."
"LEED discussion"
"Background info on climate change; too basic"

Are there any additional, major problems caused by climate change on DoD installations that these tools did not address? Are you familiar with other tools that may help natural resources managers adapt their management strategies?

"Will develop better understanding of climate change and its effects more in future as more information/data comes forward"

Please provide any other comments and/or suggestions.

"What are the ways we can work with other installations in our region? If we need a landscape approach, what steps can we take to work with other commands or branches at nearby installations?"
"What are the funding courses for climate change assessments? Vulnerability indices? Are grant programs focusing on this and how can DoD tap into this?"
"Climate change has many potential benefits to Alaska and the military in Alaska. Few of these were mentioned. In total, warming may be good for Alaska."

What are some major problems on military installations that may be caused by climate change, but were not discussed during this workshop?

"Quality habitat on DoD lands may be more resilient than marginally – quality habitat on other lands so may cause increase pressure ESA."
"Please keep pushing to installation commanders and top military that climate change analysis has to include natural resources and not just military infrastructure."
"Increased/stricter T&E species management due to increasing numbers of T&E species; this may cause impacts to the mission."

Are there specific research, monitoring, management, or technology projects that, if funded, could help solve any of the problems mentioned above?

"Identify habitats on DoD lands sensitive to climate change and habitat that may benefit from climate change and how to reduce negative impacts. Example wetland and forest decrease scrubland and grasslands increase."
"Funding for GIS or database interns or temporary positions that can crunch the data for a discrete installation."
"Additional sustainability of buildings, push government to implement highly sustainable construction and sustainable "rehab" of existing facilities. Need to present this to base civil engineers, not just natural resources folks."

What are some region specific threats that your installation faces? Do you think those threats put your installation at a greater risk than installations located in other regions? Should installations in this region receive more tools than installations in less vulnerable areas?

"We are coastal in Florida and are surrounded by bays and the Gulf of Mexico with many T&E species. Sea level rise will be an issue, as will temperature changes. Don't know if installations in this region should receive more tools than installations in less vulnerable areas."

Do you have any other questions, comments, concerns, or recommendations for topics/tools that we did not include in our workshop?

"Specific case studies would be helpful – although maybe better covered in a poster session."
"Would be nice to see specific analysis or predictions on taxa: a climate change analysis for birds, or just herps, just plants, etc. or maybe a regional focus – like the Alaska presentation."