Ecosystem Pen Pals: Using Place-Based Marine Science and Culture to Connect Students

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ABSTRACT

The marine environment provides a unique context for students to explore both natural and cultural connections. This paper reports preliminary findings on Ecosystem Pen Pals, an ocean literacy program for 4th and 5th graders focused on using a pen pal model for integrating traditional ecological knowledge into marine science. Surveys with open-ended response and differential rating scales on student and teacher perceptions are used to share findings from the preliminary pen pal program. Results demonstrate increased respect and appreciation amongst students for their local environment and culture, as well as new interest in the marine environment. Changes in student perceptions are shown as a result of the new connections made amongst Pacific Rim students from different ecosystems and cultural communities, including Hawaii and the Washington coast. This project was developed as a pilot program to support expository writing skills, understanding of traditional learning systems, and ecosystem science. Discussion focuses on presenting a framework that could be a model for dissemination to other sites in the Pacific Rim. © *2014 National Association of Geoscience Teachers*. [DOI: 10.5408/12-401.1]

Key words: traditional knowledge, marine sanctuary, place-based culture, ecological identity, Pacific Rim, indigenous learning systems

CONNECTING STUDENTS ACROSS CULTURES AND DISTANCE

A child's exploration of the natural world allows them to become familiar with and gain knowledge of their local surroundings. Too often, students are confined to classrooms with standardized curricula that do not provide the pleasure of authentic interactions with their environmental and cultural surroundings. Similarities in culture and indigenous learning systems from diverse regions in the Pacific can connect students despite great distances. Traditional knowledge and place-based experiences are important components in learning about ecosystems and are often ignored by western sciences, which represent "accepted" interpretations of biological systems and processes. By exploring natural and cultural environments, students can develop a bioregional understanding, helping to shape their identities. Using the marine environment as a context for sharing, students can connect with their surroundings, which fosters cultural responsibility and local knowledge.

Appreciation of Place—Knowing Where You Live

Knowledge of place is important in order to recognize changes in the environment. Personal involvement with one's own neighborhood brings understanding and self-identity that reflect intelligence based on experience (Bowers, 2000). In previous generations, a sense of place was more intensely felt because it was necessary for survival (Williams, 1997). While this survival-based knowledge has become unnecessary for success in present day, it is fundamental to understand that the environment is an essential part of our lives. By dismissing the importance of place, students are unaware of the environmental changes occurring in their own backyard and are less likely to exert effort to try to protect these important areas. Part of the reason we cannot come to terms with environmental degradation is that we do not have the experience with the natural world to physically see the shifting properties (Knowlton and Jackson, 2008). People's surroundings are internalized throughout their life, and a disconnection with the outdoors unconsciously affects elements of self and one's ability to build emotional attachments (Kahn and Kellert, 2002; Townsend and Weerasuriya, 2012).

Ecological identity is a way in which people explore their connection with the environment. According to Thomashow (1995), this ecological identity work is an important process used to explore how people see themselves in relation to ecosystems, and it is the primary promoter of personal transformation. Emphasis on the development of a sense of place is accomplished through recognizing biodiversity, understanding relationships, learning from elders, and revitalizing traditional knowledge (Chinn, 2011). These components were considered in the development of the Ecosystem Pen Pals program, which uses the marine environment as the context in which to achieve knowledge of place.

Pen Pal Exchange as a Learning Tool

Pen pal programs demonstrate improved literacy, communication, and learning skills amongst participants, as well as creating important cultural connections (Rankin, 1992; Lemkuhl, 2002; Charron, 2007; Shandomo, 2009; McCaffery, 2012). Through these exchanges, students are able to engage in drafting letters, which can result in higher achievement in reading and writing (Fitzgerald and Shanahan, 2000; Teale and Gambrell, 2007). According to Barksdale et al. (2007), pen pal friendships can even be effective in encouraging cross-curricular learning through

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peer support. These exchanges help to create open relationships where the students feel free to engage with others who they have never met, fostering a broader worldview (Shulman et al., 1994; Ceprano, 2007; Shandomo, 2009; Reimer and Reimer, 2012).

Research studies on the use of pen pal projects in K–12 classrooms have recently focused on cultural connections (Winn, 1998; Barksdale et al., 2007; Norton-Meier et al., 2009). However, none of these programs ties to nearby ecosystems or marine environments. The majority of cultural exchange programs have concentrated on technology, citizen science, or language themes for application, leaving a gap for science topics. While pen pal programs have been numerous, few curricula have focused on direct peer-level conversation. Most existing programs emphasize communications between elementary students with preservice teachers, college students, or high school students (Allen, 1996; Moutray, 1998; McMillon, 2009; Wilfong and Oberhauser, 2012).

ECOSYSTEM PEN PALS

Ecosystem Pen Pals is a cultural and environmental pen pal program that assembles 4th and 5th grade students from across the Pacific in a series of yearlong school activities. The goal of Ecosystem Pen Pals is to foster support for ocean conservation through learned awareness of coastal ecosystems, while facilitating cultural-themed written exchanges between students in the Pacific Rim. Using the local environment for class projects and pen pal correspondence provides a context for studying traditional knowledge, whereby students learn to value their own and other cultures and environments. Our pilot program involved two communities adjacent to National Marine Sanctuaries in the North Western Hawaiian Islands (Papahanaumokuakea Marine National Monument) and Neah Bay, Washington (Olympic Coast National Marine Sanctuary). Ecosystem Pen Pals uses the study of local ecology, cultural communications, and indigenous ways of learning through story and art to familiarize students with their own ecosystems. This framework scaffolds student learning by comparing and contrasting their local ecosystems with others in the Pacific. The project emphasizes indigenous cultures, traditional knowledge, and western scientific study as a way to understand ocean communities.

The creation of Ecosystem Pen Pals began with the meeting of marine educators through the National Oceanic and Atmospheric Administration (NOAA)–sponsored Papahanaumokuakea Ahahui Alakai (PAA) experiential leadership program. This 10-d experience in the Papahanaumokuakea Marine National Monument (North Western Hawaiian Islands) provided the inspiration for this program and demonstrated the need for students to learn more about their unique marine environment. Ecosystem Pen Pals uses an interdisciplinary approach, integrating science with the humanities, arts, and social sciences. The use of both sciences and arts to understand the natural world and solve common problems has been emphasized by education scholars as necessary in creating a holistic view of the environment (Metcalfe et al., 2008; Hardimann et al., 2009; Chinn, 2011).

Pilot Project Sites

Hawaii was chosen to pilot this program because of the success demonstrated by previous place-based initiatives, such as the *Aloha Aina* (Pacific American Foundation, 2008) and *Navigating Change* (Papahanaumokuakea Marine National Monument, 2008) curricula. The resurgence of local knowledge in teaching and learning in Hawaii schools is a promising and significant change that has occurred in the last 10 y. Hawaii has an extremely diverse and underserved population with a high proportion of Native Hawaiian and Pacific Islander students in rural areas (Bowser et al., 2012) (see Table I). The Hawaiian Archipelago makes for an interesting case study, because it has culturally rich traditions and a practicing indigenous population, as well as a fragile and unique marine ecosystem.

Neah Bay, Washington, is located within the Makah Tribal reservation lands on the outer coast of the Olympic Peninsula, at the boundary of the Olympic Coast National Marine Sanctuary. These tribal lands are geographically isolated from urban centers in Washington State. Over the past decade, there has been a movement among Washington indigenous communities to reestablish cultural teaching of traditional knowledge in school curricula. In the Cape Flattery School District, this has included teaching and learning of the Makah language, as well as traditional cultural practices such as dance and music, native food sources, and connections with traditional knowledge. Most of the students in Neah Bay are members of the Makah Tribe, and they represent a well-matched cohort for a sister school in Hawaii. The combination of a coastal resource–based economy, rich culture, and a desire to build relationships with students in other Pacific locations made this school an ideal candidate for the pilot program.

Overview of Learning Outcomes for Ecosystem Pen Pals Program

Ten student learning outcomes were designed for the Ecosystem Pen Pals program, which span a range of short- to long-term achievements gained by students through

TABLE I. Ethnicity breakdown for pilot year of participating Ecosystem Pen Pals Program schools.

Ethnicity	Neah Bay, Washington	Oahu, Hawaii
First Nations/Alaskan Native	93.1%	0.2%
Asian	0.7%	36.9%
Pacific Islander	0.7%	10.6%
Hispanic	1.4%	1.8%
Caucasian	3.5%	27%
Other	0.6%	23.5%

FIGURE 1: (From left to right) Items from Hawaii's ecosystem suitcase sent to sister school in Washington; Hawaii students enjoy smoked salmon and homemade blackberry/*salal* jam on bread sent from sister school during final celebration event; Hawaii students listen to guest visitor from Seattle Aquarium sharing about the culture and students at sister school in Washington.

participation (see Table II). The long-term outcomes relate to the program's overall goal of fostering support for ocean conservation and marine protected areas, as well as developing interest in marine science and conservation careers. These outcomes are built through continued participation in Ecosystem Pen Pal activities, which are reflected in the medium-term objectives of relationship building with students in other geographic locations and cultures, increased proficiency in letter-writing communication, learned awareness of the connection between climate change and ocean health, and gained appreciation for their own and other cultures and environments. The short-term outcomes are also achieved through participation in program activities, but these are designed to be more immediate results of specific projects in the Ecosystem Pen Pal program. For instance, the guide book that the classes developed resulted in increased ability to identify plants and animals in the local ecosystem (see Fig. 1).

Ecosystem Pen Pals Project Components

Four project components make up the Ecosystem Pen Pals program. Each project builds upon the next, further developing environmental awareness and cultural understanding of both the local environment and other locations throughout the Pacific. Interwoven between the class projects are structured letter-writing exchanges between students, which are designed to develop engagement in marine conservation, including both local and global environmental issues, as well as to support writing and communication skills (see Table III).

Ecosystem Pen Pals provides a framework for activity implementation and connecting schools in the Pacific Rim. The program implemented four project components, which are listed next; for more detailed descriptions of the activities, see Appendix A.

Letter-Writing Exchanges

Writing letters creates a forum for students to discuss relevant issues about their local ecosystem, including climate change and ocean literacy, as well as share personal experiences and local traditions. In conjunction with each of the three projects, students wrote to an assigned pen pal throughout the school year. Each student was given a pen pal from the sister school to whom they would write four letters while each project component was completed. These correspondences allowed students to get to know each other, learn about their partner's respective ecosystem, and discuss common ocean conservation issues.

Field Guide

Students researched, designed, and created field guides for their local environment and communities with a focus on understanding natural and cultural systems. Each class conducted research on their local marine environment, with emphasis on a designated marine sanctuary. Individuals selected a species from their local marine environment/

TABLE II. Learning outcomes for Ecosystem Pen Pals Program.

Short-Term	Medium-Term	Long-Term
1. Increased identification skills of common plants and animals in local ecosystem 2. Increased communication skills in writing and corresponding with peers in other geographic areas 3. Increased familiarity with the local ecosystem and issues around ocean literacy and climate change	1. Relationship building with other cultures/students in other geographic areas 2. Proficiency in letter-writing communication and development of social skills 3. Respect and appreciation for one's own traditional culture and environment 4. Understanding of the connection between climate change and ocean health	1. Support of ocean conservation and the expansion of marine protected areas 2. Increased advocacy for local marine environment and conservation 3. Career choices in ocean science or marine conservation

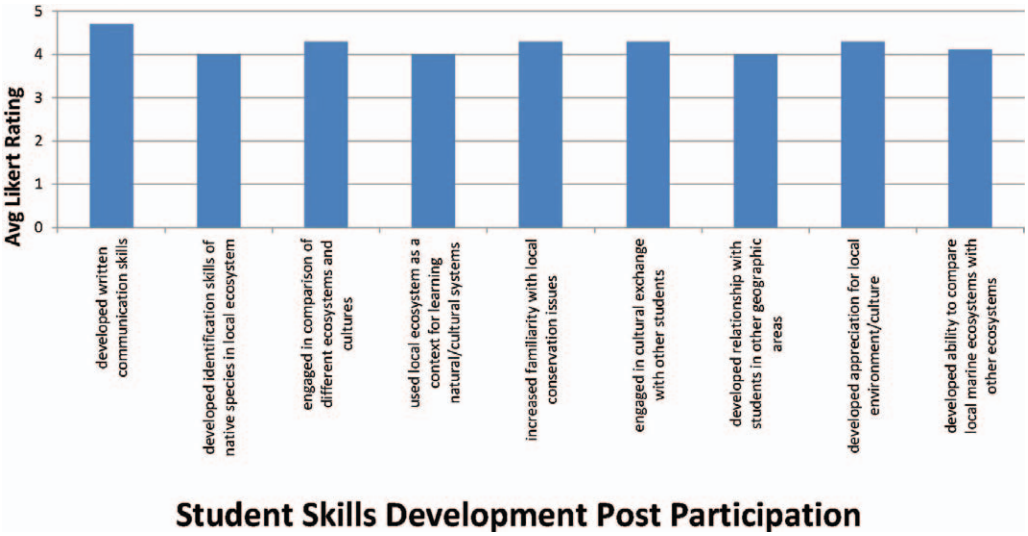

FIGURE 2: Results from the teacher survey evaluation of the student skills development after participation in the Ecosystem Pen Pals Program using Likert scale rankings ($n = 4$).

nearby marine sanctuary and completed the field guide template (see Table IV). Various species, from marine mammals, fish, birds, and invertebrates to plants, were selected to represent their ecosystem. As a class, items were assembled to develop a field guide for their marine sanctuary ecosystem, and it was then shared with their sister school classroom.

Ecosystem Suitcase

Students created an "ecosystem suitcase" containing objects from the natural environment, as well as cultural pieces created by the students. Upon completion of the guide, each class developed an ecosystem suitcase by compiling a box of artifacts that represented their natural marine ecosystem and local culture. Teachers facilitated a discussion with the class about the items to include. Items represented both natural and cultural aspects of the marine area. Artifacts were gifted to the sister school along with a written packet explaining each article. The items included physical objects (rocks, shells, animal skulls, feathers), pictures, books, stories, dried or pressed plants, and student-made objects (cedar or kukui nut bracelets, bookmarks, origami paper items, etc.) (see Fig. 1).

Video Conference or Ecosystem Poster

Students communicated through social networking during a culminating exchange activity at the end of the program. The last large-scale project was the design of a classroom poster that represented what the students learned throughout the year. Each student submitted a photograph or drawing that signified their local culture, natural environment, or sanctuary ecosystem. Pictures were then assembled and printed as one large poster collage for the sister school. A video conference with the sister school concluded the yearlong program. Additionally, students participated in the sharing of culturally relevant food from their sister school's region (see Fig. 1).

Methods for Evaluation

This pilot program was designed as a trial for future implementation of pen pal exchange and related cultural and

TABLE III. Suggested time line for projects.

Month	Scheduled Activity
June–August	Selection of schools and locations for exchange
September	Introduction to program, teacher commitment, and planning meeting
October	Introduction letter-writing #1
November	Field guide assignment
December	Letter-writing #2, development of ecosystem suitcase
January	Ecosystem suitcase completion
February	Letter-writing # 3
March	Development of class ecosystem poster
April	Letter-writing # 4, ecosystem poster completion
May	Video Web conference

TABLE IV. Field guide components.

Field Guide Component
1. My species is (include both scientific and common names)
2. General characteristics (what they look like)
3. Habitat (where it is found)
4. Diet (what they eat)
5. Adaptations/behaviors (do they do anything special)
6. Predators
7. Environmental threats
8. Interesting facts
9. Picture (photograph/drawing of species, label important features)

environmental activities. Evaluation was based on teacher and student assessment and anecdotal response to assignments, as well as overall project implementation. Project components were individually evaluated through student achievement and depth of assignment completion. Pen pal letters were reviewed by classroom teachers for improved communication skills, depth of thought, and adherence to the specified topic assigned for the writing assignment. The field guide and description reports of the ecosystem suitcases were used to provide input into how the activities enhanced student understanding of ecological concepts and the overall success of the activities.

Upon conclusion of the pilot program, qualitative surveys were distributed, and interviews were conducted with the participating teachers ($n = 4$) about the overall effectiveness of the program, student learning outcomes, and student interest in program activities. The surveys used a five-point semantic differential rating that assessed teacher perspectives on the success of the program. Student evaluations ($n = 37$) were also completed using a series of 15 questions designed to determine success in learning outcomes, preference for activities, and changes in perception through the same rating scale. Student evaluations examined level of knowledge about their own and their pen pal's nearby marine ecosystems and culture. In addition to numerical ratings, open-ended evaluation questions were included in both teacher and student surveys, to provide written feedback for further analysis. Open-ended survey responses on the student surveys permitted exploration of the benefits the students perceived during the experience, which allowed for themes to be generated. This method has been used by other pen pal programs for feedback and student evaluations (Wilfong and Oberhauser, 2012).

RESULTS

Ecosystem Pen Pals Results: Student Evaluation

Through the Ecosystem Pen Pals project, students were able to foster positive peer role models by communicating with sister school students during the year. The shared experience of the program not only tied the classes together, but the individual pen pal partners as well. Over half of the students reported that they wanted to continue relationships with their pen pals the following year. Many students indicated that they were pleased with making new friends from other places, with comments such as:

"I learned how to correspond with others and be nice to new people."

"I liked that I made a new friend from Hawaii and learned about their culture."

This is an important outcome of the program, as many studies have documented the benefit of student exposure to others in different cultures and environments (Wilfong and Oberhauser, 2012).

Students most frequently reported that they learned about the marine species in their ecosystem, a different culture or environment other than their own, and how to take care of the environment. Participants provided positive comments in the open-ended evaluation questions on their most memorable learning experiences. One student shared,

"I learned what being a scientist is like."

Others emphasized more conservation-related knowledge:

"I learned that it is good to keep garbage out of the water."

"I learned how to take care of the environment."

The skills that had the highest improvement after program participation included how to write and format a letter, confidence in writing skills, and improved social skills or learned skills on how to interact with new people. These were rated highly on the surveys, indicated in open-ended questions, and observed by classroom teachers. Pen pal letters were reviewed by classroom teachers, who informally assessed improvement in communication skills as the program progressed. The most commonly mentioned activities that students enjoyed included writing to their pen pal and receiving letters, getting the ecosystem suitcase from the sister school, researching and writing their marine species for the field guide, and learning about their pen pal's culture and making a new friend from somewhere else in the world (see Fig. 3). The most frequent complaints about the program were in regards to the long wait time for the pen pal's letters, and the lack of infrastructure set up to continue the relationship with their new friend (i.e., pen pal) for the following school year.

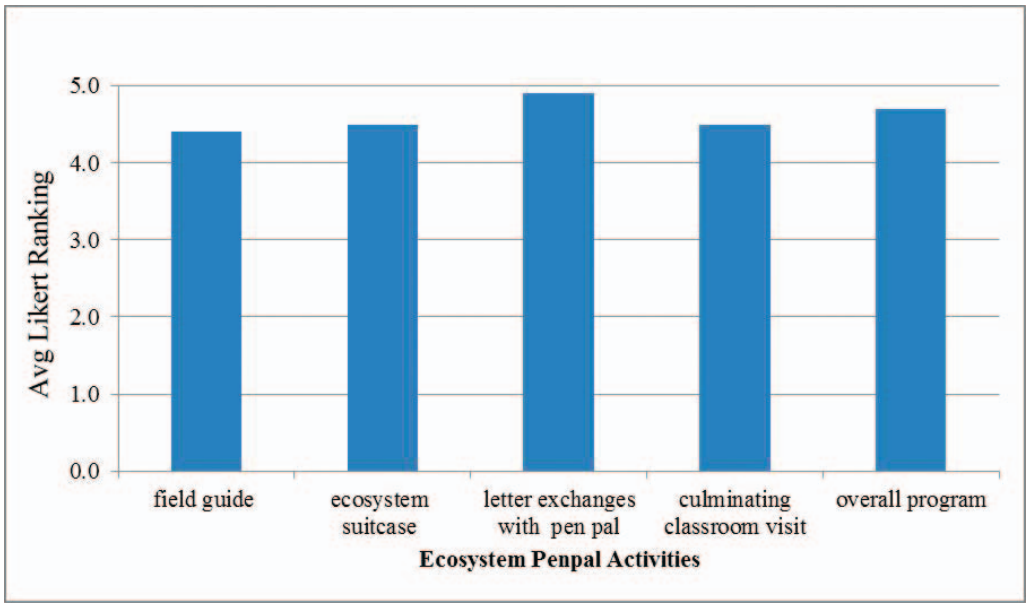

FIGURE 3: Results from the student survey evaluation following participation in the Ecosystem Pen Pals Program. The three classroom activities and individual letter-writing assignments were ranked using Likert scales ($n = 37$); the small confidence interval (95%) and error bars reflect the high consistency between students in the surveys.

Ecosystem Pen Pals Results: Teacher Evaluation

All participating teachers gave an overall favorable evaluation of the program and indicated that they would like to participate again and continue with all activities. Interestingly, teachers were most satisfied with the letter-writing exchanges over the class activities. Of the planned activities, teachers preferred the field guide, giving it the highest scores for overall satisfaction, offering the best learning opportunities, and greatest changes in student perception (see Fig. 2). Open-ended responses from the teachers indicated concerns with the intensity and time related to the program:

> *"Perhaps only two letter exchanges are needed; it takes an enormous amount of class time."*

> *"Having a meeting to plan events would be helpful; this program took a lot of class time and planning."*

The teachers found it hard to balance "required" curriculum and the Ecosystem Pen Pals program. This could be improved upon by better aligning the assignments with the existing curriculum and standards and allowing for classes to choose between the activities.

Most importantly, all four participating teachers reported changes in student perceptions from participation in the Ecosystem Pen Pals program. The greatest change in student perception was in their understanding of the differences between local marine ecosystems and other marine ecosystems in the Pacific. Even though the survey demonstrated some change in student perception towards awareness of career choices in ocean science and marine conservation, this area was ranked lowest by participating teachers. Moderate to life-altering change in student perception was indicated for relationships with other cultures and students in different geographic areas, the desire to participate in marine conservation, and to learn more about the marine environment.

PROGRAM IMPLICATIONS

Rather than using more conventional tests and lectures, the Ecosystem Pen Pals program allows students to apply what they have learned to their lives in a unique way. The program hopes to attract more underrepresented classrooms, emphasizing student awareness of their own marine environments, and potentially perpetuating interest in marine science or conservation careers and management of their local resources. Through the Ecosystem Pen Pals program, students are introduced to concepts of ecological sustainability modeled through indigenous ways of knowing and ongoing relationships with their local marine ecosystems. This empathy has direct transference to other ecosystems in the Pacific, ultimately leading to a better connection to their own resources. Implied applications of engaging students in additional science-related projects such as Ecosystem Pen Pals could further be developed for science, technology, engineering and mathematics (STEM) education goals at a later point. By drawing on both cultural and natural resources, educators can incorporate traditional knowledge into more formal learning environments. The Ecosystem Pen Pals program offers this opportunity to students at an early age by emphasizing fundamental relationships among people, their local environment, and ancestry.

CONCLUSIONS

The Ecosystem Pen Pals program represents a successful series of activities and learning goals that emphasize both natural and cultural environments using local marine

ecosystems as an overarching connector. This program was originally intended as a tool to weave together indigenous and other underrepresented students in the Pacific, to engage them with culturally relevant marine science themes, and to encourage students to formulate interest in both science disciplines and their local culture. However, the valuable connections and lessons that are shared through participation in the program could be applicable to students elsewhere in the world. Surveys with open-ended response and differential rating scales on student and teacher perceptions provided evidence for success of the preliminary pen pal program. Results demonstrated increased respect and appreciation amongst students for their local environment and culture, as well as new interest in the marine environment. Changes in student perceptions were evidenced by the new connections made amongst Pacific Rim students from different ecosystems and cultural communities, including Hawaii and the Washington coast. Programs such as Ecosystem Pen Pals can be replicated in other communities in the attempt to integrate culture, traditional learning systems, and western science.

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APPENDIX A. Ecosystem Pen Pals Project Components.

Letter-Writing Exchanges

In conjunction with each of the three projects listed below, students write to an assigned pen pal throughout the school year. Each student is given an ecosystem pen pal from the selected sister school to whom to write four letters or postcards while each project component is completed.

- *Letter-writing #1:* Students introduce themselves, tell their pen pal about who they are, where they come from, what activities they like, their favorite thing to do outside, and a bit about their cultural background.
- *Letter-writing #2:* Students write about their local ecosystem and nearby national marine sanctuary. They also include information about the natural and cultural aspects that make their communities unique.
- *Letter-writing #3:* Students write about the concerns they have regarding the ocean, how they feel about climate change, how climate change may affect their ecosystem, and what steps they are taking to protect the ocean.
- *Letter-writing #4:* Students share what they learn about their pen pal's ecosystem and how it is similar/different to their own. Students are encouraged to thank their pen pal for sharing their knowledge and provide contact information if they would like to continue to stay in touch.

Field Guide

Students research, design, and create field guides for their local environment and communities with a focus on understanding natural and cultural systems. Each class conducts research on their local marine environment, with emphasis on their designated marine sanctuary. Each student selects a species from their local marine environment/nearby national marine sanctuary and completes the field guide template (see Table IV). Students research their selected species and provide a drawing or picture and description of behaviors, adaptations, and threats. A variety of species are selected to represent the ecosystem. As a class, items are assembled to develop a field guide for their marine sanctuary ecosystem, and it is shared with the sister school classroom.

Ecosystem Suitcase

Students create an "ecosystem suitcase" containing objects from the natural environment, as well as cultural pieces selected by the students. Upon completion of the guide, each class develops an ecosystem suitcase by compiling a box of artifacts that represent their natural marine ecosystem and local culture. Teachers facilitate a discussion with the class about the items to include. Items should represent both natural and cultural aspects of the marine area. Artifact selection needs to consider the potential hazards during transportation; therefore, no live specimens, seeds, or plants can be included; this also provides an excellent opportunity to discuss invasive species. Once a list of items is selected, students break into groups and are tasked with collecting one of the items in the suitcase. Each group writes a paragraph about the object included. Artifacts are gifted to the sister school along with a written packet explaining each item. Some examples of items include physical objects (rocks, shells, animal skulls, feathers), pictures, books, stories, dried or pressed plants, and student-made objects (cedar or kukui nut bracelets, bookmarks, origami paper items, etc.) (see Fig. 1).

Video Conference or Ecosystem Poster

Students communicate through social networking during this culminating exchange activity at the end of the program. The last large-scale project is the design of a classroom poster that represents what the students learned throughout the year. Each student submits a photograph or drawing that represents their local culture, natural environment, or sanctuary ecosystem. Pictures are then assembled and printed as one large poster collage for the sister school; each student can also receive a smaller copy of the poster to take home. Video conferencing with the sister school is recommended so that the students can explain their posters. Sharing of culturally relevant food at the end of the program is also suggested (see Fig. 1).