

FINAL REPORT FOR PROJECT "LEARNING FROM LOCAL ECOLOGICAL KNOWLEDGE TO UNDERSTAND CLIMATE CHANGE IMPACTS AND PRESERVE KEY CULTURAL AND NATURAL RESOURCES IN KA'ŪPŪLEHU, HAWAI'I

1. ADMINISTRATIVE

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Project Title: Learning from Local Ecological Knowledge to Understand Climate Change Impacts and Preserve Key Cultural and Natural Resources in Ka'ūpūlehu, Hawai'i

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2. PUBLIC SUMMARY

Climate change is a global process, but its effects on local communities are site-specific. Place-based observations are critically needed to complement global climate change models to help identify: how climate is changing locally, the ecological and social impacts of climate change, and the ways people are adapting. We carried out an in-depth study of local ecological knowledge (LEK) in Ka'ūpūlehu, Hawai'i Island -a region subject to unpredictable climatic events and that has withstood major social, cultural and ecological changes over time. We identified LEK-relevant to climate and environmental change; the observed and predicted effects of climate change on the biological and cultural resources most valued by community members; and adaptation strategies and resources that promote resiliency to climate change. Our methods centered on an interdisciplinary, community-based process that integrated data from workshops, interviews, focus groups, historical literature, and ecological monitoring. We collaboratively developed series of products including a timeline of adaptation, a seasonal calendar, maps of the predicted effects of climate change on key resources in Ka'ūpūlehu, and an online database that tracks observations of weather and phenology of plants and animals on the land and in the ocean. Collectively these products reveal lessons about how people have adapted and continue to adapt to change, establish reference points for evaluating future observations of change, strengthen relationships to place and local knowledge transmission, and support adaptive management strategies. Our project illustrates how LEK has historically played an important role in strategies

recognized to promote resilience, and how some of these strategies continue to be important even as social and ecological conditions have changed. Adaptation planning should support the capacity to develop and transmit knowledge and practices over time. The co-produced products are used by the Ka‘ūpūlehu community to as educational tools to promote learning about community resilience and adaptation.

3. PROJECT REPORT

A. TECHNICAL SUMMARY

Climate change is a worldwide phenomenon, but it has site-specific ecological and social repercussions. Place-based observations are critically needed to complement global climate change models to explain in more detail how climate is changing locally, to identify both the ecological and social impacts of climate change, and the ways people are adapting. Linking local and global perspectives expands the range of knowledge and the available tools for understanding and adapting to environmental change. Local and Traditional Ecological Knowledge (hereafter LEK) is “a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationships of living beings (including humans) with one another and with their environments”. We carried out an in-depth study of LEK in Ka‘ūpūlehu, Hawai‘i Island -a region subject to unpredictable climatic events and that has withstood major social-ecological changes. We identified LEK-relevant to climate and environmental change; the observed and predicted effects of climate change on the biological and cultural resources most valued by community members; and coping mechanisms, adaptation strategies and resources that promote social-ecological resiliency to climate change. Through an interdisciplinary, community-based process that involved six community workshops, interviews and focus groups, revision of the historical literature and of locally collected ecological data, we collaboratively developed series of products available on our website (<http://hbmpweb.pbrc.hawaii.edu/kaupulehu/>). These include a timeline of adaptation, a seasonal calendar, maps of the predicted effects of climate change on key resources Ka‘ūpūlehu, and an online database that tracks observations of weather, and phenology of plants and animals on the land and in the ocean (www.nakiloaina.com). Collectively these products reveal lessons about how people have adapted and continue to adapt to change, establish reference points for evaluating future observations of change, strengthen relationships to place and knowledge transmission, and support adaptive management strategies. Our results demonstrate how LEK has historically played an important role in strategies recognized to promote resilience, and some of those strategies continue to be important even as the context has changed. LEK and place-based observations provided detail not yet recorded by scientists; and in other cases corroborated scientific assessments. Maintaining the capacity to transmit and generate LEK is critical to resilience; therefore, adaptation planning should support the capacity to develop and transmit knowledge and practices over time. The co-produced products are used by the Ka‘ūpūlehu community as educational tools to promote learning about community resilience and adaptation.

B. PURPOSE AND OBJECTIVES

Below we list the original objectives and how they were met or changed.

1) Review and interpret important ‘ōlelo no ‘eau and mo‘olelo from or about Ka‘ūpūlehu or Kekaha with an eye and ear toward better understanding and documenting environmental conditions in the past and how people have adapted to change. Together we will explore past lessons of adaptation and resilience embodied in these oral (now also written) traditions and consider if and how they can inform how we address environmental change today.

We met this objective in a way we hadn't anticipated but that was better than we had originally proposed: through the collaborative development of a community timeline of adaptation. This idea came from community members and allowed us to explore this issue in a more meaningful way and to create a lasting product that is used by the community for educational purposes. This was also met through interviews, focus group discussions and community workshops.

2) Explore and document local observations of changes in weather (i.e., precipitation, storm frequency/ intensity, volcanic activity, sea level rise, and sea-surface temperature increases).

We met this objective through the interviews and focus groups we carried out as well as using a new method that we hadn't anticipated but that was proposed by the community: through the process of creating a seasonal calendar.

3) Explore and document local observations of changes of ecological processes such as changes in the timing of flowering or spawning, species associations, and distributions of species (native, non-native, invasive species).

We met this objective through the interviews and focus groups we carried out as well as using a new method that we hadn't anticipated but that was proposed by the community: through the process of creating a seasonal calendar.

4) Identify the biological and cultural resources most used and valued by the community members and the risks they may face under different climate change scenarios.

We met this objective by identifying the resources most valued by community members (from community meetings, interviews and focus group discussions); and then developing a series of maps that depict the predicted effects of climate changes on these resources. The maps were developed from existing data (including from PICCC projects) on the effects of climate change on marine and terrestrial resources and environments. In addition to these more technical maps, an iconic image of the ahupua‘a featuring important natural-cultural resources and how they are changing was created. The image and its explanation features representative trends that are depicted in the technical maps in a way that is accessible to a broad audience.

5) Identify the challenges that cultural practitioners and kama‘āina of Ka‘ūpūlehu are already facing and how these affect their culturally important resources and resource management systems.

As for objective #1, we met this objective and in a way we hadn't anticipated but that was better than we had originally proposed: through the collaborative development of a community timeline of adaptation. This was also met through interviews, focus group discussions and community workshops.

6) Identify any coping mechanisms and adaptation strategies in practice as well as resources (social, ecological, and/or institutional) that may promote resiliency and strengthen adaptive capacity.

Same as above

7) Based on Objective 4, develop a community-based monitoring process for on-going collection of data on one of more key, at-risk resources.

Upon starting this work we soon discovered that Ka‘ūpūlehu has a community-based monitoring process to record observations of weather, and phenology of plants and animals on the land and in the ocean. As a result of interest from community members, we therefore modified this objective to instead focus on developing an online database of those observations and tools to start to analyze trends over time and space (www.nakiloaina.com)

8) Use the above to develop recommendations for, and begin a dialog on, adaptation and management strategies for natural and cultural resources (both tangible and intangible).

We met this objective by co-creating the timeline of adaptation, the seasonal calendar, an ahupua‘a image that depicts effects of climate change on culturally important resources, and the na kilo aina database, all of which were and are used to initiate a dialogue on adaptation and management strategies. The creation of these products did not lead to new ideas on specific adaptation strategies, rather community discussion centered on how things are changing, the need to monitor resources to better observe these changes, and based on that, the need to come up with more specific adaptation strategies into the future.

It is important to note that most of the community is involved in some way or another in working to conserve their resources, whether it is dry forest, the reef or other cultural resources. Community priorities are to steward their natural & cultural resources in perpetuity, which includes having access to them over the long-term. They have developed and/or are already involved carrying out plans to limit development, control invasive species, replant native species, reduce overharvest of marine resources, monitor run-off, and teach children about their cultural history and ways to protect it etc. Therefore learning about the projected effects of climate change in Ka‘ūpūlehu and the

additional threats they pose to natural and cultural resources gave the community priorities more support and urgency - hence the interest in developing the co-created resources as tools to help inform the adaptation and management process in the future – but it did not change their priorities.

Based on the central role of local ecological knowledge and place-based values in allowing the Ka‘ūpūlehu community to adapt in the past, the one major recommendation for adaptation that we came up with is to support the process of knowledge maintenance and generation, and as a fundamental part of this, the connection to place (which includes allowing people the access needed to maintain connection to place). One of the most important resources the Ka‘ūpūlehu has, as perceived by them, is the kincentric relationship people have to their place.. It is specifically because of this relationship that the community is interested in observing and monitoring changes now, so that they can make decisions on how to manage resources sustainably into the future.

C. ORGANIZATION AND APPROACH

As described above, we met our objectives by conducting a series of community workshops (6 in total), focus group discussions, interviews, reviews of the historic data and reviews of some ecological data (of plants and of fish) collected locally. Workshops, focus groups, and interviews were all conducted in the region, and often in the context of the researchers participating in other related cultural-environmental education/outreach work led by community members. We asked our community collaborators how they would like to address the issue of community resilience to climate change and the role of LEK. They proposed creating a timeline of adaptation, a seasonal calendar, and creating an online database for community monitoring. Instead of presenting our findings in written documents and oral presentations only, we met our objectives and presented our findings through the co-creation of these products, which serve as educational products used by the Ka‘ūpūlehu community and others.

D. PROJECT RESULTS

Below we describe our results:

1. Ka‘ūpūlehu Portal : <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/>
 - Features project description and most of the products

2. Seasonal Calendar

This features community-identified important natural-cultural resources in images and in text. It documents current cycles in mauka and makai environments (including flora, fauna, weather, and people) as well as the links between them. It establishes a reference point for evaluating future observations of change, strengthens relationships to place and knowledge transmission locally in Kekaha and North Kona (i.e., as a teaching tool for local educators), and provides the basis for understanding and teaching about current

cycles, how they are changing and how people will need to adapt . It can also communicate place-based and traditional and local knowledge, observations, and values to resource managers and policy makers as a way to create awareness of the contributions these sources of knowledge can make toward climate change adaptation in Ka'ūpūlehu and beyond.

The final product is in multiple formats:

- Large format (35.35 inches), durable, dynamic (spinning parts) calendar piloted and created. This includes original graphic design collage featuring natural-cultural resources called out in the text of the calendar and timing of water, sun, and human cycles.
- There are two copies made, one housed and used at the Ka'ūpūlehu Interpretive Center; the second housed at by the Dryland Forest Cultural Ecology Outreach-Education program at Ho'ola Ka Makana'a.
- A third copy was recently requested for use by the non-profit education organization, Uluha'o that works in Ka'ūpūlehu]
- Digital version is available at:
<http://hbmpweb.pbrc.hawaii.edu/kaupulehu/seasonal%20calendar>

3. Nā Kilo 'Āina, knowledge-base and observation network (NKA)

In collaboration with Pelika Andrade and Nā Maka O Papahānaumokuākea, we built on and further developed an online, digital version of the phenology monitoring database that she has developed over the past four years of monthly monitoring in Ka'ūpūlehu, which includes observations of the sky, land, and sea tracking seasons and natural cycles. It is used to identify changes to cycles; correlations between cycles; facilitate the sharing of information across users and environments; and support adaptive management strategies by using natural indicators to guide activities. It establishes a protocol that supports a process for being an astute observer who is connected to place. It also establishes a platform that can be adapted for other locations, to serve as a model for Hawai'i Island and beyond.

The final product can be viewed at: www.nakiloaina.com. The platform is being used and tested by a range of people who work in and observe cycles in mauka and makai environments. Pelika Andrade purchased the domain name and hosting from GoDaddy, so it is under the non-profit organization Nā Maka O Papahānaumokuākea, but the data entered is property of the community. We organized for Nā Maka O Papahānaumokuākea to lead a workshop with 25 people in May 2015 which exposed the protocol to a broad range of people (researchers, educators, and cultural practitioners from neighbor islands) and it advanced their proficiency with the online NKA so they can both use it and also provide feedback to guide future iterations of NKA.

4. Timeline of Adaptation

Learning from experience is a critical part of the feedback loop of the adaptation cycle at the community level and for adaptation policy formulation. The timeline integrates

existing ethnographic, ethnohistoric, and natural history data with primary data from participants. Excerpts from interviews conducted for this project as well as from existing oral histories and traditional accounts from Hawaiian newspapers and legends are used to illustrate how people have responded to environmental variability and bring the timeline to life.

The final product is in multiple formats:

- <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/>
- Book / hard copy version is kept at the Interpretive Center
- A version tailored for keiki:
<http://hbmpweb.pbrc.hawaii.edu/kaupulehu/timeline/keiki>

5. Documentation of LEK of changing climate and its effects mauka and makai

Place-based and LEK-informed observations of change can identify environmental changes associated with climate change. They can also help ground-truth and refine regional climate models; and they may improve the utility of climate change predictions and the confidence in climate change analyses. We documented local observations of changes in: weather, processes such as changes in the timing of flowering or spawning, species associations, and distributions of species (native, non-native, invasive species). These are reported in text and video.

The final product is available at:

- <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/observations> and http://hbmpweb.pbrc.hawaii.edu/kaupulehu/sites/default/files/documents/Hypotheses%20and%20weather%20prediction_0.pdf

6. Maps of biocultural resources under climate change scenarios

These feature place names; projections for native plant distributions, sea level rise, ocean acidification and coral bleaching; and fire history and threat. They are designed as tools to support adaptation and management.

The initial community reactions to these maps did not generate a lot of conversation on the specifics of what to do. The fire maps generated discussion of the need to have better fire responses and suggestions on how that was done in the past and how it could be done today. The maps of sea level rise, ocean acidification and coral bleaching, and native plant distributions, reinforced existing ideas of the importance of working to protect resources. As mentioned above most of the community is involved in one way or another in protecting their natural and cultural resources from other more immediate threats (development, invasive species, overexploitation, lack of access etc). Therefore learning about the additional impacts of climate change added urgency to what many are already focusing on. They also opened the door, allowed people to become comfortable with the language, tools and concepts used to describe climate change, and therefore able to 'take it on' as something that can be incorporated into their own narratives, and priorities, planning, but not as a stand alone agenda.

The final product is in multiple formats:

- Hard copy, large format GIS maps are housed at the Interpretive Center at Kalaemanō
- PDF versions can also be viewed online and high resolution images are available for download from: <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/mapping> .
- As a companion to the place names map, click on “Storied Landscape” under the mapping tab to view Aunty Hannah Springer and Aunty Ku‘ulei Keakealani describe the wahi pana of Ka‘ūpūlehu including Puhiapele.

7. Ahupua‘a Image

As a more accessible, “community-ready” compliment to the maps, we created an iconic ahupua‘a image that features natural-cultural resources and how they are now and may be affected by environmental and climate change in the future.

This product exists in two formats:

- It can be viewed and downloaded at: <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/cultural-resources> . Use your mouse/pointer to hover over a specific icon to learn about what community members have observed and what scientists are predicting for that resource.
- A 2x3 foot banner of the image is housed at the Interpretive Center at Kalaemanō
- A smaller 1.5 foot long poster is also on display at the Interpretive Center at Kalaemanō

E. KEY FINDINGS

Given that this was a participatory and collaborative project with Ka‘ūpūlehu community, our “key findings” are represented both by the set of products described above, as well as by our more academic interpretations of how Ka‘ūpūlehu community has adapted and continues to adapt change, and the role of LEK in allowing them to do this. In terms of the latter, our results show that while some traditional adaptation strategies are no longer relevant to resilience today (e.g., forecasting, storage, mobility), Ka‘ūpūlehu community members have maintained and adapted others (e.g., diversification of livelihoods, knowledge transmission and storage, communal pooling, and cultural identity). They have managed to do this in multiple creative ways, allowing them to continue to foster resilience in today’s vastly changed socioeconomic and environmental context. This underscores the importance of considering multiple strategies together as a means to promote community resilience. One of our most important findings was that LEK, cultural identity, and their relationships to environmental stewardship were clearly seen by community members as the strongest basis for social resilience. Our results demonstrate that understanding how people responded in the past can suggest relevant and culturally appropriate ways—through specific language, values, reference points, and indicators expressed in narratives, proverbs, songs, stories, and visuals—of situating

climate change and framing adaptation planning. Our research also demonstrates that LEK is vital for adaptation, not only for subsistence-based, indigenous, remote, rural communities, but also for place-based communities living in mixed economies. Thus it is relevant for the larger Pacific Islands region and other areas that represent a continuum from rural-to-urban and traditional-to-global economies and lifeways.

CONCLUSIONS AND RECOMMENDATIONS

We completed all the project tasks – and more (as described above) - but because this was a participatory project, it took time to develop a relationship and trust with the community members. Therefore in some cases, it took us longer than originally planned to complete some of our objectives. However, thanks to the amazing community we had the privilege to work with, this project generated a series of products that were more informative, more meaningful and more useful than we ever thought could be possible.

In terms of future research, the development of timelines and seasonal calendars by other communities would: help identify if/how the role of LEK in building resilience to climate and environmental change varies across communities and socio-economic and environmental conditions; provide information on how phenological cycles and the changes they are undergoing vary over space; and better prepare communities to observe and adapt to change.

In addition, follow-up questions that our research results pose include: How are different communities, across urban-rural and coastal -montane, independent-colonial/post-colonial gradients adapting LEK to promote community resilience? What factors contribute to the transmission and evolution of LEK? In what contexts do the same strategies contribute more or less to resilience? How is LEK being integrated and adapted into local and state sponsored adaptation planning? How are policy and decision makers integrating LEK into state sponsored adaptation planning?

A.OUTREACH

These products are described in the Results section, we list them here again below:

1. Ka‘ūpūlehu Portal: <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/>
2. Seasonal Calendar: <http://hbmpweb.pbrc.hawaii.edu/kaupulehu/seasonal%20calendar>

Also, two hard copy, large format (35.35 inches), durable, dynamic (spinning parts) calendars are housed and used at the Ka‘ūpūlehu Interpretive Center; the second housed at by the Dryland Forest Cultural Ecology Outreach-Education program at Ho'ola Ka Makana'a.

The success of this co-produced calendar is evidenced by the demand for it. We originally made only one hard copy, but two more groups since requested them.

3. Nā Kilo ‘Āina, knowledge-base and observation network (NKA) :
www.nakiloaina.com.

4. Timeline of Adaptation

The final product is in multiple formats:

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5. Documentation of LEK of changing climate and its effects mauka and makai :

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- A 2x3 foot banner of the image is housed at the Interpretive Center at Kalaemanō
- A smaller 1.5 foot long poster is also on display at the Interpretive Center at Kalaemanō

8. Honolulu Star-Advertiser Editorial “Culture with Science Can Help Guide Wise Resource Use” 8/20/14 (Written by H. McMillen, project co-coordinator)

9. “Cultural Dimensions of Climate Change: Experiences from North Kona” Climate Change Science Workshop for High School Teachers, Hawai‘i Institute for Marine Biology Laboratories. HI. 6/25/14 (Co-presented by H. McMillen – UH Manoa, K.Keakealani, and L. Lightner of Ka‘ūpūlehu)

B. SCIENCE OUTPUTS

Publications

McMillen, H., T. Ticktin, H.K. Springer, K. Keakealani, Y. Yarber-Carter and P. Andrae. In review. *Tools for Identifying and Integrating Cultural Dimensions of Climate Change into Adaptation Planning: an Example from Ka 'ūpūlehu, Hawai'i Island. For Small islands in peril or under pressure*, eds Colin Filer and Simon Foale, by ANU Press.

McMillen, H., T. Ticktin and H. K.Springer. In review. The Future is Behind Us: Traditional Ecological Knowledge and Resilience over Time in Hawai'i Island. Regional Environmental Change.

McMillen, H. and T. Ticktin. Fuzzy Cognitive Models of tuna and reef fisheries: Comparing fishers' and scientists' knowledge in Hawai'i. In preparation. To be submitted to *Society and Natural Resources*.

Presentations

Keakealani, K., H. Springer, P. Bertelmann, H. McMillen and T. Ticktin 2013. Learning from Local Ecological Knowledge to Understand Climate Change Impacts and Preserve Key Cultural and Natural Resources in Ka'ūpūlehu, Hawai'i. Hawaii Conservation Conference. Honolulu, Hawaii.

McMillen, H. and T. Ticktin. 2014. Adapting to climate change adaptation: A case study from Hawai'i Island on conveying community priorities, knowledge, and values to resource managers and policy makers and communicating climate change science to local communities." Association for Social Anthropology of Oceania. Kona, Hawaii.

McMillen, H., T. Ticktin. 2014. Tools and Products for Integrating Traditional and Place-based Knowledge, Experience, and Wisdom to Inform Adaptation Planning and Resource Management: an Example from Hawai'i. Society for Conservation Biology Oceania (SCBO) conference. Suva, Fiji.

Bertelmann, P., H. McMillen, T. Ticktin, and K. Springer. 2015. Na Kilo 'Aina: An Experiential and Digital Tool for Monitoring Natural-Cultural Resources and Supporting Management Strategies that Strengthen Healthy, Balanced Communities in Hawai'i. Hawaii Conservation Conference, Hilo, Hawaii.

McMillen, H. and T. Ticktin. 2015. Community resilience, Traditional Ecological Knowledge, and Climate Change Adaptation: Lessons from Hawai'i Island. Webinar for the Pacific Island Climate Change Cooperative. 5/14/2015. Available at: <https://mmancusa.webex.com/mmancusa/ldr.php?RCID=b078d89ffad3c10616d5dae4e38a5202>

McMillen, H. and T. Ticktin. 2015. Community Resilience on Hawai'i Island: Lessons for Climate Change Adaptation. Climate Science Symposium sponsored by the Pacific

Island Climate Science Center and the Pacific Islands Climate Change Cooperative.
East-West Center, Honolulu, Hawaii. 2/27/15.

McMillen, H. and T. Ticktin. 2015. Community resilience on Hawai'i Island, lessons for natural resource management and climate change adaptation." University of Hawai'i at Manoa, Natural Resources and Environmental Management Department Imi Ike Seminar Series. 3/5/2015.