LANDSCAPE TO SEASCAPE COLLABORATION:
An Analysis of Landscape Conservation Cooperatives Science Needs Assessments and Recommendations For Nearterm NOAA Engagement

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Submitted by:
Polly L. Hicks,
Restoration Ecologist
Fisheries Restoration Center NW Region

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1 Introduction

In 2010, the Department of the Interior established a network of 22 Landscape Conservation Cooperatives (LCCs) with the vision of achieving "*landscapes capable of sustaining natural and cultural resources for current and future generations.*" Stressors, such as climate variability and change, are impacting natural and cultural resources at scales larger than typical conservation programs and actions can address, which are focused on a single species or smaller geographic areas. The LCCs are self-directed public-private partnerships lead by the U.S. Fish and Wildlife Service (FWS) to achieve conservation at the landscape-scale and to integrate science and management actions to address landscape-scale stressors. The LCCs span all of the terrestrial land of the United States including its territories, the Pacific Island and the Caribbean as well as extend into parts of Canada and Mexico. Some LCC boundaries also extend into coastal and marine habitats (Figure 1).

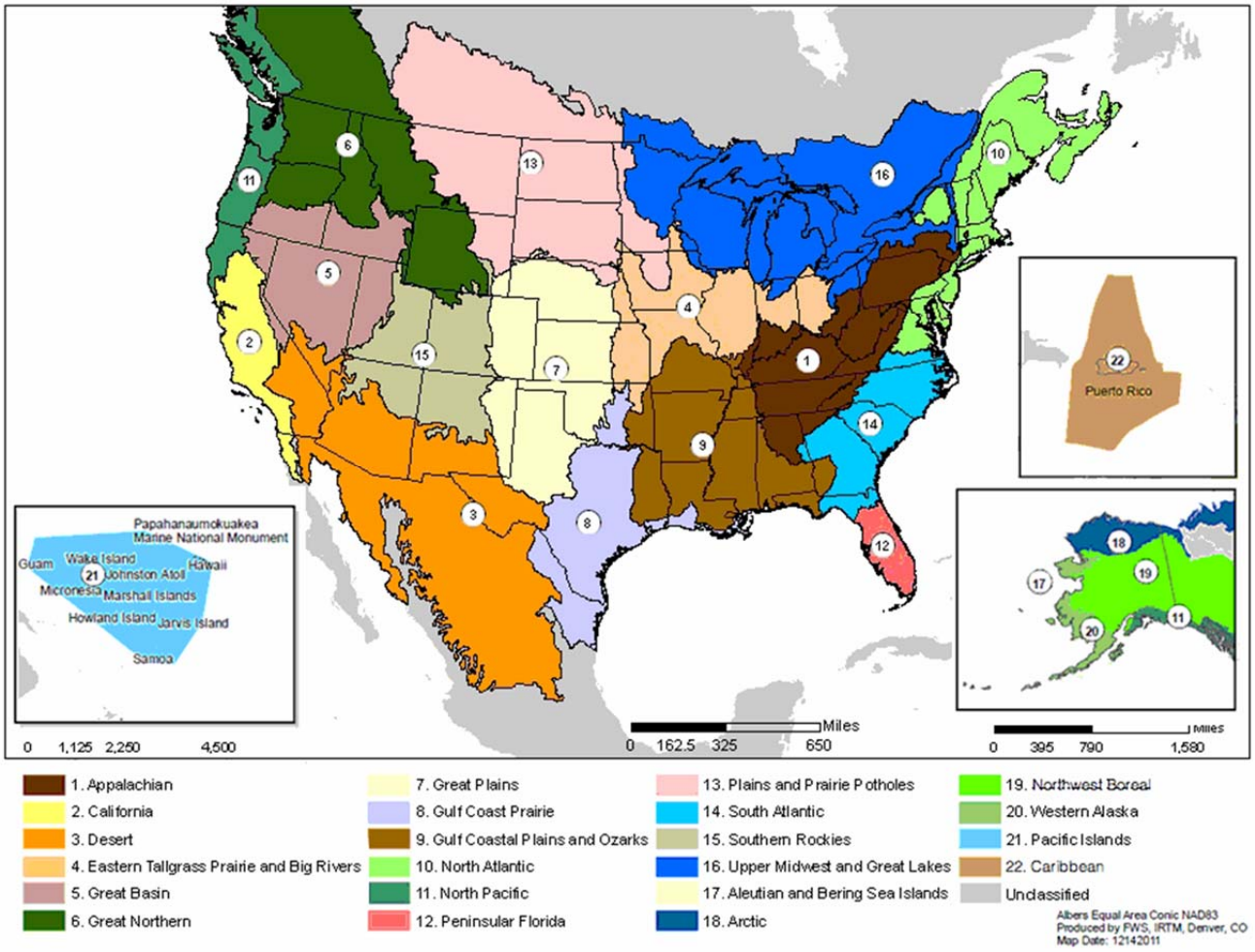

Figure 1. Map of LCC network (FWS 2011)

Together, the 22 LCCs create a network of resource managers and scientists from a diversity of organizations and agencies including federal, state, and local governments along with Tribes and First Nations, non-governmental organizations, universities, and interested public and private organizations.

Within each LCC, these partners work together to share and develop the scientific and traditional knowledge necessary to inform successful landscape-scale conservation, establish common landscape-level conservation targets, and identify strategies to achieve these targets through collaborative actions and adaptive management. A major focus and strength of each LCC is facilitating the exchange of both scientific, and in some cases, traditional knowledge to its partners and the larger public as well as creating successful collaborations among its partners. In part to support the work of the LCCs, DOI also established eight Climate Science Centers (CSCs) managed by U.S. Geological Survey to provide scientific information and tools. LCCs and CSCs support and fund targeted research to address key knowledge gaps and the development of management tools that support conservation design and implementation[1].

The approach of the LCC network to integrate science and management in order to address landscape-scale issues that affect the "sustainability of our economy, land, water, wildlife, and cultural resources"[2] aligns well with the National Oceanic and Atmospheric Administration's (NOAA) ecosystem-based management approach (EBM). An EMB approach integrates science with the management of an entire ecosystem in order to understand impacts to the system from multiple stressors and balance conflicting uses including conservation of natural resources. As a result of this strong overlap in approaches for conservation, NOAA staff serve on the LCC Council, as well as individual LCC Steering Committees and working groups, and collaborate on specific research projects and other studies. Currently, 51 NOAA staff have formal roles in 20 of the 22 LCCs within the network (Table 1, Appendix A). In 2014, NOAA's LCC Coordinator conducted an informal survey of NOAA staff who participate in the LCCs. A majority of the survey participants indicated that NOAA's participation in the LCC network helped to improve efficiencies, contribute to common conservation goals, and allowed for very strong partnership development with a large number of entities.

Table 1. NOAA Participation in LCC Network: by the numbers.

Total number of NOAA staff or partner staff participating	51
NOAA Line Office Participation	# staff
NOS	16
NMFS	15
NESDIS	5
NWS	5
OAR	3
UNSEC	2
NOAA Partner Pariticipation	# staff
RISA	1
RCC	1
NERRS	3
State CZM	1
Participation in LCC structure	# staff
LCC Council	4
Steering Committees	35
Working Groups	23

Because the individual LCCs were designed to be self-directed in order to meet the unique needs of each system, NOAA's engagement has been focused at the individual LCC level, with the exception of participation in the LCC Council. To strengthen the NOAA/LCC collaborations and identify opportunities for partnership at the multi-LCC or national-scale, an analysis of each LCC's science needs assessment was conducted as a part of a NOAA Rotational Assignment Program (NRAP). The following analysis identified common themes across the LCCs' science needs assessments and cross-walked each theme to NOAA's science and management priorities for climate and habitat conservation in order to identify shared interests. The results were then used to develop recommendations for strategic near term actions for NOAA's engagement with the LCC network. Implementation of the recommendations will allow NOAA to help address some critical need of the LCCs and maximize the benefits to NOAA trust resources and climate work. The near term actions are designed to supplement the strong collaborations already occurring within individual LCCs by NOAA staff.

[1] A full list of projects funded through the LCC network can be found at www.lccnetwork.org/projects

[2] LCC Network vision, mission and guiding principles can be found at http://www.lccnetwork.org/about

A secondary goal of the analysis and resulting recommendations is to generate awareness within NOAA about the strong overlap between the goals and science needs of the LCC network and NOAA's climate and natural resource work and inform future collaborations on shared goals and interests. Since the establishment of the LCC network, NOAA, FWS and USGS have been working together to try and understand how the overlap in activities and missions create enabling conditions for improved efficiencies. This report is an additional step in building effective collaborations that result in increased efficiencies and improved results for NOAA and the LCC network.

2 Analysis and Results

2.1 LCC Science Needs Assessments

As all LCCs were designed to be a self-governing collaboration; each LCC approached the development of a science needs assessment differently in order to meet the needs of the local region and address the landscape-scale issues of importance to that LCC. All of the LCCs are addressing climate variability and climate change as a key landscape-scale stressor; however, some also incorporated additional landscape-scale stressors such as invasive species and human development. Each LCC also incorporated human uses, values and traditional knowledge of ecosystems to different degrees. A number of LCCs identified traditional ecological knowledge (TEK) as an important source of information to be combined with traditional western science to fill key knowledge gaps. Many included impacts to cultural resources, traditional uses, subsistence living, community resilience and economies. Finally, the process and frameworks for identifying science and knowledge gaps varied greatly among LCCs. Some LCCs created a highly detailed framework that reflects the Fish and Wildlife Service's Strategic Habitat Conservation Framework (SHC) as well as adaptive management process (Figure 2 B). Other LCCs used more streamlined frameworks or process that drew on management and scientific partners to develop and rank key knowledge gaps (Figure 2 A).

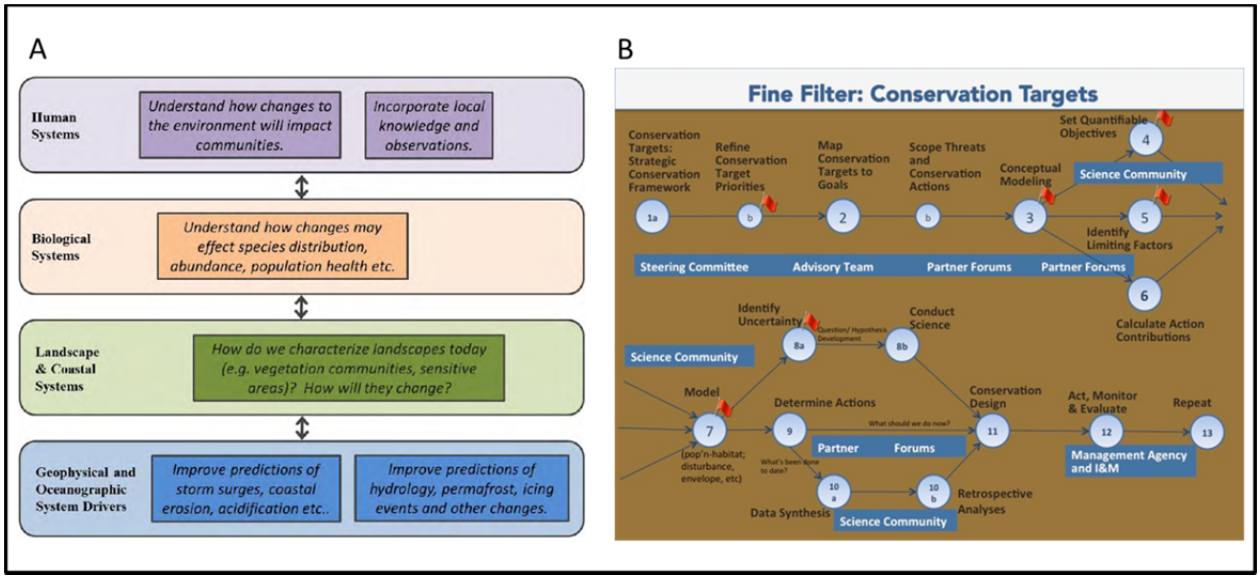

Figure 2. Logic framework and process outlines used, in part, to develop science needs assessments from Western Alaska LCC (A) and Great Northern LCC (B).

Of the 22 LCCs, fourteen had science needs assessments that were ready to be incorporated into the synthesis (Table 2). The remaining eight LCCs are in the development phase of the assessments and were not included. One multi-LCC collaboration involving the seven LCCs in the Mississippi River Basin (MRB) was also incorporated into the analysis; this collaboration is designed to strategically address the Gulf of Mexico Hypoxia Zone and is detailed in Section 3.3.1 of this report. When developing projects or strategies for addressing specific science needs it will be important to engage with the LCCs identified in this report as well as the remaining LCCs that have not completed their needs assessments at the time of this analysis. In addition, it is important to remember that this analysis is a snap-shot in time. As the natural resource managers and climate scientists continue to further our understanding of these landscape-scale stressors and the resulting impacts, priority needs may shift and evolve.

Table 2. Landscape Conservation Cooperatives incorporated into the analysis.

Landscape Conservation Cooperative	Acronym
Aleutian and Bering Sea Islands	ABSI
Appalachian	App
Arctic	Arctic
California	CA
Desert	Desert
Eastern Tallgrass Prairie and Big Rivers	ETPBR
Gullf Coast Prairies	GCP
Gulf Coast Plains and Ozarks	GCPO
Mississippi River Basin includes seven LCCs (ETPBR, PPP, UMGL, GP, App, GCP, GCPO)	MRB
North Atlantic	NA
Northern Boreal	NWB
North Pacific	NP
Pacific Island	PI
South Atlantic	SA
Western Alaska	WA

For each science needs assessment, any knowledge gaps related to climate variability and climate change were recorded. Other non-climate stressors considered by some LCCs were included in the analysis in two ways: 1. as a part of cumulative impacts from multiple landscape-scale stressors including climate variability and change and 2. if an LCC had a specific question about how climate variability and change may affect another landscape-scale stressor, such as invasive species. Similar themes among LCCs were collated together in a structured analysis so that one can step through different levels of detail regarding the knowledge gaps from high level common themes to subthemes and finally specific projects or questions of interest. Each of these collated knowledge gaps are included in separate appendices to this report, with the major themes in Appendix B, subtheme in Appendix C, and specific questions or projects in Appendix D. In the fall of 2014, a presentation on the draft analysis structure was made to the LCC science coordinators and a draft version of the analysis was distributed for their review and comment to ensure that the needs were adequately captured.

In total, 17 major themes were divided into three categories: *physical or ecosystem processes*, *assessments* as well as *data collection and management* (Table 3; Appendix B). *Physical or ecosystem processes (processes)* included knowledge gaps regarding changes to processes or drivers that form and sustain habitats on the landscape, such as weather, climate variability and long-term climate change, hydrologic processes and regimes, and coastal/marine processes among others. It is recognized that many of the processes may influence and overlap with each other, for example changes in precipitation patterns affects the hydrology of streams. However, grouping the knowledge gaps into these distinct, but related, processes creates a manageable framework in which to work. The most commonly shared processes category themes were weather, climate variability and long-term climate change as well as hydrological processes and regimes. The major theme of weather, climate variability and long-term climate change included specific knowledge regarding the changes to air temperature; precipitation patterns; the frequency and timing of extreme events; timing and intensity of seasonal effects; and windiness (Appendix C). These specific knowledge gaps are termed subthemes in this analysis. Many of these subthemes focus not only on the long-term predictions resulting from climate change, but also on increased variability in the near to mid-term, such as those driven by El Niño/La Niña or Pacific Decadal Oscillations, and how that affects our ability to predict these types of events. The common theme of hydrologic processes and regimes had the subthemes of effects on lakes, rivers, streams and riparian corridors; and changes in snow characteristics including depth and extent (Appendix C). At the specific question and project level, many LCCs identified the specific processes or indicators of concern, such a flow, temperature, erosion, stream chemistry etc. (Appendix D).

Table 3. Major themes from LCC Science Needs Assessments and the individual LCCs that identified the themes. Parentheses indicate that the knowledge gaps relevance was inferred.

LCC Themes	Landscape Conservation Cooperatives
Physical or Ecosystem Processes	
Weather, climate variability and long-term climate change	NP, Arctic, CA, App, GCP, (GCPO), SA, Desert, PI, NWB, MRB, ETPBR, NA, WA
Hydrologic processes and regimes	NP, CA, Arctic, ETPBR, App, GCP, (GCPO), SA, (Desert), NWB, WA, UMGL, NA
Coastal/marine processes	NP, Arctic, CA, GCP, SA, PI, NA, WA
Fire regimes	CA, App, NWB, ETPBR, GCP, WA
Carbon cycle and sequestration	CA, App, SA, ETPBR, MRB
Cryoshpere processes and dynamics	Arctic, NWB, WA
Sediment regime	Arctic, CA, MRB
Assessments	
Vulnerability assessments for target species	ABSI, App, Arctic, NP, GCP, SA, Desert, PI, NWB, WA, MRB, NA
Vulnerability assessment for habitat types	App, ETPBR, NP, CA, GCP, (GCPO), SA, Desert, PI, NWB, WA, MRB, NA
Vulnerability assessments for human populations	App, Arctic, NP, GCP, SA. Desert, PI, NB, WA, ETPBR, MRB
Assessment of water quality and quantity	App, GCP (CA, NP, GN), Desert, NWB, WA, ETPBR
Downscaled/improved climate models and predictions for changes in the resources, at appropriate scales	NP, Arctic, ABSI, ETPBR, App, PI, GCP, NA, WA
Assessment of conservation and restoration practices effectiveness given climate change dynamics	ETPBR, App, CA, NP, GCP, (SA), Desert
Effects on trophic relationships	Arctic, NWB, WA
Data Collection and Mangement	
Data sharing	all LCCs
Baseline and trend monitoring for key indicators, habitats or species.	NP, Arctic, ABSI, App, GCP, SA, Desert, NWB, WA, ETPBR
Guidance documents of best practices for conservation and restoration actions.	NP, App, Desert, ETPBR

The *assessment* category is focused on how changes in the system drivers and processes in-turn affect conservation targets and valued ecosystem services such as species, habitats, human communities and water quantity and quality among others. A majority of the assessment themes were widely shared across the LCCs including vulnerability assessments for target species, habitat types, and human populations; assessment of impacts to water quality and quantity; and downscaling or improving climate models for local geographies (Table 2). The first two assessment themes (species and habitat vulnerabilities) are needed to establish shared conservation targets that LCCs partners can collectively work to protect and better understand how these targets are at risk from climate change impacts. Some

LCCs have set their conservation targets before conducting vulnerability assessments while others are using an analysis of vulnerability to help identify targets. These targets and the knowledge of how they are vulnerable to climate change will inform shared conservation strategies for the LCCs and their partners. Many LCCs are also focused on how climate change and other landscape-scale stressors will affect human communities including impacts to traditional and subsistence uses as well as cultural resources; community safety and health, and economies. Assessing these vulnerabilities is often, but not always, linked to vulnerabilities of species or habitats. For example if a community has a subsistence or commercial fishery of key importance at risk from climate change, then that community will be vulnerable as well. Assessment of impacts to water quality and quantity include both concerns of increased droughts and floods as well as synergistic affects between changes in water quality and quantity and increased or changing human demands for water. The LCCs with an interest in this assessment include those typically thought of in the western United States, but also includes several from the mid-west as well as the Appalachians where an increase in the energy development sector is having effects on water quantity and quality. Finally, because climate change models are for large geographic areas, there is a desire from many LCCs to downscale the models to better understand how these larger dynamics will likely affect the ecosystems and conservation targets at the individual LCC scale.

The *data collection and management* category and related themes were included in this analysis as it was a strong component of all science needs assessments. This highlights the LCC focus on widely sharing the knowledge generated from research scientific and traditional ecological knowledge so that it can be understood and applied to conservation actions as well as decisions that impact conservation success. While these themes were not included in the rest of the analysis, the focus on shared knowledge informed the recommendations contained in this report.

2.2 Intersection with NOAA priorities

To identify strategic opportunities for collaboration, NOAA priorities for agency work related to climate variability and climate change as well as habitat conservation were identified using existing and draft strategic planning documents. Four NOAA documents were used for this purpose including NOAA's Strategic Plan, NOAA Habitat Conservation Team (NHCT) Draft Habitat Policy Outcomes, NHCT Draft Science Priorities, and NOAA Climate Societal Challenges (Appendix E). These four were selected because they are cross-line office planning and prioritization documents and, therefore, reflect the wide array of activities that NOAA conducts related to climate science and natural resource management. Additional program or line office specific planning documents were reviewed, but it was determined that the analysis would become too unwieldy if a finer level of prioritization was included. The structured analysis will be widely distributed so that program level discussions about how the science needs of the LCC network overlap with program priorities can occur within programs.

Each major theme for the physical or ecosystem processes and assessment categories were compared against the priorities or element of the selected planning documents to determine if there was overlap (Appendix F). This cross-walk was not made for the data management category as the NOAA priorities were high level priorities that did not encompass those specific types of needs or actions. As this comparison was made, the details of what rolled-up into the major theme were considered to help determine if a particular theme was aligned with NOAA's priorities. Because the specific elements and priorities listed in each of the four NOAA planning documents were redundant, these were then collated into six management-related and four science-related priorities to simplify interpretation of the analysis (Table 4; Appendix E). This process was repeated for the subthemes (Appendix C) but not for the specific project level questions as they were too fine of a level of detail for these higher level priorities.

Table 4. Collated NOAA priorities for climate change science and habitat conservation drawn from NOAA's Strategic Plan, NHCT Draft Habitat Policy Outcomes, NHCT Draft Science Priorities, and NOAA Climate Societal Challenges. Priorities were grouped into those with a management or science connection.

Management Connection	Science Connection
Climate adaptation & mitigation	Climate adaptation & mitigation
Weather ready nation	Foundational mapping & assessments
Resilient coastal communities	Habitat productivity
Healthy oceans & coastal habitats	Value of nature
Sustainable living marine resource (LMR) populations	
Water resources & management	

Most of the major themes aligned with several of NOAA's priorities and strategic planning elements. This demonstrated that collaboration with the LCC network represents a true opportunity to achieve mutual goals and leverage the collective resource of NOAA, FWS as well as the LCC partners. For physical or ecosystem processes category, weather, climate variability and long-term climate change as well as hydrologic processes and regime had the strongest alignment with NOAA management and science-related priorities and the most commonality across the LCCs (Table 5). In addition the coastal/marine processes and sediment regime also overlapped with a number of NOAA management and science priorities. Coastal/marine processes were identified by eight LCCs as a priority science need, while changes to sediment regimes was only identified by three LCCs.

Table 5. Linking common knowledge gap themes from LCC science needs assessment to NOAA management and science related priorities for climate change and habitat conservation. The first column lists the different themes under the physcial or ecosystem process category. The second column lists which LCC included those themes in their science needs assessments; LCC in parentheses indicates that the theme was inferred instead of stated directly. The third and fourth column list the specific NOAA management or science related priorities that have a connection to the themes listed in the first column.

***A complete list of NOAA management and science related priorities are listed in Table 4.**

LCC Themes	Landscape Conservation Cooperatives	NOAA Priorities	
		Management Connection*	Science Connection*
Physical or Ecosystem Processes			
Weather, climate variability and long-term climate change	NP, Arctic, CA, App, GCP, (GCPO), SA, Desert, PI, NWB, MRB, ETPBR, NA, WA	Climate adaptation & mitigation Weather ready nation Healthy oceans & coastal habitats Resilient coastal communities Sustainable LMR populations Water resources & management	Climate adaptation & mitigation Foundational mapping & assessments Habitat productivity
Hydrologic processes and regimes	NP, CA, Arctic, ETPBR, App, GCP, (GCPO), SA, (Desert), NWB, WA, UMGL, NA	Climate adaptation & mitigation Weather ready nation Healthy oceans & coastal habitats Resilient coastal communities Sustainable LMR populations Water resources & management	Climate adaptation & mitigation Foundational mapping & assessments Habitat productivity
Coastal/marine processes	NP, Arctic, CA, GCP, SA, PI, NA, WA	Climate adaptation & mitigation Weather ready nation Healthy oceans & coastal habitats	Climate adaptation & mitigation Foundational mapping & assessments Habitat productivity
Fire regimes	CA, App, NWB, ETPBR, GCP, WA	Climate adaptation & mitigation Weather ready nation	Climate adaptation & mitigation
Carbon cycle and sequestration	CA, App, SA, ETPBR, MRB	Climate adaptation and mitigation	Climate adaptation & mitigation
Cryoshpere processes and dynamics	Arctic, NWB, WA	Climate adaptation & mitigation Healthy oceans & coastal habitats	Climate adaptation & mitigation Foundational mapping & assessments Habitat productivity
Sediment regime	Arctic, CA, MRB	Climate adaptation & mitigation Healthy oceans & coastal habitats Sustainable LMR populations	Climate adaptation & mitigation Foundational mapping & assessments Habitat productivity

For the assessment category, all of the LCC science needs, with the exception of impacts to trophic relationships, had a multiple areas of overlap with NOAA management and science related priorities for climate change and habitat conservation (Table 6). Vulnerability assessments for habitats types; assessment of impacts to water quality and quantity; and downscaling or improving climate models had the most overlap. Vulnerability assessment for habitat was the most common assessment need identified across the LCCs as well. Vulnerability assessments for target species and human populations had fewer areas of overlap, but still touched on multiple NOAA management and science-related priorities. NOAA science priority regarding the value of nature overlapped with three assessment themes.

Table 6. Linking common knowledge gap themes from LCC science needs assessment to NOAA management and science related priorities for climate change and habitat conservation. The first column lists the different themes under the assessment category. The second column lists which LCC included those themes in their science needs assessments; LCC in parentheses indicates that the theme was inferred instead of stated directly. The third and fourth column list the specific NOAA management or science related priorities that have a connection to the themes listed in the first column.

***A complete list of NOAA management and science related priorities are listed in Table 4.**

LCC Themes	Landscape Conservation Cooperatives	NOAA Priorities	
		Management Connection*	Science Connection*
Assessments			
Vulnerability assessments for target species	ABSI, App, Arctic, NP, GCP, SA, Desert, PI, NWB, WA, MRB, NA	Climate adaptation and mitigation Resilient coastal communities Sustainable LMR populations	Foundational mapping & assessments Habitat productivity
Vulnerability assessment for habitat types	App, ETPBR, NP, CA, GCP, (GCPO), SA, Desert, PI, NWB, WA, MRB, NA	Climate adaptation and mitigation Weather ready nation Resilient coastal communities Healthy oceans & coastal habitats Sustainable LMR populations Water resources & management	Climate adaptation & mitigation Foundational mapping & assessments Habitat productivity Value of nature
Vulnerability assessments for human populations	App, Arctic, NP, GCP, SA. Desert, PI, NB, WA, ETPBR, MRB	Climate adaptation and mitigation Weather ready nation Resilient coastal communities	Climate adaptation & mitigation Value of nature
Assessment of water quality and quantity	App, GCP (CA, NP, GN), Desert, NWB, WA, ETPBR	Climate adaptation and mitigation Weather ready nation Resilient coastal communities Healthy oceans & coastal habitats Water resources & management	Climate adaptation & mitigation Value of nature
Downscaled/improved climate models and predictions for changes in the resources, at appropriate scales	NP, Arctic, ABSI, ETPBR, App, PI, GCP, NA, WA	Climate adaptation and mitigation Weather ready nation Resilient coastal communities Healthy oceans & coastal habitats Sustainable LMR populations Water resources & management	Climate adaptation & mitigation Foundational mapping & assessments
Assessment of conservation and restoration practices effectiveness given climate change dynamics	ETPBR, App, CA, NP, GCP, (SA), Desert	Climate adaptation and mitigation Healthy oceans & coastal habitats Sustainable LMR populations Water resources & management	Climate adaptation & mitigation Habitat productivity
Effects on trophic relationships	Arctic, NWB, WA	Sustainable LMR populations	Habitat productivity

3 Recommendations for NOAA engagement at multi-LCC level

The numerous areas of overlap between NOAA's climate and habitat related priorities and the common themes from the different LCC science needs assessments, indicate that the potential return on investment from collaborations between NOAA and the LCC network is high. It also indicates that there are a larger number of potential collaborations that could be undertaken between NOAA and the LCC network, including USGS and FWS. The following recommendations were selected based on an understanding of the FWS Strategic Habitat Conservation Framework that many LCCs are using to guide their work and of current NOAA activities that can be leveraged. The recommendations are short-term priorities (i.e., 1-3 years) to help build collaborations at a multi-LCC level or national level and demonstrate the effectiveness of this partnership; they are designed to complement, not replace, the ongoing work of NOAA staff participating within individual LCCs. The recommendations also reflect areas where the issues/knowledge gaps being addressed require a strong multi-agency, multi-level approach. As with any true collaboration, the recommended actions are a combination of ones for which NOAA may be taking a lead or for which an LCC or LCC partner may be leading. Both entities and their collective partners bring different strengths to a project and therefore, depending on resources and capacities, may provide either a leadership or supporting role to achieve the goals of a project.

NOAA's ongoing activities and resources that can be leveraged for these multiple-LCC/national collaborations will vary by the topic as well as the geographic extent of the issue. NOAA's natural resource management activities for habitat and living marine resources are focused in marine and coastal habitats and stretch inland to the extent of diadromous fish habitat. In contrast NOAA's climate and weather research, products and services cover the full extent of the LCC network as does NOAA's work supporting community resilience and climate adaptation. For each recommendation below some of the NOAA resources, activities and programs that can be leveraged to support these recommendations will be detailed. However, this should not been seen as an exhaustive list as the purpose of the analysis is to generate discussion about what resources can be leveraged and explore the recommendations further both within NOAA and the LCC network.

3.1 Conservation Target Development

To help achieve landscape-scale conservation, most LCCs are first identifying "shared, landscape-level, conservation objectives" also known as conservation targets that will be the focus of the resulting conservation strategies. Conservation targets identified by LCCs range from an individual species or ecological guilds to habitat types, ecological processes as well as cultural resources (Appendix F). Many targets are ones that are anticipated to be particularly vulnerable to landscape-scale stressors, such as climate variability and/or change, or are deemed to be of high importance for ecological or human uses. The level of NOAA staff engagement or other partners with a shared interest in NOAA-related trust resources and habitats in individual LCC steering committees may have influenced how well NOAA trust resources vulnerable to landscape-scale stressors have been incorporated into the existing conservation targets for an individual LCC. Many LCCs are in the early stage of identifying conservation targets and understanding how targets may be affected by climate change with 11 and 12 LCCs as well as well as the MRB interested vulnerability assessments for species or habitat respectively (Table 6). Regardless of whether an individual LCC has already established or are currently working on identifying conservation targets, by establishing and sharing conservations of importance to NOAA, NOAA can more effectively partner with LCC on overlapping priorities and those with synergistic connections, such and terrestrial to marine connections.

Additionally the national network of LCCs is starting to develop network-wide or multi-LCC conservation targets to help convey the collective actions of these individual partnerships. The focus of the LCCs for the first few years was on establishing effective cooperatives for each for the 22 regions and developing the frameworks for each of the cooperative. Currently, LCC leadership is working to knit these 22 cooperatives into a more functional network while still keeping the self-directed nature of the individual LCCs. The FWS has recently released the final LCC Network Strategic Plan[3] and a draft LCC Network Science Plan. As a part of this network building, there will be an examination across the cooperatives for key conservation targets that can serve as national priorities as well as indicators to help track, at a national level, the collective success of the LCCs. NOAA's engagement at this stage in the multi-LCC process could result in conservation targets that are relevant to terrestrial and marine conservation.

Below are a suite of recommend short-term actions involving conservation targets that can help NOAA be more effective in our partnership with the LCCs. Conservation target recommendations are divided into two different categories – 1. Species/ecological guild targets and 2. Habitat/ecosystem processes and services.

3.1.1 Species/Ecological Guild Conservation Targets

A first step in identifying conservation targets is to identify species or ecological guilds that are particularly vulnerable from the effects of climate variability and change. Species and ecological guilds are more likely to be relevant for identifying collaborations at the individual LCC level, although some may span multiple LCCs. As noted in Table 6, eleven LCCs and the MRB have identified a priority science need of understanding the cascading impacts of climate change and other landscape scale stressors on species as a result of changes to ecosystem processes. Table 7 shows NOAA-trust resources that have already been identified by LCCs as conservation target. For these targets, NOAA can work with the LCCs to provide technical support and resources necessary to complete the vulnerability assessments and work towards identifying shared conservation strategies.

Table 7. Species or ecological guilds identified by LCCs as conservation targets that are also NOAA trust resource.

Landscape Conservation Cooperative	Target Species or ecological guild
North Pacific	anadromous fisheries
Aleutian and Bering Sea Islands	fish
	coldwater corals
	marine mammals
	seabirds
Arctic	fish
Great Northern	salmon
	steelhead
	cutthroat trout
Gulf Coast Prairies	american oyster
Pacific Island	maintain or improve status of at-risk species

Additionally, it is recommended that using information currently available, NOAA conduct species vulnerability assessments for species or species guilds that are suspected of being particularly vulnerable to climate change or species/ecological guilds that are of particular management concern because of their listing under the Endangered Species Act (ESA) or management status under Magnuson-Stevenson Act (MSA). Species or ecological guilds designated as conservation targets for the purpose of collaboration with the LCCs should be ones for which conservation actions, such as those undertaken by LCC partners, are necessary in order to help recover or sustain populations. After identifying the species/ecological guilds that are priority NOAA conservation targets, NOAA can share these targets with the relevant LCCs are start to work on their possible incorporation into the LCC work or identify potential synergies between NOAA and LCC conservation target needs resulting in shared conservation strategies.

[3] http:/www.lccnetwork.org/strategicplan

A variety of ongoing NOAA activities can be leveraged to support the identification of conservation targets through species/ecological guild vulnerability assessments including:

- NOAA Habitat and Conservation Team - Science subgroup
- NMFS species vulnerability assessments (existing and ongoing)
- NMFS Protected Resources species recovery plans (existing and ongoing)
- NMFS Regional Fisheries Science Centers
- NOS Ecological Forecasting Team
- NOS/National Centers for Coastal Ocean Science – biogeography team
- NOS National Estuarine Research Reserves and National Marine Sanctuaries
- OAR Climate Program Office

3.1.2 Habitats/Ecosystem Processes and Services Conservation Targets

Habitat or ecosystem process and services are more relevant across multiple-LCCs and therefore are the more important conservation targets for NOAA to identify in the short-term. Conservation targets for habitat and ecosystem process also provide a stronger link to community resiliency and traditional cultural uses, making them relevant to both NOAA's natural resource management priorities and climate goals. Individual LCCs have established different kinds of targets under this category, some focus on specific habitat types that are likely to be at risk, while other focus on ecosystem processes that create and maintain habitats and ecosystem services (Appendix F).

Table 8. Habitat types and ecosystem processes and services identifited by LCC networks as conservation targets.

Landscape Conservation Cooperative	Habitats/ Ecosystem Processes and Services
North Pacific	riverine/riparian
	marine shorelines, nearshore and estuaries
Aleutian and Bearing Sea Islands	cultural artifacts/sites
	commercial fishing
	subsistence culture
	human community stability
Appalachian	human dimensions
	human dominated or economic landscapes
Arctic	access to subsistence resources
Eastern Tallgrass Prairie and Big Rivers	river restoration techniques
	agroecology conservation practices
Great Northern	riparian corridors
	riverine
	aquatic connectivity
Gulf Coast Plains and Ozarks	high gradient streams and rivers (Interior Highlands)
	mainstem big rivers (Mississippi Alluvial Valley)
	beaches and dunes (Gulf Coast)
	estuarine tidal marsh (Gulf Coast)
Desert	water and aquatic resources
	cultural and socioeconomics
Great Plains	prairie river, streams and riparian corridors
Pacific Island	maintain or improve ecosystem processes
	preserve key cultural and natural resources and their uses
Western Alaska	coastal
	freshwater

As with specific species and ecological guilds, some LCCs already have targets that align with coastal and marine habitats types or ecosystem processes of interest to NOAA (Table 8). Some of the shared habitat/ecosystem process and service targets of interest include riverine and riparian habitats; aquatic connectivity; coastal habitats including estuaries, nearshore, beaches and dunes; traditional cultural uses including artifacts and cultural sites as well as subsistence uses; and community resilience and economies. Where there is common habitats/ecosystem process and services of interest, NOAA can collaborate with the LCC network to conduct vulnerability assessments and develop shared conservation strategies. NOAA has and continues to develop a number of tools and a rich knowledge base that can be brought to bear for this effort, such as sea level rise and inundation tools in coastal areas, or long-term precipitation and temperature forecasts in terrestrial regions. For LCCs that contain NOAA priority

habitats/ecosystem processes or services, but that do not have them currently listed as a conservation target, NOAA should clearly communicate these priorities. For example, some LCCs already extend into nearshore and marine environments and have conservation targets focused on these habitats, while others have remained more terrestrially focused. Being clear about NOAA's priorities, can allow LCCs to incorporate these into their target development process or identify where share conservation strategies may occur, even if the specific targets differ. For example, riparian health and function in areas without diadromous species may not be a priority for NOAA; however, conservation strategies for improving riparian health in watersheds that drain into coastal areas may be a priority if there is a focus on water quality in connection with riparian health.

Discussions with NOAA staff who work at the individual LCC level have highlighted the power of the network to develop and catalyze strong and effective regional partnerships. LCCs provide NOAA access to key non-traditional partners that conduct terrestrial conservation actions. The condition and health of coastal and marine habitats are greatly influenced by terrestrial activities in watersheds that drain into the coastal systems. Therefore, collaboration with the LCC network can enable NOAA to develop and strengthen its partnership with organizations and agencies that focus on the terrestrial realm to achieve critical conservation actions for ecosystem processes that link terrestrial habitats to the coastal and marine environment, such as sediment and nutrient inputs and water quality and quantity. As short term recommendation for this is described in Section 3.3.1.

In addition, clearly communicating NOAA's place-based conservation priorities with LCCs is another strategy for creating and expanding on-the-ground conservation actions. These place-based priorities include focus watersheds, sentinel sites, habitat focal areas, and marine protected areas such as national estuarine research reserves and national marine sanctuaries. By working within or linking up existing place-based conservation actions, NOAA and the LCC network can begin to achieve and test methods for addressing landscape-scale conservation strategies. For example, to buffer against the impacts of coastal storms and sea level rise on estuaries, NOAA and the LCC partners could develop a coastal migration strategy for a region building off an existing network of conservation areas. The goal could be to preserve a network of saline, brackish and freshwater tidal habitats that provide enough redundancy and diversity to ensure that even as climate change alters these habitats, there remain enough core habitat to support priority species and ecosystem services.

Many of the NOAA resource that could be leveraged include those used for species or guilds, but also more climate programs and offices working on understanding and predicting the changes that feed into vulnerability assessments.

- NOAA Habitat and Conservation Team - Science NMFS Regional Fisheries Science Centers
- NOS coastal Sea Level Rise coastal resiliency group
- NOS placed-based resource management programs
- NOS Ecosystem Forecasting Species and Habitat Distribution
- NOS/National Centers for Coastal Ocean Science – biogeography team
- Targeted large-scale habitat efforts - Green shorelines/Sandy; Recovery Act
- OAR Climate Program Office
- National Weather service – coastal erosion models combining storms and tides

3.2 NOAA Climate Knowledge & Products

One focus of the LCCs is to encourage the sharing of information and knowledge to help entities make informed decisions about conservation strategies and other natural resource management issues. As a result the LCCs can be a conduit for information from NOAA to engage in a strategic manner with key natural resource managers. NOAA's various programs that engage in climate science produce quality products for the public and specific user groups. However, in an information-rich environment, communication of products through typical communication networks may not be as widely utilized as anticipated. In an informal review of NOAA staff who participate in individual LCCs, one repeated recommendation was ensuring that NOAA climate products were shared with the LCC networks because some networks were not fully aware of the wealth of climate-related products and information already available. Additionally, collaborating with the LCC networks on the potential uses of NOAA's climate-related information can strengthen future product development. Thirteen of the fourteen LCCs and the MRB identified the need to better understand changes in weather, climate variability, and long-term climate including changes in precipitation and temperature (Appendix B). Nine of the LCCs also identified the need to downscale climate models in order to better understand impacts at the local scale (Table 6). Related to these science needs, some LCCs identified that to construct appropriate conservation strategies that can be adaptively applied to address the increased climate variability, they needed support to better understand and plan for the increased variability and uncertainty around climate predictions. This is akin to some of NOAA's climate offices focus on better characterizing and interpreting variability and uncertainty around short and long-term climate predictions.

To help address these needs it is recommended that a cross-program working group be developed to review the common themes and shared knowledge gaps listed in the Appendixes B-D and identify specific needs that can be addressed with existing NOAA products. Through collaboration with the LCC networks and NOAA staff engaged in individual LCCs, the working group should identify the best mechanism to share existing work products and knowledge. The Regional Climate Service Directors may be a key part of this process as they have cross-program knowledge about NOAA's existing products and are key communicators regarding NOAA's climate science. This effort may also identify new mechanisms by which to widely share knowledge from NOAA's various weather and climate programs to maximize its use by natural resource managers. New products could be white papers, presentations or web portals. An example of this comes from the Great Basin LCC, which worked with partners to establish a central website for weather and climate related data to help local stakeholders make informed decisions about the drought in the Great Basin. This website is called the Great Basin Weather and Climate Dashboard [4] and pulls existing weather and climate products from various programs within NOAA as well as other federal and state agencies and research organizations. The need for this one-stop information page was identified by the Great Basin LCC through discussions with a wide variety of land managers across its geography. The website was developed through a collaborative effort that involved the Western Regional Climate Center and the California/Nevada Climate Applications Program (a member of NOAA's Regional Integrated Sciences & Assessments (RISA) program).

This process can also identify additional science needs that that could be addressed in the near to mid-term with ongoing research from the various NOAA weather and climate related offices as well as NOAA climate partners, such as the RISAs. One specific knowledge gap that was identified by four LCCs and resonated with several NOAA staff during internal discussions of the analysis was working with the LCCs to better characterize and interpret the uncertainty around climate variability, which can then be

[4] http://www.gbdash.dri.edu/

incorporated into natural resource management plans and actions. Some examples of the types of climate variability that could be addressed include around precipitation patterns and natural oscillations such as El Niño-Southern Oscillation and Pacific Decadal Oscillation. Over the long-term a critical need that was shared by nine LCCs on which NOAA offices and partners could collaborate is the downscaling of climate models. Some LCCs have started to develop these downscaled models through partnering with USGS Climate Science Centers, other federal entities and research organizations; however this is a long-term effort that has the potential for intersecting with the capabilities and strengths of many of NOAA's climate offices and external partnerships, such as RISAs.

Finally, through multi-LCC coordination there are opportunities to have LCCs provide input to NOAA on weather and climate products. For example, NOAA's Climate Data Record Program [5] is currently being reproduced and recalibrated for the US. Having end users provide input during this process would enhance the effectiveness of this product.

[5] http://www.ncdc.noaa.gov/cdr/index.html

3.3 Collaboration on Priority Conservation Topics

As a result of the LCCs focus on the intersection of science and management to help strengthen and align how different organizations are conducting conservation actions across the landscape, the analysis highlighted several priority conservation topics that spanned multiple LCCs and had a strong intersection with NOAA's climate change and habitat conservation priorities. Two such topics are described below along with the recommendation to develop or further strengthen collaborations between NOAA and the relevant LCCs with interests in these topics.

3.3.1 Hypoxia/Harmful Algal Blooms

While Hypoxia and harmful algal blooms (HABs) were not directly identified in the science needs assessments; seven LCCs have joined together to lead the Mississippi River Basin/Gulf of Mexico Hypoxia Initiative (MRB/GH) (Table 9). Nutrient runoff within the Mississippi River Basin contributes to the eutrophication of the Gulf of Mexico resulting in the Hypoxia Zone. MRB/GH is anticipated to compliment other efforts, such as the Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force, to reduce the Gulf Of Mexico Hypoxia Zone by "reducing nutrient loading through watershed and effectively achieve water quality benefits both locally and in the Gulf of Mexico, but with an integrated focus on habitat conservation."[6] The MRB/GH will create and implement a framework to plan, design and deliver conservation actions in targeted watershed that are found to have the highest potential for being able to successfully implement conservation actions that can significantly contribute to reducing nutrient loading. Key components to this work includes 1) the use of structured decision making to help create the framework with the involvement of conservation, water quality, agricultural and watershed management communities and 2) map areas with high potential for valuable habitat and nutrient reductions as well as an existing network to support such action and ability of actions to meet the needs of agricultural community.

Table 9. Seven LCCs involved in the Mississippi River Basin/Gulf of Mexico Hypoxia Initiative

Appalachian
Eastern Tallgrass Prairie and Big Rivers
Gulf Coast Prairies
Gulf Coast Plains and Ozarks
Great Plains
Plains and Prairie Potholes
Upper Midwest and Great Lakes

The impact of nutrient run off on marine and coastal environments and the fisheries that they support is a problem facing many bays and estuaries around the country[7]. Sources of nutrient runoff can be hundreds of miles inland from communities with little connection to the health of coastal environments. The LCCs, with a wide diversity of existing terrestrial partners, is poised to be a key partner for NOAA in addressing this landscape to seascape conservation issue by providing a platform to engage with terrestrial conservation and land managers. Furthermore, the LCCs' strong focus on climate change will help ensure related conservation strategies are sustainable for habitats and agricultural communities.

NOAA is already engaged on the Gulf of Mexico Hypoxia issue through work of the National Ocean Service and the NOAA Regional Collaboration Team in the Gulf of Mexico Task Force as well as staff engagement in the MRB/GH initiative. It is recommended that as the MRB/GH initiative grows, NOAA examine how it can bring its diverse resources from across the different line offices to help support this effort. A first step is to have the NOAA representatives on the seven different LCCs engaged in the

[6] http://www.tallgrassprairielcc.org/research-projects/mississippi-river-basingulf-hypoxia-structured-decision-making-workshop-2014/

[7] http://stateofthecoast.noaa.gov/hypoxia/welcome.html

MRB/GH initiative be briefed on these ongoing efforts and discuss opportunities to increase the collaboration within NOAA on this effort. A starting point for this could be a review of the specific science gaps identified by the MRB as important to their collaborative work in Appendix D and identification of early action items leveraging existing NOAA activities or capabilities.

Lessons learned from strengthening collaborations with MRB/GH to reduce nutrient run off through habitat conservation actions can be transferred to other geographic areas dealing with Hypoxia, HABs or other water quality issues in coastal and freshwater habitats. Several NOAA place-based initiatives are working to address hypoxia, HABs or other water quality related issues including Habitat Blueprint Focus Areas[8] in the Great Lakes and Pacific, and Sentinel Sites[9] in Chesapeake and Hawaiian Islands, among others. In addition NOAA's research and predictive capabilities may contribute to this issue such as the NOAA Ecological Forecasting Services[10] and NCCOS Research on HABs and Hypoxia.

3.3.2 Water: quality, quantity, and related impacts

The most common knowledge gap themes from the physical or ecosystem processes category all have an impact on the water quality and quantity; these include changes in precipitation, air temperature, frequency and intensity of storms, and hydrologic processes. Impacts from climate change on water quality and quantity were identified by six LCCs as an important knowledge gap and by an additional three LCCs indirectly. These include the western LCCs that have suffered from droughts as well as the Appalachian LCC and the Northwest Boreal LCC. The Appalachian and Eastern Tallgrass Prairie and Big River LCCs note that in addition to changes in water quantity and quality due to climate change, that there is also a need to understand how these changes may be exacerbated by changes in water demands for human uses, such as energy production and agriculture.

Changes in water quality and quantity was a shared priority knowledge gap because of the significant potential impacts to a numerous habitats and species including many NOAA trust resources. Changes in water quality and quantity has a strong nexus to NOAA's focus on increasing community resilience to climate change impacts, such as increased flooding and drought as well as the reliance on water for human consumption and to support vital sectors of the economy including agriculture and energy production. The high importance of water for ecosystem health as well as human use has created a long history of conflict over water and its use in the west and in other regions of the US. As water availability changes, population increases, the conflict over water use and management in many areas will only increase. It is, therefore, critical to start working with a wide network of partners from natural resource communities as well as land and water managers to identify conservation actions and water management approaches that can support the multiple needs across the landscape.

A variety of NOAA Line Offices and programs can bring scientific knowledge as well as natural resource management perspectives to help inform and establish adaptable conservation approaches needed to address water quality and quantity needs from multiple interests. As a first step it is recommended that NOAA host a series of workshops to bring together a group of relevant NOAA climate, weather, fisheries and habitat staff and partners to meet with interested LCC coordinators and partners from a sub-section of the LCCs that identified effects on water quality and quantity as a priority assessment need. For, example the meeting could focus on western LCCs where there are similar impacts of concern from climate variability and change that could be addressed at a multi-LCC level. By starting with a smaller

[8] http://www.habitat.noaa.gov/habitatblueprint/
[9] http://oceanservice.noaa.gov/sentinelsites/
[10] http://oceanservice.noaa.gov/ecoforecasting/

group of LCCs this may allow efforts to be more focused and could later be translated to other geographic areas. The goals of the workshops would be to 1) establish a common understanding of respective mission priorities, regional investments, and capacity, 2) identify some short and mid-term collaborations to develop knowledge or tools to address some of the science gaps identified in Appendix D, and 3) establish implementation plans and identify resources to support these collaborations. Some potential actions identified through this analysis include improving predictive capacity of specific weather and climate patterns such as atmospheric weather events and identifying how to incorporate this knowledge into management/conservation actions, such as water storage. Another need is better understanding of variability in precipitation at various timescales and how to plan for that variability through adaptive management/conservation actions. Focusing on a few LCCs may also allow for the incorporation of ongoing placed-based conservation actions as initial actions or as a part of a network of interconnected sites for conservation. For example, in the Russian River, California (a NOAA Habitat Focus Area and a part of the California National Integrated Drought Information System Pilot) the partners are trying to address water quantity and quality issues for multiple purposes including conservation of fish habitat, agriculture, recreation, and domestic water supply.[11]

[11] http://www.habitat.noaa.gov/habitatblueprint/russianriver.html

4 Conclusions

As shown in Table 4 and 5, there are numerous overlaps between NOAA's science and management priorities for climate and habitat conservation, and the science needs of the LCC network. This indicates that increased collaborations with the LCC network have the potential to achieve significant gains for NOAA and the LCC network and its partners. The recommendations from this analysis are short-term actions designed to 1) strengthen NOAA's partnerships with the LCC network through clear communication of priorities and identification of overlapping or complimentary goals, and 2) demonstrate the effectiveness of strong partnerships between NOAA and the LCC network through the use of NOAA's climate products or short-term actions on specific conservation targets and topics. While the focus of these recommendations are on multi-LCC collaborations the analysis is robust enough that it can be used to help inform ways in which regional offices or programs can further engage with individual LCCs.

This analysis builds upon past work between the LCC network, USGS and NOAA to identify partnership opportunities. In November 2012, a coordination session was held in Lafayette, LA, between NOAA and LCC leadership to identify methods for improved collaborations. The recommendations from that workshop were primarily focused on how to improve organizational structure to allow for better collaboration, such as having more NOAA-LCC liaisons and increasing joint funding; however other recommendations were clearly compatible with those from this analysis. For example, the recommendations for establishing and clearly communicating NOAA conservation targets including species, habitats or place-based efforts (Sections 3.1) parallels the priority actions for making coastal/ocean habitat conservation a priority focus area in coastal LCCs. The recommendations regarding communication of NOAA climate science (Section3.2) emphasizes the priority actions for increasing NOAA climate service connections to western and inland LCCs and in LCC driven projects focused on understanding climate and weather impacts on natural resources. The full recommendations from this session are included in Appendix G.

This analysis provides one method for identifying ways to build upon and strengthen collaborations between NOAA and the LCC network on a multi-LCC or national scale to help achieve shared conservation and climate change related goals. This analysis is not intended to be a comprehensive review of the LCC network or the ways in which NOAA and the LCC network have worked together in the past. The recommendations are short term actions that should be built upon as the partnerships further expand and mature.

Appendices A - F Can Be Found In:

AnalysisofLCCScienceNeeds&NeartermNOAAEngagement_AppendicesA-F.xls

Appendix G

Summary of key issues, opportunities and actions to strengthen NOAA engagement in LCCs

LCC Leadership Meeting
LCC-NOAA Coordination Session
Nov 15-16, 2012
Lafayette, LA

1. Priority issues/actions to enhance NOAA-LCC collaboration (consolidation of common ideas from breakout groups)

1. MORE NOAA-LCC LIAISONS: Explore and implement additional NOAA Liaison positions and/or other ways (NOAA Regional Teams?) to facilitate increased NOAA engagement in LCCs.

2. MAKE COASTAL/OCEAN HABITAT CONSERVATION A PRIORITY FOCUS AREA IN COASTAL LCCS: Make coastal/ocean habitat conservation a key focus of LCCs (ie Habitat Blueprint, and conservation design for coastal and ocean areas, strengthen NOAA stewardship programs engagement in LCCs).

3. STREAMLINE INFO SHARING: Streamline information sharing and connections to science providers including climate science enterprize (e.g., CSCs, RISAs, RCCs etc).

4. INCREASE JOINT FUNDING AND LEVERAGEING: Identify Areas for Joint funding programs, ways to better leverage funding.

5. INCREASE NOAA CLIMATE SERVICES CONNECTIONS TO WESTERN AND INLAND LCCS: Increase connections between NOAA climate products and services and Interior US or noncoastal NOAA services (including specific request to fill Regional Climate Service Director position to help connect NOAA climate to western LCCs as has been done with other LCCs).

6. EXPAND NOAA'S SUPPORT/PARTICIPATION IN LCC DRIVEN PROJECTS TO UNDERSTAND PAST AND FUTURE CLIMATE IMPACTS ON NATURAL RESOURCES ETC: Integrate NOAA Climate science and service capacity more broadly in LCCs (NCPP).

7. INCREASE DELIVERY, CAPACITY AND USE OF INFORMATION/TOOLS FOR COMMUNITY RESILIENCE: Strengthen delivery of important, actionable information from LCCs to communities to advance ecosystem and community conservation and resilience using NOAA programs such as communication, visualization tools, training and workshop, etc (referring largely to the NOAA Coastal Service Center types of products and services).

2. Top 5 ideas from Breakout Groups- priority issues and actions to strengthen NOAA-LCC collaboration

Group 1: (NOAA participants: Andrea)

- NOAA Liaison model
- Pilot conservation design with Habitat Blueprint
- Provide lessons learned from RISAs to identify best practices for user engagement
- Initiate NCPP pilot linking LCC needs with NOAA model testing efforts
- Synergize NOAA short term human impacts data with ecological models and Climate Science Centers-LCC focus

Group 2: (NOAA participants: Ellen and Laurie)

- Facilitate connecting LCCs to NOAA Regional Teams and key regional staff
- NOAA can help lead on the NFWPCAS landscape scale planning
- NOAA could provide a 'signal' form the top that participation in LCCs is important
- In additional to shared positions, having dedicated technical support on projects is needed
- Need more data resolution in some areas, such as climate stations
- Hold workshops or webinars around a themes and invite interested people and LCCs to help share information and identify opportunities to share data
- The LCCs could pick priority data sets needed and focus NOAA and LCC discussions around those or around an issue or program
- Create mechanisms for improved sharing of funds
- Rapid fire information exchanges- ex NOAA modeling of storms and simulations being run but not 'captured' in Alaska
- NOAA could provide a description of what they want to get out of the LCCs
- NOAA could provide a description of what their priorities are for marine conservation
- NOAA communication capabilities would help tell the LCC story and NOAA extension, training, and delivery mechanisms could help delivery
- NOAA and the LCCs, by working together, can reach nontraditional audiences
- NOAA has less of a species focus and many of its capabilities are around LMEs or ecosystems

Group 3: (NOAA participants: Roger)

- Mechanisms for sharing, aligning, and combining resources for shared priorities for regional and local collaboration
- Better connections with non-coastal LCCs
- Habitat Blueprint- LCC can be a forum to link terrestrial and marine design
- Sharing skills, data, and socioeconomic information and expertise
- Linking RFPs and facilitate data sharing across LCCs

Group 4: (NOAA participants: David)

- Coordination of Climate programs and research
- Integration of aquatic and coastal and marine with terrestrial conservation design- there is a gap between marine and coastal data
- Mechanisms to move funding
- LCCs are doing some things that would be of value to NOAA, ex- outreach to decision makers
- List of shared priorities being incorporated into NOAA programs and RFPs
- Engage NOAA's science to educate communities, ex- climate expertise to inform climate messages
- Visualization tools- extend to areas like ecological processes on shoreline erosion, ENOW model for incorporating socioeconomic information
- Prioritization and gap assessment of monitoring needs to raise awareness and pool resources to communicate the importance of long-term monitoring

3. GENERAL INPUT/IDEAS from specific LCCs

Following NOAA presentation and q&a period, several LCCs that were asked to highlight how NOAA is currently engaged, what worked well, and key issues/opportunities to strengthen NOAA engagement. This is summary of some key points from those short presentations. The LCCs were chosen in part because they had good NOAA engagement and/or innovative NOAA engagement (e.g., dedicated NOAA liaison). The presentations helped kick off full group discussion of needs, opportunities and challenges to strengthening NOAA engagement in LCCs.

Appalachian LCC:

- Bring forward examples of adaptation efforts, lessons learned, and how to move towards adaptation planning

Doug Austen:

- NOAA is part of the LCCs, on steering committees etc., and can share through these mechanisms too

N. Atlantic LCC:

- Coastal conservation and resilience is a priority and NOAA as a Steering Committee member can lead on the issue.
- The Habitat Blueprint is a good opportunity for coastal LCCs to link their land based blueprints to NOAA's.

Gulf Coastal Plains & Ozarks LCC (Louisiana):

- Help states meet their missions with coordination across states and with the larger picture. It is important to include the human component, including their impacts to resources and the impacts to humans.

- We need to manage development and look at both habitat and hazards so people are not in danger- how will communities response to SLR and Climate Change? What will retreat and responses look like? These issues are shared across all LCCs and would benefit from a coordinated response.

Pacific LCC: Priorities:

- resource needs for data to underlie projections, especially ocean chemistry; integrated biogeochemical and physical models of ecological response to climate change;
- human response to climate change to inform adaptation;
- barriers to the use of climate information by decision-makers; and visualization tools and decision support systems.
- Found that the climate assessment process allowed aligning of research and this was a good model.

Alaska: Priorities:

- coastal storm impacts on wildlife habitat as well as communities;
- better data and observations needed;
- co-funded projects for mapping and storm surge and wave models but need historical storm data;
- models for ice, tides, storm surge, future impacts, and links using Habitat Suitability Maps.

Caribbean LCC: Priorities:

- monitoring information for habitat;
- integrate models for marine and terrestrial habitat and for monitoring programs;
- habitat-species models;
- species distribution data;
- coastal ecosystem vulnerability assessments;
- matching data between nearshore and coastal ecosystems with both terrestrial and deep water areas;
- more information about MPA effectiveness.

General comments:

- make better use of interagency work groups;
- international needs for some LCCs;
- other federal agencies also use liaisons (Forest Service, National Park Service);
- US interior issues include climate data like snow pack, interior storms, etc.;
- idea for a shared project would be each LCC works with communities to be "Climate" Ready communities;
- the role or niche for USGS Climate Science Centers and for NOAA Climate Programs should be better clarified; and improved models for underserved areas like the Pacific and Alaska.