North Central Climate Adaptation Science Center

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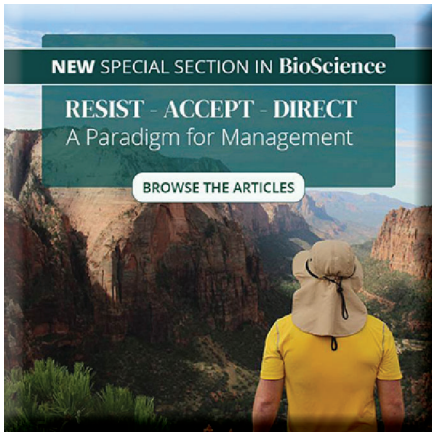
Adaptation Framework Co-Developed by CSP Senior Scientist Shelley Crausbay Highlighted in Special Section of High-Impact Journal "BioScience"

The work of NC CASC PI and CSP senior scientist Shelley Crausbay and colleagues is currently featured in a special issue of the high-impact journal, *BioScience*. The publications also feature Amanda Cravens and Katie Clifford, two NC CASC project investigators. In a series of five articles, Crausbay and her co-authors provide an in-depth exposition of the Resist-Accept-Direct (RAD) framework. Designed for and by natural resource managers, the framework provides decision-support for managers grappling with the potential for irreversible ecological transformations. After all, global change is increasingly propelling ecosystems on strong trajectories away from once-familiar conditions. Managers urgently need an approach that expressly acknowledges the likelihood of transformation and helps them make informed, purposeful, strategic choices in these novel contexts. The mental models paper is work that the NC CASC co-funded with the National CASC.



These five RAD articles explore practical application, compatibility with existing tools and approaches, social barriers and opportunities, and future science needs. Shelley led one of the five articles to call for a new ecological and social science agenda centered on the questions encountered in a RAD decision-making process. They are available to view and download, free of charge for a limited time at the BioScience site. The bundle of articles is introduced with an invited, independent opinion piece, *RAD: A Paradigm, Shifting* and the five articles are available at the links below:

Schuurman et al. *Navigating Ecological Transformation: Resist–Accept–Direct as a Path to a New Resource Management Paradigm* (overview)
Magness et al. *Management Foundations for Navigating Ecological Transformation by Resisting, Accepting, or Directing Social-Ecological Change* (application)
Lynch et al. *RAD Adaptive Management for Transforming Ecosystems* (compatibility with existing approaches)
Clifford et al. *Responding to Ecological Transformation: Mental Models, External Constraints and Manager Decision-making* (social barriers and opportunities)
Crausbay et al. *A Science Agenda to Inform Natural Resource Management Decisions in an Era of Ecological Transformation* (science needs)

UPCOMING EVENTS: NC CASC Webinar Series Webinar, Thursday, February , 10, 2022, 11am MT, TBA. Watch this space for updates.

Tribal Climate Adaptation Planning

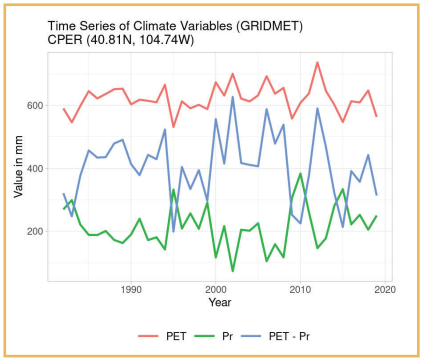
On October 18 – 21, 2021, participants from the Ute Mountain Ute, Southern Ute and Ute Tribe of Utah came together in a virtual setting to attend the Tri Ute Climate Adaptation Workshop, the first in a series of four climate adaptation workshops funded by the BIA Tribal Climate Resilience Program. Ute Mountain Ute climate change coordinator, Margie Connolly, and NC CASC tribal liaison, Stefan Tangen, led and facilitated this 4-day online training workshop. NC CASC research ecologist, Brian Miller, also provided adaptation training while Doug Kluck from NOAA provided an opening presentation on climate change impacts.

As climate change impacts Tribal nations, the crafting and implementing of strategic adaptation plans help them to address specific vulnerabilities and determine courses of action based on the best information at hand. Incorporating the tribal context is particularly important to make climate information more relevant and valuable. These types of workshops "provide relevant information about climate change impacts and adaptation opportunities at the appropriate scale and scope" says Stefan Tangen, while also providing training on tools and resources already in place.

Continue reading about the workshop in the full spotlight story on our website.

Interactive and Easy to Use R-Shiny Apps

Dr. Imtiaz Rangwala and graduate research assistant, Prasad Thota at the NC CASC have released eight different interactive and easy to use R-Shiny apps to plot and extract data for both observed and future projections of climate change as it pertains to different drought metrics, extreme dry atmospheric conditions and grassland productivity:



1. Grasslands Productivity and Climate App
2. Vapor Pressure Deficit (VPD)
3. Evaporative Demand (PET)
4. Climate Futures Toolbox
5. Standardized Precipitation Index (SPI)
6. Standardized Precipitation Evapotranspiration Index (SPEI)
7. Evaporative Demand Drought Index (EDDI)
8. Forest Drought Stress Index (FDSI)

Users are able to quantify, visualize and download data as .csv files for further analysis. These apps are developed to support quantitative scenario planning in order to more robustly assess the nature of climate change impacts, making them of particular use for researchers and stakeholders. Available on the Climate Science Support Platform, they are broadly defined as a network of NC CASC scientists and partners that provide climate science support through collaborative research. The US Fish and Wildlife Service, for example, is an important partner that regularly interacts with the NC CASC on species status assessments in a changing climate.

Read more about the R-shiny apps in the full spotlight story on our website.

Uncertainty, Complexity and Constraints, & Growing Insights into the Future of Climate and Ecosystems

In a recently published open-source paper, *Uncertainty, Complexity and Constraints: How do we robustly assess biological responses under a rapidly changing climate?*, scientists from the North Central Climate Adaptation Science Center and partner institutions explore biological responses to climate change. In the past, this has challenging for practitioners because of the complexity inherent in biology, climate, and the interactions between the two; the range of possible outcomes due to uncertainties in model predictions; and limitations due to (un)availability of appropriate spatial and temporal datasets. Collaboration, sharing of experiences, and building of partnerships, as demonstrated in this paper's collective efforts of scientists working across multiple institutions, all provide effective ways for evaluation of future climate change impacts on ecosystems and species. Despite the uncertainties, complexities, and constraints with assessing biological responses due to climate change, scientists and managers can draw on climate and ecological science, data, expertise and field experience to assess likely future conditions and point to best strategies to employ in the present and to maximize decision options for the future. Read the full spotlight story.

NC CASC Consortium Partner Dr. Molly Cross Quoted in German News Outlet Covering COP26

NCCASC Consortium Partner Dr. Molly Cross, Wildlife Conservation Society, was quoted in a German news outlet covering COP26: "There is some progress on financial investment in adaptation and country-level adaptation planning, but those efforts must be bolstered and expanded to meet the growing risks that both people and nature face from a changing climate," Molly Cross, science director for the WCS Climate Adaptation Fund, told DW.

Cross said one critical aspect of helping humans adapt to climate change is the protection and restoration of intact and healthy ecosystems. "We must make significant investments in actions that help people and nature cope with and adapt to climate change-related impacts that are already underway." Read the full article here.

James Rattling Leaf Presented at Geo for Good Annual Conference

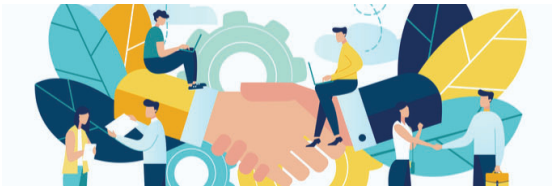
The Geo for Good Summit is an annual conference geared toward nonprofits, scientists, government agencies and other change-makers who want to leverage mapping tools and technology for positive impact in the world. James Rattling Leaf presented on November 17 in the "Remote Sensing & AI: Let's Talk Ethics" session.

As deep learning methodologies power the tools we use every day, including remote sensing tools, it's important to examine the ethics and principles behind science and datasets "powered by AI." This roundtable discussion included what to consider when applying deep learning to your science toolkit.

NC CASC Consortium Partner WCS Publishes New Paper on Criteria for Evaluating Adaptation Success for Biodiversity and Natural Resource Conservation

A new study in Environmental Science & Policy, *Flexible and comprehensive criteria for evaluating climate change adaptation success for biodiversity and natural resource conservation*, co-authored by scientists at the Wildlife Conservation Society (@WCSAdapts), presents an adaptation "scorecard" for evaluating outcomes for climate-informed conservation and natural resource management projects. The research team interviewed and surveyed 18 climate adaptation researchers and funders and 47 practitioners to develop the flexible and comprehensive set of criteria, which can be tailored to an individual project's goals and context. This paper is part of a recent collection that draws on learning from the WCS Climate Adaptation Fund , which has supported over 100 climate adaptation projects in the U.S. designed to benefit wildlife, ecosystems, and the people that depend on them. Other related publications can be found here. Read the WCS press release at CoP26.

Christy Miller Hesed publishes new paper, "Using cultural consensus analysis to measure diversity in social-ecological knowledge for inclusive climate adaptation planning"



NC CASC Research Associate Christy Miller Hesed has published a new paper in the American Meteorological Society Journals, *Using cultural consensus analysis to measure diversity in social-ecological knowledge for inclusive climate adaptation planning*:

Climate adaptation is context specific and inclusion of diverse forms of knowledge is crucial for developing resilient social-ecological systems. Emphasis on local inclusion is increasing, yet participatory approaches often fall short of facilitating meaningful engagement of diverse forms of knowledge. A central challenge is the lack of a comprehensive and comparative understanding of the social-ecological knowledge that various stakeholders use to inform adaptation decisions. We employed cultural consensus analysis to quantitatively measure and compare social-ecological knowledge within and across three stakeholder groups - government employees, researchers, and local residents in rural coastal Maryland. The results show that 1) local residents placed more emphasis on addressing socio-economic and cultural changes than researchers and government employees, and 2) that the greatest variation in social-ecological knowledge was found among local residents. These insights yielded by cultural consensus analysis are beneficial for facilitating more inclusive adaptation planning for resilient social-ecological systems. Read the full paper.

Recent NC CASC Publications

Uncertainty, Complexity and Constraints: How Do We Robustly Assess Biological Responses under a Rapidly Changing Climate? ● Climate ● I. Rangwala, W. Moss, J. Wolken, W. Travis

Recent NC CASC Webinars & Newsletters

NC CASC Webinar Series: Setting habitat protection and restoration priorities in a warming world: Lessons from Wyoming

NC CASC December 2021 Tribal Drought Webinar

NC CASC November 2021 Tribal Climate Newsletter

NC CASC December 2021 Tribal Climate Newsletter

December Urban Wildfire

December urban wildfire. Three words thought unimaginable to exist in the same sentence. That was the case until Thursday, December 30, 2021. Chinook winds ahead of an incoming cold front with gusts from 60mph to more than 100 mph carried fire over a suburban landscape classified by NOAA as under extreme drought. While not the largest wildfire in Colorado's history, at ~6,000 acres the devastation caused by the Marshall Fire in Boulder County has earned it the designation of the most destructive wildfire ever to occur in the state. To date, the Boulder County Office of Emergency Management is reporting 1084 structures lost, 149 damaged, 1 person missing, 1 confirmed fatality, and thousands of residents displaced. The cause of the fire is still under active investigation.

Boulder County is home to the North Central Climate Adaptation Science Center and CIRES at the University of Colorado. Our hearts go out to all who have been impacted by this event, many of whom are our families, friends, neighbors, and colleagues.

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