

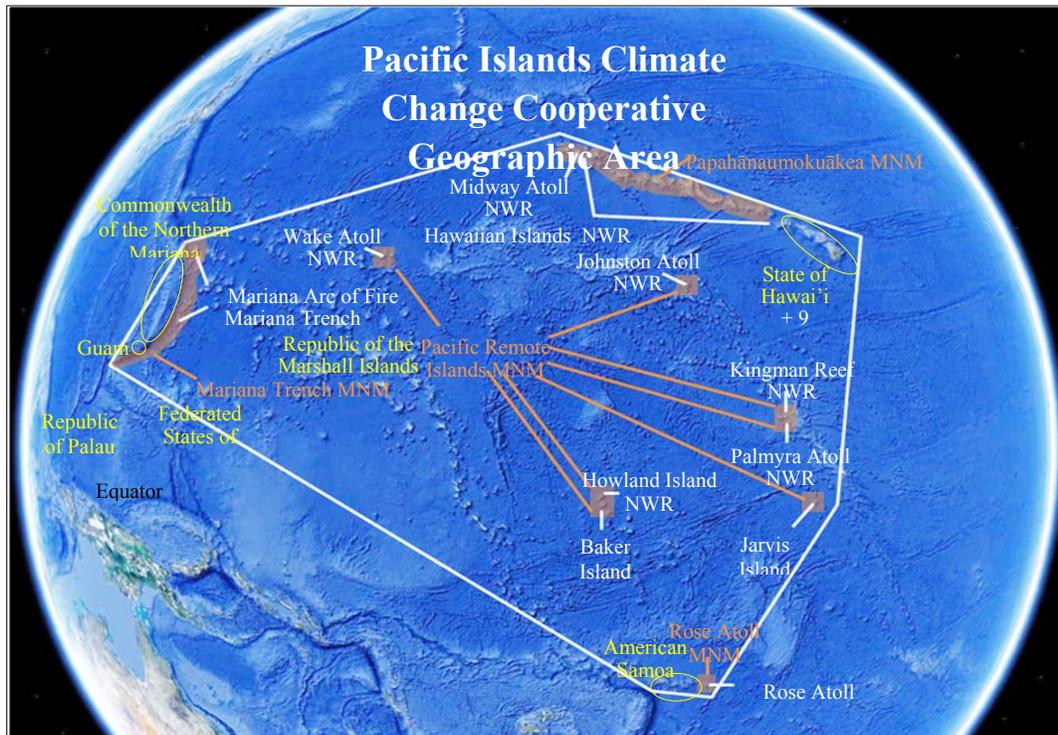
The Pacific Islands Climate Change Cooperative (LCC) Development and Operations Plan

Background

The Pacific Islands Climate Change Cooperative (PICCC) was formally established on September 10, 2009 when the Hawai'i Conservation Alliance (HCA) agreed to host this Landscape Conservation Cooperative. HCA is a cooperative partnership of 15 government, education, and non-profit organizations strongly committed to long-term environmental conservation in Hawaiian Islands through land management, collaborative research, training, and outreach. HCA members and other partners serve as the steering committee for PICCC.

On October 1, 2009 the Pacific Islands Fish and Wildlife Office assigned a full-time interim coordinator to oversee the establishment of the PICCC. The first meeting of the PICCC steering committee was held on October 14, 2009. The FWS has committed to fund several core positions, and together with partners will strategize to determine the best way to collectively address the organizational and staffing needs of the PICCC.

The boundaries of the PICCC and key components are presented below:



This LCC shares no boundary with any other LCC; instead its boundaries are defined by the major inhabited island groups under U.S. jurisdiction within the Pacific Basin (Hawai'i, the Mariana Islands, and American Samoa). Within this geographic area are unique islands and marine landscapes of global biodiversity importance, as well as sovereign island nations. The Hawaiian Islands form a subunit that will receive initial emphasis in FY 2010, with the Mariana and Samoan subunits, and the numerous remote islands, being fully addressed in FY 2011 and later.

The geography, and political and biological complexity of this area, will shape the PICCC's structure and tasks:

- 2,300 islands, over 6,500 miles of coastline, and over 90% (13,254 square miles) of U.S. coral reefs.
- Thousands of endemic species and unique ecosystems of global significance (e.g., 9 of the earth's 14 biomes are found within the island of Hawai'i).
- 410 listed species, 114 candidate species, 21 National Wildlife Refuges, 4 Marine National Monuments, 8 National Park units, and 1 National Marine Sanctuary.
- The State of Hawai'i, three U.S. jurisdictions (American Samoa, Guam, Commonwealth of the Northern Mariana Islands), three independent affiliated nations (Republic of the Marshall Islands, Federated States of Micronesia, Republic of Palau), the independent Republic of Kiribati, and several unincorporated U.S. islands.

Climate change is already showing its effects in the Pacific Islands. Climate change is not an abstract concept in our island communities. It has arrived. Long term temperature is rising; at higher elevations the rate is much higher than the global average rate. These higher elevation areas support the best remaining native ecosystems in the Pacific Islands. Precipitation is decreasing; these decreases are expected to greatly affect drier leeward areas that support the greatest amount of native biodiversity. Sea surface temperatures are steadily rising and have caused episodes of coral bleaching. While sea level has risen minimally in Hawai'i, this is not true elsewhere; some islands in Micronesia may soon be abandoned. The low elevation (less than 40 feet above sea level) of most of the Pacific Islands make them highly vulnerable to rising sea levels and storm damage.

The many unique features of the PICCC present enormous opportunities as well as daunting challenges. Organizationally, the existing HCA brings a history of diverse partners working on common conservation challenges, albeit largely focused on the Hawaiian Islands. By providing useful new conservation tools to the Marianas, Samoa and other islands, the PICCC can strengthen conservation and climate change adaptation throughout the region.

The very limited capacity for non-federal conservation planning, delivery and monitoring, due to small island economies, is also unique to the PICCC. Alignment of Federal conservation funding through adoption of Strategic Habitat Conservation via the PICCC will greatly increase the effectiveness of conservation planning and delivery across the landscape, but continued and even expanded Federal support for conservation is needed to achieve significant gains.

The PICCC is isolated from other LCCs, and due to its endemic species and unique and fine-scale habitats, it cannot use the downscaled climate models, population or bio-climate models, or monitoring data or infrastructure from any other LCC. Science support for modeling and monitoring will be crucial to the success of the PICCC.

The ocean dominates the PICCC geographic area, and as such NOAA is a uniquely important partner with substantial science resources and connections across the region. However, projected changes to oceanic ecosystems such as coral reefs may greatly affect biodiversity and human populations, and modeling, conservation delivery, and monitoring are more difficult in the marine environment.

The island biotas within the PICCC area are uniquely susceptible to the effects of invasive species, which is largely responsible for the extinction crisis in Hawai'i. Synergies between invasive species and climate change will determine the fate of many island species in the coming decades, posing a key challenge to the ecological modeling that the PICCC must perform.

In parallel with the species assemblages unique to each archipelago within the PICCC area, the indigenous peoples of the islands are diverse, with rich and unique traditions and relationships with nature that are distinct from continental societies. Engaging conservation practitioners from all these traditions will be a challenge best met by incorporating cultural viewpoints early in the planning process.

Partnerships

The steering committee for PICCC is composed of the 15 member organizations of the HCA and other partners, forming a cooperative partnership of federal, state, private, Hawaiian, and nongovernmental conservation organizations and academic institutions. Other members may be added as the PICCC continues to develop and interest grows. Table 1 shows the steering committee members and their currently anticipated contributions to the PICCC, and the following narrative highlights aspects of those contributions.

HCA members on the steering committee (one member each unless otherwise noted):

U.S. Fish and Wildlife Service: Two members, one each from the Pacific Islands Fish and Wildlife Office and the Hawaiian and Pacific Islands National Wildlife Refuge Complex. Anticipate contributing 5 to 7 FTE core PICCC staff, plus research funds.

U.S. Geological Survey: Three members, one each from the Pacific Island Ecosystems Research Center, the Pacific Islands Water Science Center, and the Pacific Basin Information Node. Anticipate contributing 0.5 FTE PICCC hydrologist, and management of 1 FTE GIS/data manager. Ongoing research will project future ranges of entire Hawaiian native flora, and assess risks to seabirds in Northwest Hawaiian Islands. Existing expertise in terrestrial bioclimate modeling, population viability analysis, and monitoring methodology may be bolstered by landscape and species modeling expertise and additional funding if a Regional Climate Change Response Center is established in Hawai'i.

Table 1. Pacific Islands Climate Change Cooperative Steering Committee members and contributions, as of December 2009.

PICCC Member	PICCC Staffing	PICCC Support	PICCC Expertise	Oversees high value conservation land/water	Strategic Habitat Conservation Support			
					Biological Planning	Conservation Design and/or Delivery	Monitoring	Research
U.S. Department of the Interior (DOI)								
FWS Ecological Services	4-5 positions	staff; research	science and management		X	X		
FWS Refuges	1-2 positions	staff	science and management	X	X	X	X	
USGS BRD			science and management		X	X		X
USGS Water Resources	¼ - ½ position	staff	science and management		X	X	X	X
USGS NBII-PBIN			data management		X			
National Park Service	2 positions	staff; research	science, cultural and management	X	X	X	X	
U.S. Department of Agriculture (USDA)								
NRCS			management		X	X		
U.S. Forest Service			science and management		X	X	X	X
National Oceanic and Atmospheric Administration (NOAA)								
NMFS			science and management		X	X	X	X
National Marine Sanctuaries Program	anticipate 1 position	staff	science and management	X	X	X	X	X
U.S. Army Garrison, HI								
University of Hawai'i, Manoa CCRT Program	anticipate ¼ admin position	staff	science and conservation training		X	X		X
HI State Division of Forestry and Wildlife (DOFAW)								
HI State Division of Aquatic Resources (DAR)			science and management	X	X	X	X	
HI State Office of Hawaiian Affairs (OHA)								
The Nature Conservancy of Hawai'i (TNCH)			science and management	X	X	X	X	
Kamehameha Schools (KS)								
			cultural and management	X	X	X		

National Park Service

Will contribute 2 FTE PICCC staff focusing on cultural resource management and social science. Access to competitive grants on social/cultural impacts. NPS-managed uplands will be crucial habitats as islands warm. Inventory and monitoring program will contribute key data and protocols.

U.S. Department of Agriculture: Two members, one each from the Natural Resources Conservation Service and the Forest Service's Institute of Pacific Islands Forestry.

Has unique expertise and ongoing research in agricultural conservation, tropical forest ecology, carbon sequestration, and invasive species.

National Oceanic and Atmospheric Administration: Two members, one each from the National Marine Fisheries Service and the National Marine Sanctuaries.

Anticipate providing funding for PICCC staffing and research. Co-managers of Marine National Monuments with FWS and State of Hawai'i. NOAA's proposed emphasis on marine zoning and ecosystem management will complement PICCC terrestrial planning efforts.

U.S. Army Garrison Hawai'i, Natural Resource Program

Manages and monitors unique montane ecosystems in Hawai'i with focus on restoration and invasive species control.

University of Hawai'i at Mānoa, Center for Conservation Research and Training

The umbrella institution for HCA and PICCC, providing administrative services. Links to university programs in population biology, marine and terrestrial ecology, and invasive species. Ongoing National Science Foundation grant projects will contribute cyber-infrastructure, monitoring networks and modeling of hydrological changes in Hawai'i.

State of Hawai'i Division of Forestry and Wildlife (DOFAW)

By virtue of their forest reserve system and other lands, DOFAW is central to adaptive management of forest ecosystems and endangered species in Hawai'i. Forestry program links to forest management in other Pacific Island nations. Can adapt State Wildlife Action Plans to incorporate PICCC products and processes.

State of Hawai'i Division of Aquatic Resources (DAR)

DAR will be central to freshwater and near-shore adaptive management. Has an active response network to monitor coral bleaching, and ongoing program to manage invasive algae. Co-manages Marine National Monument with FWS, NOAA. Will be key partner with FWS on high-priority project to develop stream flow assessment and aquatic species response tools in Hawai'i, if funded.

State of Hawai'i Office of Hawaiian Affairs (OHA)

With a mandate to perpetuate resources for the benefit of Native Hawaiians, OHA plays a major role in cultural resource management but also manages native forest lands and trains local managers. Will be important in promoting cultural viewpoints in planning and conservation delivery in the context of native Hawaiian traditions and communities.

The Nature Conservancy of Hawai'i (TNC)

With lands of high conservation value that adjoin public lands, and a commitment to adapt to climate change, TNC will contribute planning expertise and help coordinate conservation delivery across landscapes in Hawai'i. TNC has a long-term conservation presence in Micronesia and Melanesia and will assist in dissemination of PICCC products across the region.

Kamehameha Schools (KS)

A key member of watershed partnerships across Hawai'i, KS has a mission to perpetuate educational and natural resource values on its lands for the benefit of Hawaiian youth. Will play a key role in cultural orientation of PICCC products and outreach, and in application of science-based conservation in the context of native Hawaiian traditions and communities.

Additional key Steering Committee members:

U.S. Office of Insular Affairs (OIA - tentative member at this point)

OIA funds marine management and assessment programs in U.S.-flag Pacific Islands, and has offered to assist in convening and funding regional workshops to assist in PICCC planning and outreach.

U.S. Army Corps of Engineers

With expertise in coastal and riparian infrastructure and planning, the Corps will assist in incorporation of sea level rise and hydrologic projections into management recommendations. LiDAR mapping capability may be used to generate coastal impact projections.

NOAA Pacific Services Center

The Pacific Services Center has an ongoing training program for marine managers across the Pacific, and expertise in communicating climate change information.

Hawai'i Wetland Joint Venture (HWJV)

An ongoing partnership focused on wetland bird conservation, the HWJV can promote climate-informed conservation delivery among a wide array of existing programs, and assist PICCC in integration with Joint Venture activities nationally and regionally.

Pacific Science Association

Published preliminary climate change impact assessment for ecosystems in Melanesia in 2009 based on a MacArthur Foundation grant; can assist PICCC in vulnerability analyses and outreach to ecosystem planning efforts and partners in the western Pacific.

Priority Species and Habitats

The PICCC shares very few species in common with other LCCs, and therefore most of its priority species and habitats are likely to be unique to the Pacific Islands and not shared with other LCCs. Some potential priority species include international migration routes adding to conservation complexities. The PICCC's Steering Committee has not yet engaged in a formal

priority-setting process, but will begin this process early in 2010. Criteria for designating priority species have not been selected, but will likely include vulnerability to climate change, ease of monitoring, and importance in maintaining or disrupting ecosystem function. As the PICCC geographic area has 410 listed species and 114 candidate species, many with very small ranges, rarity and vulnerability alone will not suffice to determine priority.

Critical but unlisted native species that provide essential terrestrial or marine ecosystem structure may be prioritized, such as the dominant forest trees ‘ohi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*), and major species of reef-building corals (e.g. *Porites lobata*). In addition, there are numerous terrestrial and marine invasive species that, when established, extensively modify native ecosystems, sometimes beyond restoration or recovery. These include trees such as *Miconia calvescens* and strawberry guava (*Psidium cattleianum*); fire-prone grasses such as fountain grass (*Pennisetum setaceum*); predatory invasive insects such as the little fire ant (*Wasmannia auropunctata*) and yellowjackets (*Vespula* spp.); and mat-forming algae such as *Gracilaria salicornia* and *Kappaphycus alvarezii* that smother native corals.

The priority species selected will be different for each of the main island groups (Hawai‘i, Mariana Islands, and American Samoa) and may be different from island to island within an island group. The State of Hawai‘i has an approved Comprehensive Wildlife Conservation Plan in place that can help guide the PICCC. Selecting priority species will be a critical process to be undertaken by the PICCC steering committee and will involve structured decision-making. Initially, the PICCC will likely focus on changes to ecosystems, key habitat components, and selected high profile species.

The PICCC will also face a challenge in selecting priority habitats, which again are largely distinct from habitat types in North America. Native biodiversity on high islands is often concentrated at upper elevations where climate is changing rapidly and habitat extents are small, near sea level with limited opportunity to expand upward with sea level rise, or in shallow coastal waters. All of these are vulnerable to one or more elements of global change.

As stated above, there are 21 National Wildlife Refuges, 4 large Marine National Monuments, 8 National Park units, and 1 National Marine Sanctuary within the PICCC geographic area. A limited set of priority habitats will be unlikely to inform management in all of these diverse landscape units, but if selected with care, the priority habitats will capture most of the range of ecosystem responses to climate change and other stressors. Criteria that will be important in selecting priority habitats will likely include endemism, intactness, monitoring history, vulnerability to climatic changes, management potential, and geographic range. As with the selection of priority species, determining priority habitats will require structured decision-making by the PICCC steering committee.

Conservation Delivery

Scientific information developed by the PICCC will be used by the partner agencies to address climate change and other stressors as they implement conservation actions. The conservation delivery mechanisms that will be used are mostly traditional and established (e.g., land management, invasive species control, land acquisition, recovery planning), but also include

linkages to new programs such as the State of Hawai‘i Climate Change Task Force, the University of Hawai‘i Law School’s Center for Island Climate Adaptation and Policy (ICAP), the NOAA-funded Regional Integrated Sciences and Assessments (RISA) program, and NOAA’s new Coastal and Marine Spatial Planning (CMSP) effort. All of these groups are interested in the activities and products of the PICCC, and may provide novel ways of promoting and delivering climate-driven conservation actions. In particular, the CMSP initiative mandates that NOAA practice ecosystem management informed by climate change science, suggesting that PICCC may help create a seamless peak-to-pelagic conservation management framework.

It is expected that PICCC member organizations with large conservation land holdings, such as the State Division of Forestry and Wildlife, TNC, U.S. Army, and Kamehameha Schools, will join closely with FWS in executing PICCC-planned conservation actions at landscape scales and tracking the results in an adaptive fashion.

The Pacific Islands National Wildlife Refuges and the Pacific Islands Ecological Services anticipate using climate change information provided by the PICCC as foundational products from which to do more detailed site-specific and species-specific analyses critical to the preparation of planning documents (*e.g.*, listing packages, recovery plans, CCPs) and to define on-the-ground conservation actions in HCPs, section 7 consultations, recovery project grants, land acquisition, and establishing cooperative agreements. Examples include high-priority plans such as the Kaua‘i Ecosystem Recovery Plan and the Pacific Region Seabird Conservation Plan, which need to incorporate updated projections of sea level and ecological change. Although the information developed by PICCC will be focused on priority species and habitats and may not be specifically targeting the Service’s climate science needs, it is hoped that it will provide much of the basic scientific information needed to design and deliver climate-informed conservation actions.

PICCC products will likely include:

- Projections of precipitation and net water availability at the scale of island watersheds (10 km or less)
- Projections of temperature change, including different rates of change with elevation
- Regional projections of sea level rise and variability
- Potential ranges of native and invasive species under geographically scaled temperature and precipitation projections;
 - A preliminary product, the potential ranges of the entire native Hawaiian flora (approximately 1000 taxa) at 2100 under the A1B scenario, will be available in 2010.
- Vulnerability assessments for rare species, communities and species that structure habitats;
- Web-based GIS decision support tools for managers and the public;
- Predictions of future community composition within protected areas under different scenarios;
- Identification of potential corridors linking present and future habitat;
- Recommended acquisition priorities based on future climate and sea level projections.

To help promote the application of climate change information to conservation management, the PICCC will support outreach activities by its staff and by the staff of steering committee members. These outreach activities will involve working directly with conservation managers in helping them apply climate-change information to ongoing and future management actions. These same staff may also assist the Climate Change Task Force, RISA, and ICAP in applying climate change information to their particular activities, which may include infrastructure development and policy formulation.

Science Capacity

A substantial science capacity gap exists in the Pacific Islands due to the relative lack of climatic and ecological modeling expertise in Hawai‘i, compared to other LCC regions which have multiple large universities and research centers. As noted above, climatic and ecological projections for North American ecosystems are of little or no utility to the PICCC, so relevant base science must be initiated and funded locally. Placement of a USGS Regional Climate Change Response Center in Hawai‘i would greatly increase the modeling and analytical capacity for climate change adaptation planning throughout the Pacific Islands.

The science capacity for the PICCC is being supported by multiple organizations:

1. FWS funds:
 - a. Region 1 Science Applications funding may support:
 - 1) PICCC coordinator, Science/technical manager, Species modeler, Landscape conservation planner, GIS/data management specialist (managed by USGS), Administrative support person
 - b. Region 1 Refuges funding:
 - 1) A position may be funded.
 - c. Region 1 Ecological Services funding:
 - 1) Interim PICCC coordinator (assigned 10/1/09 using PIFWO funds. Will transition to LCC funds in the near future).
 - 2) PIFWO Science Advisor – interim full time helping the PICCC until 1/1/10.
 - 3) An additional position may be funded.
2. Committed NPS funded positions for the PICCC
 - a. Cultural resources specialist
 - b. Cultural resources/social scientist (term)
3. Committed USGS funded position for the PICCC:
 - a. Hydrologist – ¼ to ½ time scientist
4. Committed Hawai‘i Conservation Alliance position for the PICCC:
 - a. Traditional Ecological Knowledge social scientist (post-doctoral fellow)
5. Potential USGS funded positions for a local Climate Change Response Center (not committed, but important to the functioning and success of the PICCC)
 - a. Ecosystem modeler
 - b. Species modeler – additional to the FWS LCC funded position
 - c. USGS Science Support Funding for additional science positions (e.g. GIS data manager or landscape modeler).
6. Other positions for the PICCC:
 - a. Fire modeler (potentially USGS, NPS, DOD, or USFS)

- b. Coastal geomorphologist (potentially USGS or University of Hawai‘i)
- c. Marine ecologist (potentially NOAA, State of Hawai‘i, or USGS)
- d. Avian ecologist (potentially NOAA or State of Hawai‘i)
- e. Outreach specialist (potentially NPS, FWS or NOAA)
- f. Monitoring and evaluation team (potentially all partners)

Science needs for FY2010

Determining the priority science needs for this fiscal year will be an early task of the PICCC Steering Committee. Meeting the major science needs would substantially exceed the total science budget proposed for the LCC. Following prioritization for FY2010 funding, remaining projects may be submitted for consideration for held-back science support funding. Potential projects that could be initiated in whole or in part include the following:

- Downscaled climate models for Hawai‘i, the Mariana Islands, and American Samoa will be the basis for all terrestrial ecological projections and derived PICCC products. While an initial statistical downscaling effort has been completed for Hawai‘i for one time point (2100) and one scenario (A1B), second-generation modeling is required to address mid-century projections, multiple emission scenarios, and a finer geographic scale. Additional model modifications may be needed to generate a range of ecologically-relevant climate attributes (e.g. extreme event probabilities and return frequencies). A first-generation dynamical downscaling product for Hawai‘i has yet to be completed due to computer time costs.

The Mariana and Samoan archipelagos are climatically distinct from Hawai‘i and each other, and lack even initial regional downscaled models, although some modeling efforts may be underway for the independent nation of Samoa by Australian or New Zealand meteorological authorities. The remaining islands and marine areas within the PICCC geographic area are within the regional climatic regimes of these three archipelagos. However, special attention may be needed for islands and marine areas that fall within the Intertropical Convergence Zone, or other areas with unique climatic features, such as strong El Niño effects.

- Vulnerability assessments for a preliminary list of priority habitats and species identified by the steering committee, which will generate ranking factors needed for final prioritization.
- Analyses of historical records of past climate in Hawai‘i, the Mariana Islands, and American Samoa. This will provide a baseline for evaluating the frequency, intensity and direction of climate change in terrestrial and marine habitats. Information will include temperature, rainfall, trade wind intensity and direction, severe weather and drought, sea surface temperature, ocean pH, etc.
- Bio-climate models (e.g. climate-envelope and other approaches) that build off of the downscaled climate modeling information and historic climate information described above. The targets for the bio-climate models will be those species and habitats prioritized by the steering committee.
- Development of high-resolution digital elevation models (DEMs) to guide and inform management of coastal natural resources that will be impacted by sea level rise. It will be necessary to invest in extensive topographic and near shore bathymetric (15 to 20 meters depth) LiDAR data collection to support the creation of these DEMs. This will comprise the

database for modeling wave and current impacts to coastal areas, including the impacts of rare storm events that may be of critical ecological significance on low atoll islands.

- Integration and maintenance of biodiversity databases critical to creating and testing bio-climate effects models. Existing data on forest birds, water birds, sea birds, endangered plants, and invasive species, need to be integrated, sustainably managed, and made available to modelers and climate researchers.
- Tracking of marine ecosystem changes in the North Pacific using seabirds as low-cost sampling devices. Seabirds are both potential vulnerable priority species and efficient samplers of prey across enormous areas, and can now be tracked via satellite. Establishing baseline data for multiple species could involve 2 adjacent LCCs on the Pacific coast of North America and help integrate terrestrial and oceanic bio-climate modeling efforts.

Anticipated Successes

In FY2010, the PICCC anticipates the following:

- Complete the establishment process for the PICCC –
 - a subcommittee is scheduled to draft a Charter that is due to the committee in mid-December 2009;
 - PICCC is currently exploring several office space lease options to house the PICCC staff and will have this completed by early 2010;
 - a formal process for decision making will be agreed upon and implemented;
 - steering committee will establish expectations for steering committee participation.
- The steering committee will prioritize a draft list of science acquisition projects for the Pacific Islands geographic area by early 2010.
- A preliminary assessment of range shifts and associated climate-change impacts on the native Hawaiian flora.
- Climate modeling and downscaling will be underway for one to three (depending on funding) of the major climatic regimes in the PICCC geographic area.
- An assessment of the climate adaptation projects and opportunities of Pacific Island nations within and adjoining the PICCC geographic area will be compiled.

Funding Needs

The following budget outlines the FY 2010 funding needs for the PICCC. PICCC is expecting some support for these funding needs from several agencies and organizations that will be part of the Cooperative. Science needs in excess of the proposed allocation may be submitted for additional funding consideration.

Budget category	Salaries	Operating	Science
PICCC Coordinator and Science/technical manager	290,000		
Science staff - Landscape Modeler - Population Modeler - GIS/Data Manager - Monitoring Planner	450,000		
Administrative staff	58,000		
Operational support		210,000	
Travel		90,000	
Prioritized science acquisition			500,000
Data acquisition			300,000
Total Funding Need	\$798,000	\$300,000	\$800,000