Implementation Plan

for the

NPLCC Science and Traditional Ecological Knowledge Strategy, 2013-2016

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S-TEK Strategy Implementation Plan

Executive Summary

This *Implementation Plan* identifies a set of priority activities that can be undertaken by the NPLCC and its partners to support and implement the *NPLCC Strategy for Science and Traditional Ecological Knowledge, 2013-2016* (S-TEK Strategy). From its beginning, the NPLCC partners recognized that effective landscape level conservation and sustainable resource management in a changing climate will require the strengths and resources of many organizations working together. Therefore, this *Implementation Plan* identifies activities appropriate for direct support from the NPLCC, and activities that would be useful to the partnership, but that may be more appropriate for support by one or more individual NPLCC partners.

The NPLCC S-TEK Subcommittee identified potential activities consistent with the NPLCC mission, goals and S-TEK Strategy for consideration, and then evaluated and ranked those activities in terms of the importance of each activity for resource management decision-making, and appropriateness for NPLCC direct support. A total of eight to ten Priority Activities for 2013-2016 were identified for each of the five Priority Topics for implementation by the NPLCC, partners, or both. The following five Focused Activities were developed for implementation in 2013 and 2014:

- Focused Activity 1: Integrate and share existing S-TEK data and information through continued development and expansion of the NPLCC data discovery and management platform
- Focused Activity 2: Align and coordinate the delivery of Science and TEK with decision-maker needs
- Focused Activity 3: Identify S-TEK information necessary to support landscape-scale planning in the face of climate change that involves multiple entities and jurisdictions.
- Focused Activity 4: Incorporate existing climate information into "line management activities"
- Focused Activity 5: Provide support for partner-initiated joint projects - Climate Change Adaptation for Subsistence/Cultural Resources (2013)

Specific actions were developed for funding in 2013 and/or 2014, depending on funding availability. Prior to selection of actions to fund in 2014, the *Implementation Plan* will be revisited to determine if updates or new areas for future work are needed. The NPLCC encourages its partners to consider these identified high priority activities in their individual planning processes, and to share the results of these types of activities with the NPLCC partnership.

I. Introduction

Background

The North Pacific Landscape Conservation Cooperative (NPLCC) is one of 22 cooperatives in North America established to respond to climate change and other conservation challenges faced by natural resource managers and conservation professionals http://www.doi.gov/lcc/index.cfm, The NPLCC addresses these challenges in a coastal geographic region extending from the Kenai Peninsula in Alaska, southward along the west coast of British Columbia, to Bodega Bay in Northwestern California.

The activities identified in this *Implementation Plan* directly relate to, and step down from the *NPLCC Strategy for Science and Traditional Ecological Knowledge, 2013-2016* (S-TEK Strategy) http://northpacificlcc.org/documents/S-TEK%20Strategy_Final_11-2012.pdf.
They are all consistent with the NPLCC mission and goals http://www.northpacificlcc.org/About.
The S-TEK Strategy was developed in 2012 by a coalition of scientists, tribal representatives, resource managers, and decision-makers representing diverse organizations from throughout the NPLCC and adopted by the Steering Committee in November, 2012. The S-TEK Strategy identified five **Priority Topics** and four **Guiding Principles** (see box) and guided this planning for applied science and TEK activities to be implemented in 2013 to 2016. For further information on the NPLCC's S-TEK Strategy see http://northpacificlcc.org/documents/Strategy%20Technical%20Supplement_Final_11-2012.pdf.

From 2013-2016 S-TEK Strategy	
Guiding Principles	***Priority Topics***
In annual implementation planning, and in the activities it supports, the NPLCC will: • **Focus on helping managers understand the availability and effectiveness of adaptation and mitigation response actions** • **Focus on facilitating coordination, collaboration, and capacity building, and on developing or assisting with tools to assist decision-makers** • **Identify and promote opportunities to use TEK to inform partner and stakeholder decisions** • **Promote and facilitate consideration of the connections and interactions between ecosystems**	**A.** Effects of hydrologic regime shifts on rivers, streams, and riparian corridors **B.** Effects of change in air temperature and precipitation on Forests **C.** Effects of changes in sea levels and storms on marine shorelines, the nearshore and estuaries **D.** Effects of the changes in the hydrologic regime on anadromous fish **E.** Invasive species, diseases, pests and their effects on biological communities

TEK

The S-TEK Strategy recognizes the importance of considering both western science and TEK. The S-TEK Strategy also recognizes that Tribes and First Nations have proprietary rights to their TEK, and it is up to individual Tribes and First Nations to decide if they want to share that knowledge and, if so, what TEK to share and how and with whom to share it. Therefore, identifying and promoting opportunities to use

TEK to inform partner and stakeholder decisions is limited to when and where it is desired by tribal owners of the information.

Goals of the Implementation Plan

From its beginning, the NPLCC partners recognized that effective natural and cultural resource conservation in a changing climate will require the strengths and resources of many organizations working together. During planning, the S-TEK Subcommittee recognized that some efforts would best be undertaken or leveraged with LCC funding and other efforts would best be undertaken by partners. Therefore, this *Implementation Plan* identifies both activities appropriate for direct support from the NPLCC, and activities that would be useful to the partnership but are more appropriate for support by one or more individual NPLCC partners. Actions that can be accomplished jointly with both NPLCC and partner support are particularly important. As an example, this plan identifies one such joint activity to be implemented by the NPLCC in collaboration with the Alaska and the Northwest Climate Science Centers (CSCs) (Section IV). As the NPLCC matures, it is expected that more and more of these funding opportunities will arise, and an important part of the this *Implementation Plan* is to encourage and continue to provide support for partner-initiated activities that are consistent with the NPLCC S-TEK Principle and Topics when possible.

This *Implementation Plan* covers a four-year planning horizon to promote continuity with the S-TEK Strategy and to better align this planning with similar efforts by the three USGS CSCs that overlap the geographic range of the NPLCC (http://www.doi.gov/csc/index.cfm) and with adjacent LCCs. The last section (IV) of this Plan describes in more depth the focused activities to be supported by the NPLCC in the immediate future (2013 and 2014). Some flexibility in annual implementation is useful as some activities require multi-year efforts, and previously supported studies may point out new areas for future work (for example, results of NPLCC-supported TEK studies in 2012 may suggest new priorities for 2014 work). Additionally, the NPLCC is establishing a Tribal/First Nations Committee and a Communications and Outreach Subcommittee, and is developing robust partnerships with Climate Science Centers (CSCs) and other partners. Input from these activities over the next year may lead to changes in the priorities established in this *Implementation Plan*.

II. Implementation Plan Development

The S-TEK Subcommittee generally followed the planning approach identified in the S-TEK Strategy to develop this *Implementation Plan*, supplemented to include an initial assessment of which priority activities were most appropriate for NPLCC or partner support. Figure 1 illustrates the general approach undertaken to identify the Priority Activities for this *Implementation Plan*, and the NPLCC focused activities for 2013 and 2014. Additional detail is provided in Appendix A.

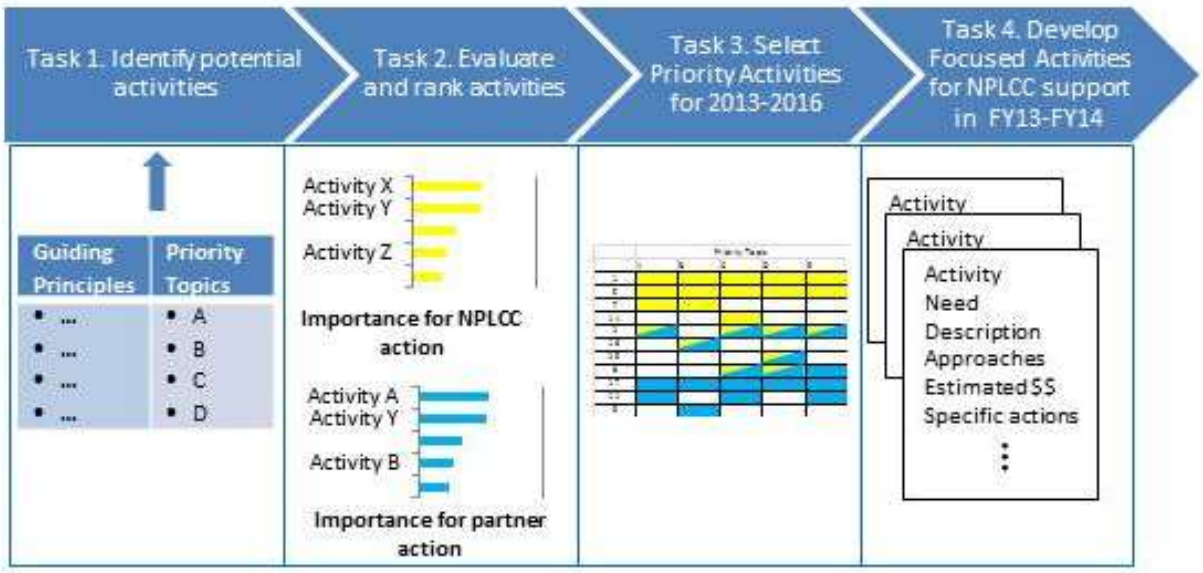

Figure1. Process used to develop implementation priorities

Task 1: Identify potential activities that could be pursued over 2013-2016, consistent with the Guiding Principles and the Priority Topics described in the S-TEK Strategy. Building on activities identified during the development of the S-TEK Strategy, the S-TEK Subcommittee prepared a "long list" of activities that would provide management-relevant information for each of the Priority Topics. The "Long List" activities had already been identified as high priority, among many other possible activities considered during the LCC's planning process. To facilitate comparing and further ranking the potential activities, the list was consolidated and re-organized into about 20 generic activities that are relevant to all of the Priority Topics, and several Topic-specific activities (Appendix A).

Task 2: Rank the potential activities for each Priority Topic. S-TEK Subcommittee members independently evaluated the activities identified in Task 1 for each Priority Topic. Formal evaluation criteria were not provided, but individuals were asked to consider which potential actions would provide "the most valuable support for decision-making" in their assessments. They conducted their assessments twice: first to identify activities that would be appropriate for direct support by the NPLCC, and second to identify those that would be of value to the NPLCC, but are better undertaken separately by NPLCC partners. A modified "dot voting" approach was used for the evaluation, with each person allocating 12 points across the generic and topic-specific activities identified in Task 1 for each evaluation. Activities were ranked based on the total number of points assigned by the S-TEK Subcommittee.

Task 3: Select priority activities for each Priority Topic in 2013-2016. A broad range of activities and multiple approaches and methods related to each of the Priority Topics exist that could provide useful information to NPLCC partners, as illustrated by the results of Task 1. This *Implementation Plan* seeks to describe priorities in enough detail to provide useful guidance for those seeking to support NPLCC

efforts, without over-prescribing how the work should be accomplished. Therefore, the priority activities identified for 2013-2016 are defined in broad terms, at the level of the generic activities evaluated in Task 2, not at a project-specific level. This allows for creativity, innovation and flexibility in how those activities are carried out, so NPLCC partners will be able to define specific projects that both meet their own internal needs and provide useful information to the NPLCC partnership. The highest ranked activities from Task 2 were selected as the Priority Activities. (See Section III).

Task 4: Develop focused activities for potential NPLCC funding in 2013 and 2014. The final step in developing this *Implementation Plan* was to define a set of focused activities and detailed actions or projects for the NPLCC to pursue in FY13 and FY14. Five focused activities were identified by consensus of the S-TEK subcommittee based on discussion of the overall list of Priority Activities (see Section IV). The ability of the NPLCC to implement these projects will depend on the availability of funding.

III. Priority Activities, 2013-2016

A total of eight to ten Priority Activities for 2013-2016 were identified for each Priority Topic, as summarized in Table 1. Based on the vote counts resulting from the S-TEK ranking process, this list of Priority Activities is comprised of the five highest-ranking activities identified as appropriate for direct NPLCC funding (yellow cells) and the five highest-ranking activities identified as more appropriate for partner-lead efforts (blue cells) for each Priority Topic. Consideration was also given to regionally important activities.

Several activities were highly ranked for both the NPLCC and by partner entities action, so those cells show both yellow and blue. The blue entries in Table 1 are not intended to define or limit all LCC collaborations with partners, nor are they intended to summarize what partners do (such summaries are available in each partner organizations own planning documents). Rather, the partner designations are seen as fertile ground for some new ways organizations might effectively work together over the next four years. The NPLCC encourages its partners to consider these identified high priority activities in their individual planning processes, and to share the results of these types of activities with the NPLCC partnership.

Some of the collaborations identified in Table 1 are already being supported. As an example the NPLCC asked the directors of each of the CSCs that overlap with the NPLCC to review the list of activities in Table 1 and provide an indication of which types of activities they are also engaged in, or which are consistent with their science plans. The S-TEK subcommittee will continue this dialogue with the CSCs, adjacent LCCs, and other partner entities and work with them to identify additional potential areas for collaboration.

IV. NPLCC-Focused Activities and Detailed Actions for 2013 and 2014

The final goal of this *Implementation Plan* is to describe the focused activities and detailed actions that the NPLCC will support in 2013 and 2014. Considering the Priority Activities for NPLCC support from

Table 1, the S-TEK subcommittee developed five focused activities for NPLCC support in the near-term. Each of these supports the mission and goals of the NPLCC. A general description, importance and relevance to natural resource managers, and a list of potential approaches were identified for each of the focused activities. The list of approaches was intentionally left long for developing appropriate specific actions in subsequent years and to allow for flexibility. Other identified priority activities included in Table 1 are expected to receive NPLCC support in 2015 and 2016. As the NPLCC matures and initial case studies and assessments are completed, more focused activities will be implemented.
A short list of prioritized specific actions for each of the five focused activities has been developed for implementation in 2013 and 2014 (Table 2 and descriptions below). The total funding available to the NPLCC in 2013 from U.S. Fish and Wildlife Service (USFWS) for S-TEK actions is estimated to be $350,000 to $500,000. The estimated allocation of funds to each of the five focused activities is based on this total funding level and consideration of the amount of work that can be accomplished within each activity in a year.

Including a base amount ($20,000 - $50,000) for each focused activity demonstrates the importance of providing financial support for actions included in each focused activity. Setting an estimated maximum amount of funding for each focused activity also shows that the funds will be distributed between the different activities. The quality and type of project proposals received from the two requests for proposals will affect the distribution of funds between the different focused activities. Additionally, the total NPLCC funding level could change once a final budget is established, and could be supplemented by other NPLCC partners.

The specific amount of funding necessary for each action, as well as appropriate funding mechanism (e.g. contracts or grant agreements) will be determined during detailed project planning. Actions not funded in 2013 will receive priority consideration by the NPLCC in 2014; however, NPLCC needs will be reevaluated to assess if other focused activities or actions should be considered of higher priority before a final decision is made. Efforts will be made to leverage NPLCC funding with partners such as CSCs, other agencies, non-governmental organizations and others.

Table 1. Results of S-TEK Rankings of Potential Priority Activities, 2013-2016[(1)]

Yellow color shows high priority for potential NPLCC support based on S-TEK Subcommittee rankings

Blue color shows high priority of NPLCC for potential support to request from Partner entities based on S-TEK Subcommittee rankings

	Activity code from Appendix A	**Priority Topic A**: Effects of hydrological regime shifts on rivers, streams, & riparian corridors	**Priority Topic B**: Effects of changes in air temperature & precipitation on forests	**Priority Topic C**: Effects of changes in sea levels & storms on marine shorelines, the nearshore, & estuaries	**Priority Topic D**: Effects of changes in the hydrologic regime on anadromous fish	**Priority Topic E:** Invasive species, diseases, & pests & their effects on biological communities
Improve cross-boundary data availability, integration and synthesis	1					
Identify existing tools and approaches being used to support decision-making. Evaluate the usefulness of those tools for: (a) providing decision-relevant insights, and (b) aiding in the development of adaptation or mitigation response actions. Include consideration and use of TEK where desired by Tribes. Use insights from this review to develop guidance for future tool/support development; provide training for resource managers in how to use existing tools	5					
Conduct workshops to further clarify decision-maker needs: Convene managers, scientists, and tribes to discuss specific sub-topics. Identify management decisions and actions, share information on existing data, models, etc.; identify gaps and common needs	13					
Develop case studies to enhance practicality and utility of existing tools / previous studies through direct engagement of decision-makers: illustrate how a particular type of study or model can provide useful information for a specific type of decisions (e.g., use a vulnerability assessment to directly inform on potential adaptation response actions)	7					
Conduct or support adaptation planning exercises to assist management decisions related to specific sub-topics, considering uncertainties in future climate / climate impacts. (E.g., scenario planning exercises, triage analyses, contingency planning, etc.)	12					
Conduct or support stakeholder outreach workshops and meetings, either convened by the NPLCC or by NPLCC partners. Goals of such outreach activities could include: communicating information on projected impacts to interested stakeholders; supporting with local community planning by conveying information on local impacts and on the availability of adaptation and mitigation actions, etc.	14					
Identify, compile, collate and integrate existing data and information concerning climate impact data and modeling, monitoring and monitoring networks, TEK, etc. Make this information readily available for decision-makers (as desired by Tribes/First Nations for TEK).	2					
Improve information on how climate change will affect linkages between ecological and human resources (e.g., forest-riparian-stream habitat connections)	16					
Develop tools and/or assist partner entities in applying existing tools to identify and inform managers of high priority conservation and/or restoration targets (species, locations, etc.).	9					

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Identify potential impacts or changes to tribal/First Nations subsistence activities linked with hydrological regime changes (e.g. impacts to anadromous fish or fishing under more extreme/adverse conditions)	25					
Evaluate the interactive effects of changes in invasives, pests, and diseases with other large-scale stressors; determine effects of multiple stressors (e.g., environmental contaminants, realignment of community organizations etc.) on organismal and population health and condition	26					
Assess vulnerability and resilience of the resource(s) to projected climate change: identify critical stressors, valued/necessary resources (including Tribal and First Nations valued resources, corridors and refugia, etc.), anticipated changes, and locations of more vulnerable and less vulnerable resources. Include consideration of the effects of multiple stressors on the resource(s)	8					
Collect data to improve basic understanding, to provide baseline information, to provide a basis for long-term monitoring, to support modeling, etc.	17					
Develop downscaled / improved climate models and forecasts of changes in the resources, at appropriate scales	20					
Identify focal indicators, processes or thresholds that can serve as indicators of change, can be used track climate change impacts, and potentially assess management options and effectiveness.	11					
Evaluate relationships between existing infrastructure and infrastructure planning and projected changes in the hydrological regime (e.g., culverts and fish passage; road and trail access; hatcheries, etc.)	22					
Identify and document tangible examples of climate change adaptation or mitigation response actions; evaluate their successes and failures, and develop "best practices" guidance documents on how to incorporate successful approaches in existing management practices. Include consideration of TEK in developing these examples and in guidance documents	6					
Carry out fire regime / fire management research	23					

(1) All of the activities on this list, as well as all of the activities on the original list included in the Appendix, are important activities that can support the NPLCC S-TEK Strategy. NPLCC established the near-term priorities in this table as a way to focus their efforts over the next four years. It is intended to prioritize NPLCC efforts, and to encourage work by partners in these areas, but should not be interpreted as the only areas of interest or importance to the NPLCC.

Table 2. Focused activities and specific actions for NPLCC support in 2014.

	NPLCC Goals / Priority Topics	Likely Funding Mechanisms	Est. 2014 funding[(1)]
1. Augment, Integrate and share existing S-TEK data and information	**Goals: 1, 2, 4, 5, 6**		$40K - $100K
1.1 (updated for FY14) Maintenance, "care and feeding" of the data discovery and management platform	All Topics	USFWS Salary, Contract or Agreement	
1.2 (updated for FY14) Synthesize existing spatial data and put it into the data management platform to support planning (FY14 focus on DEM / hydrology and, if available, invasives, diseases, and pests)	Topics A & E	USFWS Salary, Contract or Agreement	
1.4 (new) Platform roll-out. Outreach, communication with partners about the platform, how they can use it, learning what they might want from it. Follow-up to previous work exploring what stakeholders want from the platform	All Topics	USFWS Salary, Contract or Agreement	
1.5 (new, moved from other Focused Activities) Support partnership efforts to develop, share and integrate data (e.g., through support of workshops, Partner Forum, etc.)	Any Topic	Agreement / contract	
2. Align and coordinate the delivery of Science and TEK with decision-maker needs	**Goals: 1, 2, 4, 5, 6,**		$40K - $100K
2.3 Increase knowledge, sharing and use of existing tools and approaches among partner entity decision-makers	Any Topic	RFP	
2.5 (new, refocusing of 2.1, 2.2 from FY13) Synthesize information from existing work related to a species, ecosystem, or ecosystem services in different geographic locations to characterize the common factors affecting that resource across a broader geography (e.g, the species range, the NPLCC region, etc.) and the issues that may be unique to one geography. Work with decision-makers to understand how this information can be used and how scientists can deliver the information so it is relevant.	Topics B, C, or E	RFP	
3. Identify S-TEK information necessary to support large-scale planning and management efforts in the face of climate change that include multiple entities and jurisdictions	**Goals 1, 2, 3, 6**		$40K - $120K
3.1 Identify climate-related information and tool needs for managers and decision makers involved with forest resources (to include expansion of FY12 USGS work)	Topic B	Agreement / contract	
3.3 Identify climate-related info. needs and tools for managers and decision makers related to one of the other three Priority Topics	Topics C, D, or E	Agreement, contract, or RFP	
3.4 Expand on FY13 USGS-sponsored workshops Identifying climate-related information and tool needs for managers and decision makers and hydrologic regime shifts	Topic A	Agreement / contract	
4. Incorporate climate information into line management activities	**Goals 1, 4, 5, 6**		$40K - $140K
4.2 Assist one or more partner entities with incorporating climate change information into habitat conservation and restoration planning	Topics B or E	RFP	
4.4 Assist decision-makers with incorporating climate information into their planning efforts and implementing adaptation actions. Work could include vulnerability assessments of key natural and cultural resources in a targeted location or scenario planning exercises, etc.	Any Topic	RFP	
5. Provide support for partner-initiated joint projects			$20K - $60K
2014 Focus: To be determined	Any Topic		

(1) Based on an estimated 2013 funding availability of $250,000 to $400,000 from USFWS

Focused Activity 1: Integrate and share existing and new S-TEK data and information

Importance and Resource Management Need: Landscape-level planning and management actions should be informed by science, traditional ecological knowledge, baseline data, and other information that crosses jurisdictional and geographic boundaries (called "cross-boundary data"). Often data and information on a common set of issues exist within different entities or different countries; however, using the information on a regional- or NPLCC-wide basis is often not possible due to a variety of issues (e.g., data may be on different scales, in different units, or not available; "boundaries" of different datasets might not align; the relevant information may be available in qualitatively different forms, such as statistics from monitoring as well as TEK; etc). Improving the ability to integrate and share the information across such boundaries is an activity that can benefit all NPLCC Partners, yet does not fall within the mission of any particular partner, making it a role that the NPLCC is uniquely suited to fill.

Activity Description: Several NPLCC partner entities have various efforts underway that relate to spatial conservation planning and design, habitat connectivity, and integrity and resilience at different scales across the NPLCC. All of these activities would benefit from improvements in identification, integration and synthesis of cross-boundary data (including TEK where desired, tools and additional types of information) currently held by different entities. This activity focuses on identifying, integrating, synthesizing, and making available existing cross-boundary data and information relevant for such landscape-level planning efforts. This Focused Activity relates to Activity 1 (a priority activity for NPLCC action) and Activity 2 (a priority activity for both the NPLCC and for partners) shown in Table 1.

Potential Approaches:

- Work with scientists and managers to identify existing data and information related to one or more of the five Priority Topics that would be broadly useful for natural resource management planning. Identify existing data and information, their formats, and the most efficient and effective ways to make it available for use. This process could include:
    - Conducting an inventory or assessment of the existing data, tools, activities, etc. related to any/each of the Priority Topics
    - Targeted workshops with people working in related areas from different organizations.
- Continue ongoing work and build on past work to integrate existing and new cross-boundary data and information using the NPLCC's data discovery and management platform.
- Facilitate collaborative efforts (e.g. standing work groups or discipline groups) to share information and data related to one or more of the Priority Topics, evaluate the quality of the data, and facilitate integration of the information into projects.
- Where management-relevant data gaps have been identified, work across LCCs and with partners to facilitate filling the gaps.
- Identify and share examples of how various data and information types have been used or develop and implement case studies on the use of various types of data related to climate stressors and landscape effects.

***Recommended 2013/2014 Actions*:**

Action 1.1: Implement improvements to NPLCC's data discovery and management platform and improve the usefulness of the platform for use in landscape-level planning and design efforts. Continue the maintenance, care and expansion of the platform.

Priority Topic(s): All

Action Objective(s):

- Implement recommended modifications and enhancements to the NPLCC's data discovery and management platform to improve usability and support the preparation of visualization tools.

Action 1.2: Increase data access and synthesize existing spatial data to support climate change adaptation and resiliency planning and conservation design across the NPLCC footprint.

Priority Topic(s): All

Action Objective(s):

- Provide access to the spatial data inventory initiated in 2012 by USFWS that was identified as a priority action by the NPLCC GIS Technical Team.
- Compile, integrate and synthesize existing spatial information from across the NPLCC in the LCC's geospatial digital atlas and database to support climate resiliency planning, landscape-level conservation and sustainable resource management, and adaptation actions (actions are listed in priority order for initiating). Prior to starting this effort, inventory any existing efforts to avoid duplication. This work will be coordinated through the NPLCC GIS Technical Team with participants from throughout the NPLCC.
    - Geophysical Setting: Develop a classification of "land facets" using Digital Elevation Models and derived products (slope, aspect, topographic position), soils, and geology.
    - Ecological Integrity: Synthesize existing information on human impact, including land cover, roads, mining, fire suppression, timber extraction, and other factors that determine landscape scale ecological condition. Existing efforts on integrating land cover data layers across international boundaries will be expanded if needed.
    - Species Characteristics: Identify current patterns of biodiversity and species abundance, occurrence, and condition, particularly for anadromous fish.
    - Climate Change Threats: Synthesize existing and best available climate data and make available through the NPLCC data discovery and management platform.

Action 1.3: Assess the availability of hydrological data including streams (NHD, stream flow, temperature, etc.), snowpack and glaciers across the range of the NPLCC and conduct case studies to identify whether and what additional data are required, in specific geographic areas, to answer the most critical questions related to management actions. The availability, scale and accessibility of fundamental or baseline data vary across the geographic range of the NPLCC. This is especially true for hydrologic data in Alaska and British Columbia and glacier information throughout the NPLCC.

Priority Topic: All

Action Objective(s):

- Identify key hydrology data and assess their availability throughout the NPLCC.

- Catalog findings from the assessment and make it available on the NPLCC's data discovery and management platform or provide links to it.
- Prior to starting this effort, inventory any existing assessment efforts to avoid duplication.
- Work in partnership with neighboring LCCs to assist with obtaining missing baseline data where appropriate.
- Address this task as a cross-ecosystem action (freshwater, terrestrial and nearshore marine ecosystems), consistent with the Guiding Principles from the S-TEK Strategy.

Action 1.4: *Outreach, communication with partners about the platform, how they can use it, learning what they might want from it. Continue follow-up to previous work exploring what stakeholders want from the platform.*

Priority Topic: All

Action Objective(s):

- Communicate with partners regarding the availability and uses of data and other information on the platform.
- Continue to assess user needs and preferences for the NPLCC's data discovery and management platform to facilitate improving its effectiveness.

Action 1.5: Support the development and expansion of the Cascadia Partner Forum (a current Great Northern LCC and NPLCC sponsored transboundary partnership) and other similar identified partnership efforts within the geographic range of the NPLCC. Partner forums and other partnership efforts provide a framework for diverse groups of managers, scientists and other stakeholders to work across geographic areas on specific natural and cultural resource issues. They provide a mechanism for developing, sharing and integrating data and other information.

Priority Topic(s): Any

Action Objective(s):

- Identify and prioritize shared management needs and resources to increase adaptive capacity in the Cascadia landscape and in other identified partner forum areas.
- Help provide a forum to facilitate developing, sharing and integrating data and other information related to climate change impacts to natural and cultural resources.
- Work with the partnership efforts to identify climate-related information and tools that the NPLCC could support or develop.
- Facilitate communication to share ideas and expand implementation of adaptive actions including identification of new approaches.
- Highlight successes and challenges in implementation of adaption actions.

Focused Activity 2: Align and coordinate the delivery of Science and TEK with decision-maker needs

Importance and Resource Management Need: Incorporation of climate-relevant information into conservation and sustainable natural and cultural resource management is essential to help managers make informed decisions. A significant amount of climate-relevant information is already available, but

that information is often not easily available or communicated in a way that is useful to decision-makers. Effective communication and transfer of information from scientists to decision-makers is critical to ensure best available knowledge and information is used and, with respect to NPLCC activities, redundancy and duplication of effort is avoided.

Activity Description: Develop approaches to improve the transfer of relevant S-TEK information to decision-makers. Facilitate better communication among researchers, "tool-makers," (those who develop databases, guidebooks, decision-support tools, etc.) and the resource managers who can benefit from it. While Focused Activity 1 deals with spatial data, this Focused Activity aims at developing a more comprehensive picture of how researchers and scientists can communicate climate-relevant information in a way that managers can use it. By focusing these initial efforts in areas where relatively extensive data and information already exist, it will help researchers both communicate their past work and plan their future work more effectively. This Focused Activity supports both the S-TEK Strategy and the *NPLCC Communication and Outreach Strategy*. It relates to Activities 5, 7, 13, and 14 from Table 1, each of which is a priority activity for NPLCC action for one or more Topics.

Potential Approaches:

- Bring together decision-makers with researchers, social scientists, and "tool makers" to identify and discuss communication/delivery methods through:
    - Workshops that provide background information on climate change and training on use of applications.
    - Surveys or reviews of existing tools, followed by discussions with decision-makers about whether such information and tools are useful and/or how they would need to be modified to expand or increase their utility.
- Review existing tools: when and how they are used, where they are most useful and where they are not, what data/information are needed to use the tools.
- Review existing tool guidebooks (e.g. Ecosystem-Based Management Tools Network is in the process of writing a guide) or where appropriate, develop tool "guidebooks".
- Support and/or promote the "co-production" of visualization tools for information delivery (e.g., maps) and other synthesis products between research entities.
- Improve effectiveness of communication between decision-makers and researchers and scientists (e.g., Tribal and First Nations with researchers: consider academic and agency participation at Tribal gatherings or other opportunities).
- Work with the Tribal liaisons and TEK project sponsors as a potential mechanism to improve understanding, delivery, and incorporation of TEK, where appropriate and desired by Tribes and First Nations, into natural resource planning and management and help decision-makers understand how that information can be used in an appropriate context or ecological scale.
- Establish/strengthen/expand virtual "groups" or communities of practice that support ecosystem based management approaches to understanding landscape-scale effects of climate chance. This may include ecosystem groups or a "tools experts" registry.

***Recommended 2013/2014 Actions*:**

Action 2.1: Coordinate and integrate existing efforts to provide information on sea level rise and coastal storms and their effects so it can be communicated with resource managers and others that will be affected.

Priority Topic(s): C

Action Objective(s):

- Bring scientists and researchers addressing sea level rise and coastal storm hazards together to share findings, tools, lessons learned and identify information that should be shared with resource managers that they can use in adaptation and mitigation planning and stakeholder engagement.
- Develop communication and outreach tools needed to transmit findings to resource managers for use with adaptation and mitigation planning.

Action 2.2: Conduct a case study using existing data to assess the vulnerability and resilience of selected anadromous fish populations for a specific audience. As these populations are important cultural and economic resources, assessing vulnerabilities and resilience is of concern to managers when determining actions to protect or enhance these resources.

Priority Topic(s): Topic D

Action Objective(s):

- Identify one or more locations where data and information on anadromous fish populations exist and climate conditions have been projected, and where there is a management entity seeking a vulnerability assessment to support conservation and management planning. This action would not replicate efforts already underway in the Columbia River Basin or elsewhere.
- Convene information providers and tool-makers with managers to provide review, demonstration, and instruction in the application of vulnerability assessment tools for a selected case study.

Action 2.3: Increase knowledge, sharing and use of existing tools and approaches by entities involved in landscape-level planning. Focus on understanding unique approaches that may be applied in one area of the NPLCC and not familiar to those in others (e.g., consider differences across international borders). Assistance with identifying and applying appropriate tools was consistently identified as a key management need in work conducted by the National Wildlife Federation on behalf of the NPLCC (http://nplcc.s3.amazonaws.com/Advancing+Landscape-Scale+Conservation+in+the+NPLCC_Final.pdf)

Priority Topic(s): Any.

Action Objective(s):

- Conduct a survey or inventory of existing tools and approaches being used to support decision-making, including:
    - both sides of the NPLCC's international borders; identify who has the expertise for using the tools

    - consideration and use of TEK where desired by Tribes and First Nations
    - existing communities of practice
- Clearly describe how existing tools are being used and evaluate their usefulness. Identify best practices or guidance for use of selected tools. Prior to starting this action, inventory existing guidebooks to avoid duplication.
- Share the information among interested partner entities across jurisdictions and provide training to interested practitioners on how to use the various tools properly.

Action 2.4: Create an "experts registry" for planning tools and approaches. Many tools are currently available; however, knowing who is associated with certain tools and finding support for using various tools is challenging.

Priority Topic(s): Any of the Priority Topics are appropriate; however, begin by focusing on just one to ensure completeness.

Action Objective(s):

- Create a registry and provide access through the NPLCC website so it is easily accessible.
- All entries of experts on the registry are voluntary.
- Ensure a screening is in place to provide a critical assessment of any entries.

Action 2.5: Synthesize information from existing work related to a species, ecosystem, or ecosystem services in different geographic locations to characterize the common factors affecting that resource across a broader geography (e.g, the species range, the NPLCC region, etc.) and the issues that may be unique to one geography. Work with decision-makers to understand how this information can be used and how scientists can deliver the information so it is relevant.

Priority Topic(s): Any of the Priority Topics are appropriate; however, a focus in FY14 will be on B, C or E

Action Objective(s):

- Create products for distribution to managers that synthesize information on species, ecosystems, and ecosystem services so they will be better equipped to manage, conserve, monitor, or other respond to species range shifts or changes in regional or local abundance.
- Reduce the information and institutional barriers associated with managing species range shifts or changes in local abundance by connecting scientists and managers with existing information from other parts of the species range or elsewhere in the NPLCC geography.
- Develop effective strategies for disseminating this synthesized information between decision makers/managers and scientists.

Focused Activity 3: Identify S-TEK information necessary to support landscape-scale planning and management efforts in the face of climate change that include multiple entities and jurisdictions.

Importance and Resource Management Need: Natural resource managers and decision-makers in the NPLCC are working on many large-scale projects (e.g., landscape conservation design projects) where climate is clearly relevant. Many of these involve multiple jurisdictions and decision-makers, and it is often not clear what climate-related information is needed or what support is already available.

Understanding current and expected plant and wildlife sensitivities to climate change, land-use, and appropriate management response actions is necessary for the development and implementation of successful adaptation strategies and actions. Because of the implications to natural and cultural resources, attention should to be given to identifying priority climate-related information and tool needs. This activity will build on work such as the National Wildlife Federation reports that the NPLCC has already funded.

Activity Description: For one or more landscape-level planning process and/or resource management decisions that involve or affect several management entities, identify a set of common (and perhaps unique) information needs based on an understanding of the decisions that must be made. Under this activity (in contrast to Focused Activity 2) the focus is on identifying the needs of decision-makers and establishing information and research priorities based on those needs. These identified research priorities can then inform future NPLCC planning and that of research-oriented NPLCC partners. The set of projects conducted under this activity should be sufficiently diverse that the NPLCC can compare approaches and potentially draw conclusions about which approaches for assessing information needs are most useful. Care will be taken to ensure that this activity complements, but does not overlap with similar efforts by other entities to identify information needs. This Focused Activity relates most closely to Activities 6 and 13 (priority activities for NPLCC action) and Activity 16 (a priority activity for both the NPLCC and by partner entities) shown in Table 1.

Potential Approaches:

- Expand on existing partnerships involved with the design of reserve networks, conservation design, and landscape planning (especially those with a cross-border focus) to identify climate-related needs (e.g. Alaska Coastal Rainforest Center, Cascadia Partner Forum, etc.). Conduct workshops and case studies with managers and scientists to identify climate-related information needs that support management decisions and planning efforts, especially those that involve multiple decision-makers.
- Build on efforts started during focus groups initiated by USGS, National Wildlife Federation, and EcoAdapt.
- Any of these efforts may include:
    - Evaluating the scale where we should be addressing these types of planning questions (temporal and spatial).
    - Identifying examples of efforts that have different “natural” scales (ex. Partners in Flight workshops on forest management).
    - Conducting an inventory of existing information for the relevant decisions in the project.
- Indirect or survey methods for identifying S-TEK information needs, which could include:
    - Direct interviews with individuals working on large-scale conservation planning.
    - Reviews of prior exercises on identifying needs (including current effort on identifying spatial data needs).

***Recommended 2013/2014 Actions*:**

Action 3.1: Identify climate-related information and tool needs for managers and decision makers involved with forest resources.

Priority Topic(s): B and E

Action Objective(s):

- Conduct additional workshops in several different locations in the NPLCC to complement and expand the work started by USGS in Seattle, Washington in December, 2012 (report will be prepared and made available through the NPLCC website).
- Workshop focuses likely would include continuing to address the following:
    - Identifying valued forest resources, services and related management goals.
    - Identifying potential effects of climate change-related changes on valued forest resources and services.
    - Identifying potential management actions to respond to effects of climate-related stressors.
    - Identifying sources of information that already exist to support adaptation planning and potential management actions.
    - Identifying areas of focus for the NPLCC and other partners related to data, information and tool gaps, and adaptation planning.

Action 3.2: ***In FY 2014*** *Activity moved to Action 1.5 and expanded.*

Action 3.3: Identify climate-related information and tool needs for managers and decision-makers related to one of the other four Priority Topics (this action to follow completion of Action 3.1). It is anticipated the management decision context and the key information needs related to each Priority Topic will evolve over time; having partner entities periodically review their decisions and information needs will help ensure that the NPLCCs will continue to identify the most relevant and useful information.

Priority Topic(s): C, D or E (Identified in FY14)

Action Objective(s):

- Conduct additional workshops in different locations in the NPLCC to clarify and communicate among partners:
    - What decisions each entity makes relevant to the Topic.
    - What climate-relevant information each entity has and how they use that information.
    - What the key information needs are.

Action 3.4: Identify climate-related information and tool needs for managers and decision makers involved with natural and cultural resources affected by hydrologic regime shifts

Priority Topic(s): A

Action Objective(s):

- Conduct additional workshops, similar to a USGS-sponsored workshop in winter 2014, related to Priority Topic A to cover a broader portion of the NPLCC. These workshops would be in different locations in the NPLCC to complement the efforts initiated by USGS.

Focused Activity 4: Incorporate existing climate information into "line management activities"

Importance and Resource Management Need: Managers charged with protection and management of natural and cultural resources make numerous decisions on a regular basis where the outcomes of those decisions will be affected by climate change. In some cases there is no precedent or accepted approach for how climate change impacts can or should be considered in those decisions. For many day-to-day type decisions, it may not be necessary or helpful to explicitly consider the effects of climate change, but considering those effects may help direct limited funding and resources to where it is most cost effective and beneficial to natural and cultural resources over the long run.

Activity Description: Identify decisions and activities that management agencies are making now and where climate change is relevant, but not typically considered. Find opportunities to assist the management agencies with consideration and incorporation of climate information in their project selection, design, and implementation. In contrast to Activity 3, the focus of this activity is on providing immediate benefit to smaller-scale "regular" decisions typically made by a single entity. From a set of examples, identify characteristics of the line management activities that can benefit from climate information and the types of climate information that are most relevant. This Focused Activity relates to Activities 7, 12, 13, and 14 (priority activities for NPLCC action) and to Activities 9 and 16 (priority activities for NPLCC and partner action) shown in Table 1.

Potential Approaches:

- Assist partner entities in applying tools to support adaptation and mitigation strategies
- Conduct a set of demonstration projects or case studies with a diversity of management agencies, scale/scope of decisions and different habitats, which incorporate climate information into the types of decisions natural resource managers make on a regular basis.
    - Identify several of these types of decisions (e.g., habitat restoration planning, infrastructure design) and experts to work with the managers to identify climate-relevant information and incorporate that information in their planning and implementation processes.
    - Address social science issues and incorporate the human dimension in the development and implementation of adaptation strategies. This could include addressing impacts to natural and cultural resources caused by humans as they respond to observed or perceived impacts from climate change and/or related stressors.
- Identify an example of climate-relevant TEK and an interested Tribe or First Nation to explore how that TEK can help inform management activities.

- Evaluate a set of demonstration projects and develop lessons learned. Compare approaches and identify types of decisions that benefit from climate information, common types of information needed, and barriers to considering climate information, etc.

***Recommended 2013/2014 Actions*:**

Action 4.1: Assess vulnerabilities of key natural and cultural resources in a targeted location (e.g. the Skagit watershed) with partners from different jurisdictions and develop adaptation and mitigation strategies that can be implemented to address climate-related issues in areas beyond the targeted location. Addressing landscape-scale ecosystem, habitat, and species vulnerabilities requires working together across boundaries with various decision-makers and stakeholders. Cross-boundary collaboration and developing and sharing adaptation strategies is essential to be effective.
Priority Topic(s): A and B
Action Objective(s):

- Assess vulnerabilities of selected key ecosystems, habitats, species, and/or best practices in a targeted location.
- Scientists leading the effort will work with managers to identify key ecosystems, habitats and/or species of interest (cross-walk selections with habitats or species identified as being of high value or of concern by Tribes and First Nations) where they are focusing management actions and have concerns related to climate change (and related stressor) impacts.
- If appropriate, once vulnerabilities have been assessed, the scientists will work with participating managers to develop adaptation and mitigation strategies that can inform decision making beyond the selected geographic area.
- Training will be provided to the managers and other decision-makers so use of the tools is improved and adaptation strategies can be applied.

Action 4.2: Assist one or more partners to incorporate climate change information into habitat conservation, restoration, adaptation, or enhancement efforts.
Priority Topic(s): C and/or D
Action Objective(s):

- Test methodologies and develop pertinent background information, involving diverse groups of NPLCC partners.
- Using case studies, identify management decisions, potential climate change impacts, existing available adaptation strategies and potential information gaps.
- Determine when it is appropriate to ask questions related to climate impacts and how to address those issues in efforts being considered.
- Develop guidance related to adaptation and mitigation planning and implementation for managers to use as appropriate.

Action 4.3: Support or conduct scenario planning exercises with one or more NPLCC partners interested in applying that tool to a planning problem (specific to ecological process, habitat, resource or species).

Exercises/workshops will be used to assist with incorporating climate change adaptation actions into habitat conservation, restoration and enhancement efforts

Priority Topic(s): C and/or D

Action Objective(s):

- Review of scenario planning exercises: how has it been used within the NPLCC, how have entities using scenario planning benefited.
- Conduct one or more case studies of the use of scenario planning. Facilitate and support the incorporation of climate change considerations into scenario planning. Support the participation of representatives from partner entities not familiar with the approach who are interested in observing and learning. Support or provide training in scenario planning, if sufficient interest among NPLCC partners exists.

Action 4.4: *Assist* decision-makers with incorporating climate information into their planning efforts and implementing adaptation actions.

Priority Topic(s): C and/or D

Action Objective(s):

- Work directly with natural and cultural resource managers to facilitate consideration and incorporation of climate information in their project selection, design, and implementation.
- Work could include vulnerability assessments of key natural and cultural resources in a targeted location or scenario planning exercises, etc.

Focused Activity 5: Provide support for partner-initiated joint projects

As discussed above, the NPLCC encourages its partner entities to pursue activities that benefit the entire partnership when possible, and has provided both the S-TEK Strategy and this Implementation Plan partly to communicate those priority topics and activities. To promote this aspect of the partnership, the NPLCC will endeavor to provide co-funding for at least one partner-initiated activity each year. For 2013, the NW and Alaska Climate Science Centers approached the NPLCC with a proposal to co-fund an activity focused on climate change adaptation for subsistence and cultural resources. The three organizations worked together to identify an activity that falls within the five Priority Topics, is consistent with the S-TEK Guiding Principles, and that meets the needs of the CSCs. That activity is described below. In future years, similar concepts for joint funding could come from any partner, who would work with the NPLCC staff to define a mutually beneficial activity.

2013 Focus: Climate Change Adaptation for Subsistence/Cultural Resources (joint with the NW Climate Science Center and the Alaska Climate Science Center)

Importance and Resource Management Need: Natural resources of cultural significance are threatened by climate change in both the short and long term. Changes in phenology, habitat availability and condition, and the range of disease vectors, invasive species and pathogens will impact natural and cultural resources important to Tribes and First Nations. To protect these resources, it is necessary to

explore and test adaptation actions that will lead to enhanced persistence of natural resources of cultural importance threatened by climate change or related stressors.

Activity Description: In 2013, the NPLCC and the Northwest and Alaska Climate Science Centers are planning on working in partnership to fund projects with cross-cutting themes from the two comparative geographical areas (the northern and southern portions of the NPLCC). Each project must have management application, address adaptation actions, and be relevant to resources of importance to Tribes and First Nations. Although the exact focus of the comparative projects do not need to be the same and can be led by different entities, there will be a thematic connection between the projects. Two general themes are described in the recommended actions below: (1) non-salmonid anadromous fish; and (2) important terrestrial natural/cultural resources. This Focused Activity is intended to be a joint project with the NPLCC and the Climate Science Centers. Depending on available funding and project proposals received in response to a request for proposals, the NPLCC may choose to fund an additional project that does not have a comparative project in a different geographic area of the NPLCC. This Focused Activity relates to Activities 16, 25, and 26 from Table 1, identified as priority activities for both the NPLCC and for partner entities.

Potential Approaches: Working directly with Tribes or First Nations, carry out:

- Identify specific management adaptation needs and how they can be addressed.
- Determine the potential for use of TEK in support of vulnerability assessments and climate change adaptation.
- Assess socio-economic significance of selected subsistence/cultural resources and how changes in trends can be addressed.
- Conduct vulnerability assessments and identify potential adaptation actions that can be used by managers.
- Utilize existing downscaled climate change projections specific to ecological processes, habitats (vegetation types) or species of value. A component of this downscaling would be to consider which metrics (units of measure) or thresholds (extreme ranges of variation) are being used by scientists (precipitation, snow/rain elevation shifts, winter temperature) compared to Tribes/First Nations evaluation of change or “extreme” changes observed that are linked to specific subsistence of ceremonial practices.
- Explore adaptation actions that address identified climate stressors.

Recommended 2013/2014 Actions:

Action 5.1: Support assessment and adaptation planning for non-salmonid anadromous fish of cultural or subsistence significance (e.g. eulachon or lamprey). Climate influences on fisheries will require that both Tribes and other governmental entities adapt new approaches to management. However, currently available information on fisheries impacts and adaptation options, as well as support for implementation of these options, is insufficient to meet this challenge.
Priority Topic(s): A, D, and E

Action Objective(s):

- Assess the vulnerability of non-salmonid anadromous fish populations to climate change in the NPLCC (the entire area does not need to be covered).
- Work with Tribes/First Nations to assess impacts to selected vulnerable fish populations.
- Explore or test methods to increase resiliency against climate-related impacts.
- Investigate adaptation options and the needed support for their implementation.

Action 5.2: Support assessment and adaptation planning for cultural and/or subsistence resources that are traditionally gathered or hunted (e.g., basketry materials, berry or nut trees and bushes, roots or bulbs, wildlife; not fish or shellfish). Currently available information on impacts and adaptation strategies are limited and insufficient.

Priority Topic(s): A and B

Action Objective(s):

- Assess the vulnerability of cultural and/or subsistence resources that are traditionally gathered or hunted (non-fish or shellfish) and test or explore potential adaptation actions.
- Explore mechanisms for resiliency and which practices maintain the viability of certain populations of plant/animal species in place over time.
- Investigate adaptation options and the needed support for their implementation.

Action 5.3: FY 14 joint partner action(s) to be determined.

Appendix A. Additional detail on potential actions considered

This appendix provides additional detail on the process used to develop the *Implementation Plan*, in particular the first two steps of identifying and ranking potential actions within each Priority Topic.

Identification of potential actions

Table A1 (starting on p. A-4) lists the 28 potential actions (in no particular order) that were evaluated and ranked for each topic and for each source of support -- NPLCC action or potential partner-led actions. This is the "short list" referred to in the main text. The first 21 of these actions are applicable to any of the five Priority Topics, and those towards the bottom of the list are Topic-specific. This table also shows the more specific example actions and projects that were identified during S-TEK discussions about actions for each Priority Topic, by the numeric codes. Immediately following Table A1 (starting on p. A-8) are these more detailed lists – the "long list" We note that these longer lists were the results of brainstorming, and represent some, but not all, of the potential actions that could be pursued. While it would certainly be possible to expand these lists, the S-TEK subcommittee felt that these lists provided a sufficient basis to develop the more general list of potential actions shown in Table A1.

Ranking of Potential Actions

S-TEK subcommittee members individually ranked the list of potential actions for each Topic following a simple "dot voting" process. They were provided with a set of tables (one for each Priority Topic), listing the potential activities and asked to assign points to each of those potential activities based on their assessment of the lists shown above, and asked evaluate each list two times:

- First, for the value of the potential action as a direct NPLCC supported activity
- Second for the value of the potential action to the NPLCC partnership, better undertaken by individual partner entities (e.g., the Climate Science Centers)

To facilitate prioritization, each person had 12 "dots" or votes for the value of potential actions for each Priority Topic and each type of evaluation. No formal evaluation criteria were provided, and each subcommittee member was asked simply to evaluate the lists in terms of which actions they thought would provide the most valuable information or support for decision-making.

Eighteen subcommittee members completed the evaluation. For each Priority Topic, almost all activities received at least one point, suggesting that that work within any of these activity areas on any of the five Topics would be useful, which is consistent with the emphasis of the S-TEK Strategy.

Distinct areas of emphasis emerged for NPLCC direct-funding and NPLCC Partner activities. Figures A1 and A2 summarize the ranking results for all topics for NPLCC Action (Figure A1) and Partner Action (Figure A2). These figures show only the 21 potential actions considered relevant to all Priority Topics,

and each column is color-coded so that the potential actions receiving the most votes are green and those receiving the least votes are red. By inspection, four types of potential activity emerged as high priority for NPLCC action across all five Topics:

- Improve cross-boundary data availability, integration, and synthesis
- Identify, compile, collate and integrate existing data and information concerning climate impact data and modeling, monitoring and monitoring networks, TEK, etc. Make this information readily available for decision-makers (as desired by Tribes/First Nations for TEK).
- Identify existing tools and approaches being used to support decision-making. Evaluate the usefulness of those tools for: (a) providing decision-relevant insights, and (b) aiding in the development of adaptation or mitigation response actions. Include consideration and use of TEK where desired by Tribes. Use insights from this review to develop guidance for future tool/support development; provide training for resource managers in how to use existing tools
- Conduct workshops to further clarify decision-maker needs: Convene managers, scientists, and tribes to discuss specific sub-topics. Identify management decisions and actions, share information on existing data, models, etc.; identify gaps and common needs

And two emerged as high priority for Partner Action across all five topics:

- Collect data to improve basic understanding, to provide baseline information, to provide a basis for long-term monitoring, to support modeling, etc.
- Develop downscaled / improved climate models and forecasts of changes in the resources, at appropriate scales

Within each of the Priority Topics, additional actions were highly ranked, and different actions emerged as high priorities for the different topics. Table 1 in the main text summarizes those results and indicates the Priority Activities selected for this Implementation Plan.

	NPLCC Action - Total points				
	A	B	C	D	E
Activity code	Hydrol. Regime shifts & effects of rivers, streams, riparian corridors	Climate effects on forest ecosystems	Sea level rise and coastal storms	Hydrol. regime & effects on anadromous fish	Invasive species, diseases, and pests
1	17	18	16	18	16
2	15	11	24	15	16
3	4	2	4	9	3
4	11	7	7	7	8
5	14	17	14	14	18
6	11	11	10	9	10
7	15	15	6	10	6
8	12	9	14	14	11
9	9	10	14	6	9
10	3	6	8	12	3
11	13	11	13	10	7
12	9	13	12	8	10
13	14	13	19	17	20
14	13	10	14	10	13
15	3	1	1	1	0
16	8	14	8	6	6
17	11	4	2	6	5
18	2	2	3	1	6
19	13	9	12	11	10
20	3	3	2	1	4
21	3	7	1	3	3

Figure A1: Relative ranking of potential activities for NPLCC action. Green shading indicates higher priority, red shading indicates lower priority

	Partner action - Total points				
	A	B	C	D	E
	Hydrol. Regime shifts & effects of rivers, streams, riparian corridors	Climate effects on forest ecosystems	Sea level rise and coastal storms	Hydrol. regime & effects on anadromous fish	Invasive species, diseases, and pests
1	7	9	11	11	7
2	14	10	12	13	17
3	10	11	2	4	7
4	5	1	2	1	2
5	12	8	10	12	5
6	10	16	11	12	10
7	5	7	8	8	4
8	9	12	24	21	15
9	8	6	12	6	7
10	8	2	6	11	3
11	15	15	13	11	13
12	7	4	3	3	3
13	8	7	11	7	7
14	7	7	11	10	9
15	4	2	2	2	2
16	8	21	11	8	6
17	16	17	18	16	13
18	8	4	6	2	11
19	3	3	3	4	5
20	17	17	17	19	11
21	8	11	7	8	8

Figure A2: Relative ranking of potential activities for Partner action. Green shading indicates higher priority, red shading indicates lower priority

Table A1. Consolidated list of potential actions

		Priority Topic					
		A	**B**	**C**	**D**	**E**	
	Activity code	**Hydrol. Regime shifts & effects of rivers, streams, riparian corridors**	**Climate effects on forest ecosystems**	**Sea level rise and coastal storms**	**Hydrol. regime & effects on anadromous fish**	**Invasive species, diseases, and pests**	**Cross-topic**
Applicable to all Priority Topic(s):							
Improve cross-boundary data availability, integration and synthesis	1	7	8	4, 15	7, 17, 20	8, 14	
Identify, compile, collate and integrate existing data and information concerning climate impact data and modeling, monitoring and monitoring networks, TEK, etc. Make this information readily available for decision-makers (as desired by Tribes/First Nations for TEK).	2	8, 11	9	5, 6, 19	8, 18, 20	9, 11	
Evaluate existing datasets, models, and TEK (as appropriate) for climate relevance: how well do they take into account climate change and climate change impacts	3	9	24				
Develop a data portal or "climate clearinghouse" with a brief description of people, their projects, and how to contact them	4						2
Identify existing tools and approaches being used to support decision-making. Evaluate the usefulness of those tools for: (a) providing decision-relevant insights, and (b) aiding in the development of adaptation or mitigation response actions. Include consideration and use of TEK where desired by Tribes. Use insights from this review to develop guidance for future tool/support development; provide training for resource managers in how to use existing tools	5	19, 31	15, 16, 17	18	14		3
Identify and document tangible examples of climate change adaptation or mitigation response actions; evaluate their successes and failures, and develop "best practices" guidance documents on how to incorporate successful approaches in existing management practices. Include consideration of TEK in developing these examples and in guidance documents	6	22, 23	18, 27, 28, 30	13, 23	15, 25, 27	20	
Develop case studies to enhance practicality and utility of existing tools / previous studies through direct engagement of decision-makers: illustrate how a particular type of study or model can provide useful information for a specific type of decisions (e.g., use a vulnerability assessment to directly inform on potential adaptation response actions)	7	16	31	22	24	19	

Table A1. Consolidated list of potential actions

		Priority Topic					
		A	B	C	D	E	
	Activity code	Hydrol. Regime shifts & effects of rivers, streams, riparian corridors	Climate effects on forest ecosystems	Sea level rise and coastal storms	Hydrol. regime & effects on anadromous fish	Invasive species, diseases, and pests	Cross-topic
Assess vulnerability and resilience of the resource(s) to projected climate change: identify critical stressors, valued/necessary resources (including Tribal and First Nations valued resources, corridors and refugia, etc), anticipated changes, and locations of more vulnerable and less vulnerable resources. Include consideration of the effects of multiple stressors on the resource(s)	8	5, 18, 20, 13.2, 13.3	11, 13, 14, 18, 25, 30.1	9, 10, 11, 12, 20	5, 10, 11, 13, 22	7, 12, 17	
Develop tools and/or assist partner entities in applying existing tools to identify and inform managers of high priority conservation and/or restoration targets (species, locations, etc).	9	25, 29	29, 32	8, 12, 17, 24, 27, 28	12, 26, 27	21	
Identify how restoration activities in systems related to this Priority Topic can/should be modified to account for climate-related changes	10			25			
Identify focal indicators, processes or thresholds that can serve as indicators of change, can be used track climate change impacts, and potentially assess management options; identify and synthesize information on the habitat requirements for growth and survival of those species	11	12, 13.1	10	7	9	10	
Conduct or support adaptation planning exercises to assist management decisions related to specific sub-topics, considering uncertainties in future climate / climate impacts. (E.g., scenario planning exercises, triage analyses, contingency planning, etc)	12	21	26	21	23	18	
Conduct workshops to further clarify decision-maker needs: Convene managers, scientists, and tribes to discuss specific sub-topics. Identify management decisions and actions, share information on existing data, models, etc.; identify gaps and common needs	13	14.1	22.1	14.1	16.1	13.1	
Conduct or support stakeholder outreach workshops and meetings, either convened by the NPLCC or by NPLCC partners. Goals of such outreach activities could include: communicating information on projected impacts to interested stakeholders; supporting with local community planning by conveying information on local impacts and on the availability of adaptation and mitigation actions, etc.	14	14.2	22.2	14.2, 16.1, 26	16.2	13.2, 16	

Table A1. Consolidated list of potential actions

		Priority Topic					
		A	B	C	D	E	
	Activity code	Hydrol. Regime shifts & effects of rivers, streams, riparian corridors	Climate effects on forest ecosystems	Sea level rise and coastal storms	Hydrol. regime & effects on anadromous fish	Invasive species, diseases, and pests	Cross-topic
Develop "report card" type tracking and reporting tools so that progress of climate change adaptation and mitigation can be tracked and reported to stakeholders and the public	15	24					
Improve information on how climate change will affect linkages between ecological and human resources (e.g., forest-riparian-stream habitat connections)	16	30	3, 20, 21, 34		2, 21		1
Collect data to improve basic understanding, to provide baseline information, to provide a basis for long-term monitoring, to support modeling, etc.	17	1	7	1, 2, 3, 9	1, 3, 4, 19		
Develop standard quality assurance and quality control measures, other protocols, and data stewardship guidance for topic-related data collection and monitoring, with special provisions as necessary in consideration of climate-related changes	18	10				5	
Coordinate and share results of ongoing and future data collection activities among NPLCC partners who have related needs, interests and expertise (esp. for cross-border data)	19	15, 17	23	15	17	14	
Develop downscaled / improved climate models and forecasts of changes in the resources, at appropriate scales	20	3	1, 2, 4, 19		1, 3, 4	1, 2	
Develop specialty climate / Topic models	21	2, 4, 5, 6	5, 6, 30		5	6	
Applicable to a single Priority Topic							
Evaluate relationships between existing infrastructure and infrastructure planning and projected changes in the hydrological regime (e.g., culverts and fish passage; road and trail access; hatcheries, etc)	22	26, 27, 28					
Carry out fire regime / fire management research to assess changes in fire regimes, the interaction of fire with other disturbances, and the combined effects of those changes on subsistence resources, basketry resources, watershed conditions and processes. Include consideration of TEK and fire management, and the impacts on Tribal and First Nations subsistence, ceremonial, and economic interests and values	23		12				
Develop strategies for forest harvest and forest regeneration after cutting (modifications to current practices to take into account climate change impacts)	24		33				

Table A1. Consolidated list of potential actions

		Priority Topic					
		A	B	C	D	E	
	Activity code	Hydrol. Regime shifts & effects of rivers, streams, riparian corridors	Climate effects on forest ecosystems	Sea level rise and coastal storms	Hydrol. regime & effects on anadromous fish	Invasive species, diseases, and pests	Cross-topic
Identify potential impacts or changes to tribal/First Nations subsistence activities linked with hydrological regime changes (e.g. impacts to anadromous fish or fishing under more extreme/adverse conditions)	25				6, 19		
Evaluate the interactive effects of changes in invasives, pests, and diseases with other large-scale stressors; determine effects of multiple stressors (e.g, environmental contaminants, realignment of community organizations, etcs) on organismal and population health and condition	26					3	
Study the genetics of species hybridization	27					4	
Develop research partnerships to study fish and bird disease	28					15	

Priority Topic A: Effects of hydrologic regime shifts on rivers, streams and riparian corridors

Potential actions to address new science, TEK, information, data or modeling

1. Acquire additional data to support the modeling efforts described below. E.g.,
   1.1. streamflow data for watersheds in Alaska
   1.2. empirical data on the effects of changes in flow regimes on fish distributions
   1.3. collection of weather data, including snow and other precipitation across a range of elevations
   1.4. support refinement of National Hydrology Dataset (NHD) or development of NHDPlus for Alaska portions in NPLCC
2. Create watershed ecosystem models (headwaters to nearshore marine) linking hydrologic changes to patterns of species abundance and health, habitat quality, quantity, and use, material transport, and aquatic productivity
3. Create downscaled climate models and forecasts of hydrologic change for specific regions within the NPLCC. Particular areas of near-term interest include:
   3.1. snowmelt, glacier melt, and ice melt watersheds (Alaska, North Cascadia)
   3.2. the fog belt
4. Improve snow models – accumulation, dissipation throughout winter (SE Alaska) to assess effects such as:
   4.1. Wildlife survival and mortality (e.g., impact of sustained heavy snowpack on Sitka black-tailed deer)
   4.2. Storage capacity and retention of water (e.g., for hydro facilities)
5. Develop generic modeling tools to assess stream/river impacts (vulnerabilities) from climate change.

6. Develop approaches and models to characterize the ecosystem goods and services associated with the hydrologic regime, and changes in the hydrologic regime

Potential actions addressing analysis, integration, and synthesis

7. Improve cross-boundary data availability, integration and synthesis
8. Systematically compile, collate and integrate existing data and information on hydrologic regimes affected by precipitation, glaciers, and groundwater and make it available for decision-makers. Intensively monitored watersheds are an example of an ongoing effort that could serve as a pilot for improved coordination and collaboration. E.g.,
   8.1. USGS, BOR or USFS long-term ecological/hydrological monitoring data sets?
   8.2. The state of WA has a number of intensively monitored watersheds, and there are some LTER sites in the region (one in Oregon, two in Alaska, the Malcolm Knapp Research Forest in BC, etc)
9. Evaluate existing hydrologic models for climate change applications in the NPLCC.
10. Develop standard quality assurance and quality control measures, other protocols, and data stewardship for hydrologic monitoring that consider climate-related changes.
11. Consolidate a unified hydrology for SE Alaska
12. Identify focal indicators to track climate change and assess management options
13. Synthesize information on habitat requirements for growth and survival of key (indicator) aquatic biota (plant and animal).
    13.1. Include thermal bioenergetic criteria
    13.2. Use as a baseline to evaluate confirmed distributional shifts from recent climate trends and potential climate change
    13.3. Identify and describe corridors and refugia for aquatic biota.

Potential actions addressing coordination, sharing, and capacity building

14. Conduct workshops specific to one or more detailed sub-topics
    14.1. Convene managers, scientists, and tribes to discuss specific topics relative to this Priority Topic to identify management decisions and actions, needs and gaps.
    14.2. Scientists communicating their results/information to stakeholders, E,g,,
        14.2.1. *Changes in species range as a function of changes in flow/temp*
        14.2.2. *Sea level rise and its effects on near-shore communities (e.g, forage fish, shellfish)*
        14.2.3. *Remobilization of environmental contaminants due to climate change.*
15. Coordinate and share data collection activities, research results, tools, and management lessons for cross-border datasets
16. Connect science to practical implementation. Eg.,
    16.1. Using existing/previous vulnerability assessments – but work with decision-makers to model a specific problem and illustrate how vulnerability assessment can inform adaptation (hatchery vulnerability assessment could be an example)
17. Facilitate the coordination of available data and modeling projections for expected climate change influence on the flood/drought fluctuation or variation on rivers and streams. This may be prioritized by LCC sub-regions where existing research modeling indicated vulnerability

18. Assess possible changes to the network of corridors and refugia and identify potential activities that will enhance climate-resilience in the region

Potential actions addressing ability to use information directly for decision support (including developing decision support tools)

19. Identify and evaluate existing tools and approaches being used to support decision-making regarding flow management as to their usefulness in: (a) adapting to impacts of climate change on flows, and (b) providing insights on the ecological impacts of changes in flow regimes.
20. Conduct vulnerability assessments for ecological resources likely to be affected by hydrologic regime shifts; host workshops on vulnerability to assist regional and community planners
21. Conduct scenario planning workshops to assist with planning for one or more subtopics
22. Provide "actionable-level" information and tangible examples of progress or success with climate change adaptation (ex. case studies)
23. Provide guidance documents with best management practices on how to incorporate climate change into existing management practices
24. Develop climate change "report cards" such that progress of climate change adaptation or mitigation can be tracked
25. Develop tools to identity and inform management of high priority conservation targets
26. Evaluate the effectiveness of existing culverts and fish passage structures given projected changes in hydrology. Address sizing of culverts and other infrastructures, and how these will affect fish migration (Currently sized to historic data). E.g.
    26.1. 100 year floods (how will they change)
    26.2. Mean high / mean low levels (and how will they change)
    26.3. Demarcation of flood impact zones
27. Build on existing work on assessing predicted changes in hydro regimes and their effects on road and trail access and infrastructure on NPS and FS lands to better understand the distribution and characteristics of areas of increasing risk.
    27.1. Examine ways to increase resilience to maintain access under a changing climate
28. Identify at-risk infrastructure – including where hatcheries are at risk from changes in flow (reduced flows, increased flows, changes in flow timing)
    28.1. (work is currently underway on this)
29. Identify potential areas for restoration
    29.1. Flood plains, upstream, etc
30. Identify linkages between change in hydrologic regimes and human/wildlife health. E.g.,
    30.1. Klamath River toxic algae and summer/fall low flow conditions expose tribal fisherman and ceremonial practitioners (bathing) to increased risks
    30.2. Algae die offs can impact wildlife and domestic animals.
31. Support special analyses and syntheses to support the understanding of and ability to use relevant information in decision-making (help in using information appropriately and effectively).
    31.1. On-the ground changes, such as hydrologic regimes and water temperatures, that are closer to affecting the actual resource should be considered more important

Priority Topic B: Effects of changes of air temperature and precipitation on forests

Potential actions to address new science, TEK, information, data or modeling

1. Improve information and predictions of forest species distribution - include combining climatic effects with disturbance regimes (fires, insects, diseases, etc.)
2. Improve information and understanding of how timing and amount of precipitation impacts forests or culturally important forest plants.
    2.1. E.g., Huckleberries: as a result of changes in soil moisture, drought stress, and lack of berry maturation/development. A lack of *Vaccinium* sp. (different types) across the NP this summer/fall has resulted in lack of food for tribal gathers and wildlife.
3. Improve information on how climate change will affect linkages between streams, rivers, wetlands, etc and the surrounding forest (riparian-water interactions)
4. Improve information and predictions of forest cover distribution (including forest, subalpine, wetlands, etc)
    4.1. A potential focus is on changes in alpine-dependent species on islands and the effects on biodiversity and/or potentially shrinking alpine habitats in general
5. Improve predictions of changes in soil moisture/chemistry changes and improve models of the effect of these changes on species distributions and growth rates. Include a focus on valued plant resources.
6. Improve information and prediction of changes in fog patterns and fog-associated hydrologic regimes and how they relate to species distribution and the effects to coastal redwood forest health and resilience (esp. growth rates). This also pertains to non-summer riverine/valley fog patterns and low elevation forests adjacent to the rivers.
7. Assess and monitor the responses of wildlife habitat, food webs, and nutrients to climate change effects

Potential actions addressing analysis, integration, and synthesis

8. Improve cross-boundary data availability and integration.
9. Systematically compile, collate and integrate existing data and information on forest and forest species distribution, the predicted effects of climate on both, and make that information available to decision-makers.
    9.1. Inventory of existing monitoring networks and monitoring entities may be a precursor
10. Identify focal indicators to track climate change and assess management options. Consider key indicators from both a western science and TEK perspective, and identify similarities and differences between the indicator species or processes identified by science and tribes.
11. Study the interaction of multiple stressors (including fire with other disturbance regimes such as insects, pathogens and disease) given current and potential future climate change effects
12. Fire regime research and management
    12.1. Assess changes in fire behavior/effects on subsistence resources, basketry resources, watershed condition; Need for integration of results from different fire regime efforts
    12.2. Study the interaction of fire with other disturbance regimes given current and potential future climate change effects

12.3. Better understanding of the link of fire regime (frequency and intensity)/forests to watershed processes (i.e., nutrient, organic matter and sediment dynamics, food web interactions) and phenological events
12.4. Incorporate TEK with fire regime research and management regarding forest condition to support tribal subsistence, ceremonial, and economic interest/values
12.5. Incorporate TEK for wildland fire management (suppression/pre-treatments)
12.6. Consider types of hazardous fuels reduction treatments being implemented, how they align with adaptation strategies given predicted climate change impacts to forests.

13. Assess the connections of land use stressors to refugia and associated adaptation strategies
14. Assess the locations and sizes of protected lands and projected habitat changes due to climate change to assess the adequacy of the current reserve system.
15. Assess how forest management practices can affect water management (e.g., improve snowpack retention)
16. Assess how forest management practices can increase resilience to large catastrophic wildfires exacerbated by climate change.
17. Assess how to align local to landscape "Strategically Planned Landscape Area Treatments [SPLATs]" with climate change mitigation strategies implemented with forest and fire management practices.
    17.1. How does TEK inform managers with prioritization and selection of the areas to be treated, considering tradeoffs for the identified Values at Risk? E.g. United States Wildland Fire Decision Support System
18. Assess possible changes to the network of corridor and refugia to enhance climate-resilience in the region given the expected climate induced changes in forest composition, fuel loading (vegetation mortality/productivity), and increase in wildfire occurrence.
19. Assess how projected climate change effects will affect sustainable forest harvest levels and forest practices with the NPLCC
20. Relate changing forest conditions to productivity of key aquatic species (e.g., anadromous fish).C
21. Assess climate effects on pest infestation and potential damage (disease and parasites; insects, and small mammals).

<u>Potential actions addressing coordination, sharing, and capacity building</u>

22. Conduct workshops specific to one or more detailed sub-topics
    22.1. Convene managers, scientists, and tribes to discuss specific topics relative to this Priority Topic to identify management decisions and actions, needs and gaps.
    22.2. Scientists communicating their results/information to stakeholders
23. Coordinate and share data collection activities, research results, tools, and management lessons for cross-border datasets
24. Evaluate the effectiveness of current forest monitoring, including instrumentation, for forecasting climate change effects.

Potential actions addressing ability to use information directly for decision support (including developing decision support tools)

25. Conduct vulnerability assessments for ecological resources associated with this Priority Topic
    25.1. Conduct vulnerability assessments to determine which species are susceptible to change due to changes in fog, rain, and snow
26. Conduct scenario planning workshops to assist with planning for one or more subtopics
    26.1. Possible subtopic: landscape-level changes in vegetation composition
    26.2. How to integrate predicted Climate Change impacts identified by scientists, managers, and tribes/First Nations with wildfire management frameworks for assessing threats (by fires) to Values at Risk (see Wildland Fire Decision Support System, adopted nationally by the US).
27. Provide "actionable-level" information and tangible examples of progress or success with climate change adaptation (ex. case studies). Examples include:
    27.1. Identification of the types of hazardous fuels reduction treatments being implemented and how they align with adaptation strategies given predicted climate change impacts to forests
    27.2. Integration of TEK with silviculture and wildland fire treatments addressing predicted climate change impacts. For example, particular thinning or timber harvesting treatments which increase resilience of forest to fire, drought stress and improve access and the quality of traditional foods, materials or medicines
28. Provide guidance documents with best management practices or how to incorporate climate change into existing practice. Ensure that these documents include examples based on tribal/First Nations subsistence activities, such as conservation tenants or related adaptive practices to maintain resources.
29. Develop integrative tools to identify high priority targets for conservation
30. Develop tools, based on existing information, to help managers predict and address the impacts of changes in forest species distribution, their retention of water, and potential impacts on aquatic systems
    30.1. Generic models to help assess impacts/vulnerability at local/regional scale
    30.2. Menu of options to address issues
31. Develop concrete example(s) of how improved information (on any one of the above items) can be used to inform decisions: about adaptation, restoration, etc
32. Address how climate change will affect old growth reserve priorities.
33. Support strategy development for forest harvest & forest regeneration after cutting
    33.1. E.g., drier/warmer summers → lower natural regeneration
    33.2. Changes in harvest locations/policies
    33.3. Align with hazardous fuels and wildland fire treatments to protect Values at Risk (valued natural and cultural resources or infrastructure)
34. Assess the degree to which existing riparian and coastal buffers are resilient to climate change; are they adequate to provide temperature protection on streams

Priority Topic C: Effects of change in sea levels and storms on shorelines, the nearshore and estuaries

Potential actions to address new science, TEK, information, data or modeling

1. Characterize and track climate change effects on physical, chemical, and ecological processes in the intertidal zone and marine nearshore. For example:
   1.1. Effects of increasing storm frequency and storm surge on wildlife habitats at the land-sea interface.
   1.2. Effects of changing estuarine conditions on the growth and survival of salmon during early phases of their seaward migration.
   1.3. Effects of changing estuarine habitat conditions on productivity, food webs, and nursery values for key marine fishes.
   1.4. Role of large scale-atmospheric pressure systems and ocean conditions on regional and local scale oceanographic conditions and storm events.
2. Conduct baseline data on sea-level rise to inform decisions about where to place tidal gauges, as well as restoration planning and permitting.
3. Baseline data collections to inform modeling and monitoring efforts. Data needs include:
   3.1. Vertical elevation data (to support models examining the effects of sea level on specific local marine shorelines).
   3.2. Environmental contaminants (e.g., persistent organic compounds and other emerging contaminants) remobilized by sea level rise on coastal habitats and species, and their effects

Potential actions addressing analysis, integration, and synthesis

4. Improve cross-boundary data availability, integration and synthesis
5. Collate existing data on monitoring networks
6. Assess existing coastal geomorphologic, hydrologic, hydrographic and meterological data and oceanographic models (e.g., transport and circulation and sea-level rise) for their application to projecting effects of climate change on NPLCC estuaries and nearshore marine.
7. Identify focal indicators to track climate change and assess management options
8. Combine storm data with SLR knowledge to inform conservation decisions about shoreline habitats and sites
9. Map and characterize the intertidal zone and associated habitats in light of SLR and coastal storms
10. Identify and map areas vulnerable to sea level changes and coastal erosion, including coastal communities, wildlife habitats, federal, state, provincial, tribal and First Nations lands.
11. Assess the effects of seawater incursion on coastal hatcheries
12. Vulnerability maps and downscaled models of hydrology, air and stream temperature, and fish habitat change in order to inform the prioritization of restoration and adaptation strategies
13. Inventory and evaluate existing adaptation options

Potential actions addressing coordination, sharing, and capacity building

14. Conduct workshops specific to one or more detailed sub-topics
    14.1. Convene managers, scientists, and tribes to discuss specific topics relative to this Priority Topic to identify management decisions and actions, needs and gaps.

14.2. Scientists communicating their results/information to stakeholders

15. Coordinate and share data collection activities, research results, tools, and management lessons for cross-border datasets
16. Compile and communicate options for addressing sea level rise – tools for local communities to better understand those options
    16.1. "roadshow" underway to communicate National Academy of Science results – can we use feedback from these efforts to inform our (S-TEK) identification of potential activities
    16.2. Tribal-specific issues related to sea-level rise: their concerns, impacts, and options, esp. including impacts on cultural resources
17. Translate new knowledge related to SLR to shoreline conservation issues and site specific impacts.
18. Compare decision-support tools and share datasets
19. Leverage related initiatives related to data platform, data sharing, coastal resilience, etc. E.g., WCGA, National Ocean Council, other regional planning bodies

<u>Potential actions addressing ability to use information directly for decision support (including developing decision support tools)</u>

20. Conduct vulnerability assessments for ecological resources associated with this Priority Topic. Potential focus areas include:
    20.1. Wetland vulnerability due to SLR and compare management options
    20.2. Where are high-value / critical wildlife habitats associated with estuaries that are most vulnerable to climate change
    20.3. Ecological resources likely to be affected by altered coastal flooding regimes.
21. Conduct scenario planning workshops to assist with planning for one or more subtopics
22. Provide "actionable-level" information and tangible examples of progress or success with climate change adaptation (ex. case studies; indicators of change that can be easily communicated to the public)
23. Provide guidance documents with best management practices or how to incorporate climate change into existing practice
24. Develop tools to identify high priority targets for conservation
25. Identify how restoration activities related to estuaries can/should be modified to account for climate-induced changes
    25.1. E.g., Tidal cycles / tide gates / levies / dikes and effects on estuary systems
26. Assistance for local community planning for climate change
    26.1. What are local impacts
    26.2. What tools are available (and what can those tools do and what do they NOT do)
27. Identify conservation opportunities for shoreline and coastal salt marsh areas such as wetlands that have the opportunity to migrate
28. Evaluate and compare effectiveness of management options for wetland protection given SLR

Priority Topic D: Effects of the changes in hydrologic regimes on anadromous fish

Note that anadromous species include the "Pacific salmon," steelhead, coastal cutthroat, the bull trout/Arctic char/Dolly Varden complex, eulachon, sturgeon and lampreys.

Potential actions to address new science, TEK, information, data or modeling

1. Effects of flow changes (timing and amount) on migration timing, corridors, and freshwater rearing/spawning habitat conditions, including effects of invasive species, pests, disease, competition and predation
   Note that effects may be different in different parts of the ranges of the various species (esp. warming effects at the southern extremes of the ranges)
2. Examine relationship between potential changes in migrational timing and production events in the coastal sea, and any effectson the growth and survival of anadromous fish
3. Assess how changes in temperature will influence metabolic demands in fish, and how those changes will affect species distribution
4. Effects of changes in water temperature on spawning behavior and physiology (increasing water temperature may cause a mismatch between egg development and spawn timing leading to reduced egg viability)
5. Conduct habitat assessments and develop habitat criteria models.
6. Identify potential impacts or changes to tribal/First Nations subsistence activities linked with hydrological regime changes. E.g., Adoption or reduction of particular harvest strategies, methods, equipment, or times.
   6.1. Effects on target species (e.g., salmon) and/or related safety issues (e.g., fishing under more extreme/adverse conditions).

Potential actions addressing analysis, integration, and synthesis

7. Improve cross-boundary data availability, integration and synthesis
8. Collate existing data on monitoring networks
9. Identify focal indicators to track climate change and assess management options
10. Identify areas of "thermal refugia"; identify areas of "thermal blockage" along migration routes (under future climate conditions).).
    10.1. Consider effects of wildfire smoke/inversions on buffering solar radiation/heating of river/water quality.
11. Identify areas where increased environmental contamination or contaminant mobilization may be a concern
    11.1. From glacial melt
    11.2. From increased sedimentation after forest fires
12. Identifying potential areas for restoration, given species-specific considerations and considering the effects of future climate on the effectiveness of restoration
13. Study climate change effects on the Pacific salmon lifecycle and on other tribal subsistence species (sturgeon, lamprey) and map current and projected salmon habitats to assess habitat viability and

inform management decisions (vulnerability assessments). Consider all climate related changes (e.g., climate induced drought)

14. Synthesize lessons learned, methodologies, etc. across watersheds that have been addressed to draw conclusions about applicability to other watersheds in the NPLCC (tide-water glacier valleys versus valley glaciers versus dams & water diversions, salmon runs present, etc.)
15. Inventory and evaluate existing adaptation options

Potential actions addressing coordination, sharing, and capacity building

16. Conduct workshops specific to one or more detailed sub-topics
    - 16.1. Convene managers, scientists, and tribes to discuss specific topics relative to this Priority Topic to identify management decisions and actions, needs and gaps.
    - 16.2. Scientists communicating their results/information to stakeholders: e.g., Restoration strategies to mitigate climate effects (flow/temp) on species (e.g., salmonids)
17. Coordinate and share data collection activities, research results, tools, and management lessons for cross-border datasets
18. Systematically compile and integrate data for water quality, especially temperature, and make it available to decision-makers
19. Identify potential impacts or changes to tribal/First Nations subsistence activities linked with hydrological regime changes which affect anadromous fish and or related safety issues (e.g., fishing under more extreme/adverse conditions).
20. Assess stream gauge information being collected to determine what data is being collected, where, and if it is coordinated with anadromous fish information. Assess if similar systems are in place in both B.C. and the U.S. and what coordination efforts are in place.
21. Put restoration efforts and climate-induced changes in hydrology into an NPLCC-wide context that considers effects on salmon species across their range rather than on a watershed-by-watershed basis.

Potential actions addressing ability to use information directly for decision support (including developing decision support tools)

22. Conduct vulnerability assessments for hatchery and wild fish (current efforts underway for hatcheries). Consider vulnerability of different fish populations and the linkages of hydrology, water quality, fish health, and fish population viability
    - 22.1. E.g., If particular thresholds are met more often. For example, warmer river temperatures during salmon migration increase disease and predispose fish to stress and other parasites. Vulnerability of different fish populations-linkages of hydrology, water quality, fish health, and fish population viability.
23. Conduct scenario planning workshops to assist with planning for one or more subtopics
24. Provide “actionable-level” information and tangible examples of progress or success with climate change adaptation (ex. case studies)
    - 24.1. A focus might be on management actions to protect cold-water refugia

25. Provide guidance documents with best management practices or how to incorporate climate change into existing practice. Include lessons learned from tribal subsistence activities that may increase harvesting efficiency, and/or also prevent overharvesting of vulnerable stocks or runs of fish?
26. Develop tools to identify high priority targets for conservation
    26.1. Identify locations of potential cold-water refugia
27. Identify tools that can be provided to managers (e.g., scenario planning, data sources, management menus, improving resilience/ adaptation) to address management decisions generically in the absence of good site-specific data. Potential topics include the following:
    27.1. Evaluating the effectiveness of management actions at reducing sedimentation
    27.2. Evaluating the effectiveness of management options for reducing non-point-source contamination under future climate conditions
    27.3. Evaluating the effectiveness of flow management options on anadromous fish, including habitat quality and quantity, and linkages to life histories of species (at which stage are they most vulnerable, e.g. coho juveniles-summer, fall Chinook-fall).
    27.4. Effects of changes in flow and in flow management on migration, habitat, species health (e.g., diseases and parasites likely to increase with changes in water quality/quantity).
    27.5. Riparian corridor management options and effects on water temperature

Priority Topic E: Invasive species, pests, diseases and their effects on biological communities

<u>Potential actions to address new science, TEK, information, data or modeling</u>

1. Model climate effects on invasive species, pathogens (e.g, Such a Phytophthora. SOD and Port Orford Cedar root rot), and diseases: their introduction, establishment, spread, and effects
2. Model climate-related changes in disease ecology (reservoirs, vectors, pathways, epidemiology of infectious diseases)
3. Evaluate the interactive effects of changes in invasives, pests, and diseases with other large-scale stressors Effects of multiple stressors (e.g, environmental contaminants, realignment of community organzations etcs) on organismal and population health and condition
4. Study the genetics of species hybridization
5. Assist regional partners in ensuring an adequate monitoring plan for invasive species is designed
6. Model and monitor adaptive management outcome.
7. Identify the corridors invasive species, pests, pathogens, and diseases are likely to use in response to changes in climate

<u>Potential actions addressing analysis, integration, and synthesis</u>

8. Improve cross-boundary data availability, integration and synthesis
9. Collate existing data on monitoring networks
    9.1. Provide a single location / database for sharing and accessing information on invasives, pests, pathogens, and diseases
10. Identify focal indicators (or thresholds) to track climate change and assess management options

11. Synthesize existing data on invasive species and infectious diseases
12. Assess habitat and resource vulnerability to changing patterns of invasion and disease

Potential actions addressing coordination, sharing, and capacity building

13. Conduct workshops specific to one or more detailed sub-topics
    13.1. Convene managers, scientists, and tribes to discuss specific topics relative to this Priority Topic to identify management decisions and actions, needs and gaps.
    13.2. Scientists communicating their results/information to stakeholders
14. Coordinate and share data collection activities, research results, tools, and management lessons for cross-border datasets
15. Develop research partnerships to study fish and bird disease
16. Assist regional partners with outreach and delivery of data on invasives, pests, and disease

Potential actions addressing ability to use information directly for decision support (including developing decision support tools)

17. Conduct vulnerability assessments for ecological resources associated with this Priority Topic
18. Conduct scenario planning workshops to assist with planning for one or more subtopics
19. Provide "actionable-level" information and tangible examples of progress or success with climate change adaptation (ex. case studies)
    19.1. What treatments have land managers been implementing and how effective have these been. How effective will these treatment be in the near future given predicted climate change?
20. Provide guidance documents with best management practices or how to incorporate climate change into existing practice
    20.1. Consider y applicable tribal practices or approaches
21. Develop tools to identify high priority targets for conservation

Potential actions not tied to specific Priority Topics

1. Coordinate science activities between various entities to ensure that river, riparian and other coastal systems are linked in experimental designs
2. Develop a data portal or "climate clearinghouse" with a brief description of people, their projects, and how to contact them
3. Provide trainings to decision-makers and demonstrations of available tools